July 9, 2026

Stasia Ferby
Project Assessment Director
BC Environmental Assessment Office
By Email: Stasia.Ferbey@gov.bc.ca

SUBJECT: Overall Final EAO Water Information Request Response Summary

Dear Ms. Ferbey:

Telkwa Mining Limited (Telkwa Mining) is pleased to provide an overall summary of our final EAO Water Information Request response summary and organization which proivdes the complete respoonse to the EAO water IR as follows:

ATTACHMENT A provides the January 29, 2026 that represents the Water Information that was approved for submission after discussions with the EAO and the line agencies of Ministry of Environment and Parks (MENV) and Minsitry of Mining and Critical Minerals (MMCM) on the September 15, 2026 EAO Water IR submission for review.

ATTACHMENT B provides the response to the follow up information requests from MENV on April 15, 2026.

ATTACHMENT C provides the response to the follow up information requests from MMCM on May 15, 2026.

ATTACHMENT D provides the response to the follow up information request 8 and 9 from MENVe on May 22, 2026.

ATTACHMENT E provides the response to the follow up Information request 8 from MENV and MMCM on June 25, 2026.

If you have any questions please do not hesitate to contact Dan Farmer at 604-220-5703 or dan.farmer@telkwa-mining.ca.

Sincerely,



Daniel J. Farmer
Project and Development Manager
Telkwa Mining Limited

Cc: Elise Matzanke, Project Assessment Officer, EAO, email: Elise.Matzanke@gov.bc.ca
Matt Scarr, Project Assessment Director, EAO, email: Matthew.Scarr@gov.bc.ca
Jessy Chaplin, Ecosystems Biologist, Telkwa Mining, email: Jessy.chaplin@telkwa-mining.ca
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Attachments:

Attachment A: Telkwa Mining Response submitted January 29, 2206 to the Overall EAO Water IR issued by EAO to Telkwa Mining on November 23rd, 2022

Attachment B: Telkwa Mining Response to the follow up information requests from MENV on April 15, 2026

Attachment C: Telkwa Mining Response to the follow up information requests from MCMM on May 15, 2026

Attachment D: Telkwa Mining Response to the follow up information requests 8 and 9 from MENV on May 22, 2026

Attachment E: Telkwa Mining Response to the follow up information request 8 from MENV and MCMM on June 25, 2026

Attachment A: Telkwa Mining Response submitted January 29, 2206 to the Overall EAO Water IR issued by EAO to Telkwa Mining on November 23rd, 2022

MEMORANDUM

TO: Stasia Ferbey, Project Assessment Director, BC Environmental Assessment Office

Elise Matzanke, Project Assessment Officer, BC Environmental Assessment Office

FROM: Dan Farmer, Project, and Development Manager, Telkwa Mining Limited

DATE: January 29, 2026

SUBJECT: **Tenas Project Water Quality EAO Information Request Response**

0. INTRODUCTION

In response to the Information Request (IR) related to water dated November 23, 2022, for Telkwa Mining Limited's (Telkwa Mining) Tenas Project's (Project) Environmental Assessment Certificate (EAC) Application submitted in early 2022 please find Telkwa Mining's response to the questions raised by the British Columbia Environmental Assessment Office (BC EAO) working group.

As part of Telkwa Mining's commitment to undertake additional water flow monitoring for Four, Goathorn, and Tenas Creeks as recommended by SRK Consulting (Canada) Inc. (SRK), the water and load balance model (WLBM) has been updated to reflect the water monitoring completed in 2021 and 2022 for these creeks, see **Appendix 1: Tenas Project, Water and Load Balance Modeling Report (Updated 2025), SRK**. In summary the following was found:

- Goathorn Creek high flows were underestimated by the WLBM provided by the EAC Project Case (August 2022). Low flows were slightly overestimated by the WLBM provided by the EAC Project Case (August 2022), so low flows were reduced for Goathorn Creek in the Final EAC Project Cases (2024).
- Tenas Creek flows measured were comparable to the EAC Project Case (August 2022) for low and high flows and if anything were underestimated by the EAC Project Case (August 2022) model, so the parameter concentrations provided were conservative. High flows were updated for Tenas Creek but no change to low flows were made as part of the Final EAC Project Cases (2024).
- Four Creek flows measured were again comparable to the EAC Project Case (2022) for low and high flows and if anything were underestimated by the EAC Project Case

(August 2022) model. High flows were updated for Four Creek but no change to low flows were made as part of the Final EAC Project Cases (2024).

Additional years of precipitation data have been gathered since the EAC Application was submitted, and it was found that precipitation values in the EAC Project Case (August 2022) model were under reporting annual precipitation values, so these were increased in the Updated and Final EAC Project Cases (2024) versus the EAC Project Case (August 2022)'s WLBM. Please see **Appendix 2: Tenas Project, Hydrometeorological Baseline and Model Development Report (Update 2025), SRK**. Telkwa Mining continued monitoring for Four, Tenas, and Goathorn Creeks in October 2023, and will review stream flow levels again if the Project moves into the permitting process.

Telkwa Mining commenced an acid rock drainage (ARD) barrel program in late 2019 to better understand the potential ARD and metal leaching (ML) characteristics of the material rock zones and overburden recovered within the EA Open Pit. Telkwa Mining has continued testing material seepage from these barrels since 2019. Key observations based on this testing is as follows:

- Only one of the potentially acid generating (PAG) barrels (Barrel 6) has gone **acidic after approximately 4 years** of monitoring. The onset of acidic drainage under field conditions may be accelerated because the barrel samples have been crushed to minus 1/4 inch (8 millimetres [mm]) as the material was the same as used in the humidity cells. There will be a mixture of grain sizes in the commercial operation with several grains much larger than the barrel material size. In addition, the barrel contains a mixture of rock from Zones 6, and 7 and had a weighted Neutralizing Potential Ratio (NPR) of Neutralizing Potential (NP) to Acid Potential (AP) of 0.55. The average weighted NPRs of Zones 6, and 7 in the drillhole database were 1.8 and 1.7, respectively (SRK 2025). The material in Barrel 6 therefore provides a conservative estimate of the lag time to the formation of acidic conditions.
- The source terms for some parameters were overstated (higher concentrations) while others were understated (lower concentrations) in the water and load balance provided in the EAC Project Case (August 2022) based on the laboratory measurements of the effluent collected from these barrels due to assumed scaling factors that were not site-specific. SRK developed updated source terms for *non-PAG* rock, PAG rock Flush term, EA Open Pit Walls, and overburden using the barrel results provided in: **Appendix 3: Geochemical Field Barrel Results Interpretation, Tenas Project, SRK;** and **Appendix 4: Updated Water Quality Source Terms, SRK.**

These source terms were further reviewed and modified for the *non-PAG* rock backfilled into the EA Open Pit by Okane Consultants using a more detailed model that accounted for dimensionality in the *non-PAG* rock backfill (backfill) and oxygen convection and diffusion for several different cover scenarios. Okane Consultants developed a distributed 3-dimensional model focused on

water infiltration and storage, and oxygen levels based on the material properties and the rock backfill pile construction methodology employed by the Project with their report included in **Appendix 5: Tenas Project - Suboxic Evaluation of Non-Acid Generating Mine Rock, Okane**. This modelling exercise modified the source terms for parameters being potentially leached from the backfill and was used for the Final EAC Project Case (2024).

Several updates were made in the water and load balance model since the EAC Project Case (August 2022). The new Project Case was titled "Final EAC Project Case (2024) (as found in **Appendix 1, Tenas Project, Water and Load Balance Modeling Report (Updated 2025), SRK)**, and the integrated changes are described as follows:

- Incorporate the effects of progressive reclamation and backfill/dam/buttress development (for progressively covered areas of *non-PAG*).
- Use of seasonal background parameter concentrations (50th percentile) to reflect the seasonality of the background/baseline parameter quality concentrations related to winter (November to March) and summer (April to October) seasons to develop predicted concentrations from the Project more accurately in the receiving environment.
- Incorporation of blasthole liners for the source control of nitrogen species. This Best Management Practice (BMP) was identified through the additional mitigations assessment.
- Revision of how downstream parameter concentrations in relation to groundwater seepage was calculated based on updated values from the hydrogeological model and to account for dilution from non-contact groundwater to the streams.
- Updates to reflect the recently published climate change models from 2023 versus the 2018 versions that were used in the EAC Project Case (August 2022).

Through the Best Achievable Technology (BAT) assessment, it was determined that the introduction of water treatment through In-situ Active Gravel Bed Reactors (GBR) and/or active water treatment using Reverse Osmosis with an Anaerobic Bioreactor and High-Density Sludge Lime Treatment were not recommended but should only be incorporated using a Trigger Action Response Plan based on site monitoring during all phases of the Project. Further information on the Final EAC Project Case (2024) can be found under **Theme 1**.

Error! Not a valid bookmark self-reference. below provides a summary of the EAC Project Case (August 2022) and the Final EAC Project Case (2024) for parameters that were exceeding water quality guidelines for the EAC Project Case (August 2022). As demonstrated the Final EAC Project Case (2024) does not have exceedances in the receiving environment except for parameters that are already in exceedance for background conditions and a short duration (4 year) exceedance of cobalt in Four Creek which is likely not to occur if attenuation mechanisms in groundwater were accounted for in the water model.

Table 0-1: Water Quality (Maximum Monthly Mean) Results for the EAC Project Case (August 2022) and the Final EAC Project Case (2024) in Post-Closure at Relevant Prediction Nodes Using Expected Source Terms and Average Hydrology Conditions

Location Creek	Parameter	BC WQG (2025) (mg/L)	EAC Project Case (August 2022) (mg/L)	Final EAC Project Case (2024) (mg/L)
WQSEA1 Goathorn Creek	Copper (d)	0.0013	Not Available	0.0016
WQS06 Goathorn Creek	Copper (d)	0.0013	0.0019	0.0016
WQS03_DS Four Creek	Cadmium (d)	0.00023	0.00026	0.000012
	Cobalt (d)	0.00050	0.00066	0.00063
	Nitrite (t)	0.020	0.038	0.0090
	Sulfate (t)	309	360	33
	Selenium (t)	0.0020	0.0058	0.00081
WQS04 Tenas Creek	Cobalt (d)	0.00045	0.00082	0.00029
	Copper (d)	0.0026	0.0031	0.0013
	Nickel (d)	0.0025	0.0031	0.00063
	Nitrite (t)	0.020	0.045	0.0056
	Sulfate (t)	218	260	24
	Selenium (t)	0.0020	0.0041	0.00079

Notes: BC=British Columbia; EAC=Environmental Assessment Certificate; mg/L=milligrams per litre; WQG=water quality guideline.
Red text indicates exceedances of WQGs.
Please note that dissolved copper exceeds the WQGs under background conditions.

1. INFORMATION REQUEST (IR) THEMES 1-8

The IRs provided by the EAO have been grouped into a series of themes for subsequent discussion.

- **Theme 1**: Design alternative treatment options and/or provide additional mitigation measures which are capable of meeting BC Chronic Water Quality Guidelines for the Protection of Aquatic Life (BC WQGs) near appropriately sited discharge locations;
- **Theme 2**: Substantially review the Water Balance Model. The Water Balance Model is key to assessing mitigations against effects to many Valued Components not only water quality;
- **Theme 3**: Have a Qualified Professional (QP) identify lentic areas in the receiving environment which may receive selenium from mine operations, and ensure that background concentrations of selenium in water, sediment, invertebrate, and fish tissues are collected and compiled in those lentic areas;
- **Theme 4**: Conduct additional water quality predictions using recent sensitivity analysis of the semi-permeable pond liner;
- **Theme 5**: Ensure all planned discharges are incorporated into the Water Balance Model and water quality predictions;
- **Theme 6**: Other comments not specified in BC EAO's IR request letter, but provided in the ITT table;
- **Theme 7**: EMLI Geoscience clarifications and information requests; and,
- **Theme 8**: EMLI Geotechnical clarifications and information requests.

Please note:

The order in which the themes are addressed is not the same as the list specified above since Themes 5, and 2 need to be completed prior to commencing Theme 1 which entails a BAT assessment to review alternative treatment technologies/additional mitigations as it is dependent on the WLBM being accepted and understood by the Working Group as it forms the basis of the BAT assessment.

2. RESPONSES TO INFORMATION REQUEST THEMES 1 THROUGH 8

THEME 5: ENSURE ALL PLANNED DISCHARGES ARE INCORPORATED INTO THE WATER BALANCE MODEL AND WATER QUALITY PREDICTIONS

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

The WLBM is missing data from all planned discharges.

507 ITT TABLE AND 516 ITT TABLE

Table 6.2-1 of the Discharge MP lists many surface discharges that are not incorporated into the Water and Load Balance Model. The WLBM application considers the discharges from the Tenas Control Pond, the Management Ponds, and the Rail Infrastructure Pond. For all other discharges, please indicate where each is characterized in the application including source term assessment, water quality predictions, frequency and duration of discharge, mitigation strategies (include liner permeability where applicable), identification of parameters of concern, and residual effects assessment. For all unlined ponds and other discharges to ground, evaluate the discharge following the guidance in ENV "Authorizing Point and Non-point source discharges to ground" (https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/7276_env_rob_dtg_factsheet.pdf) [EA Information Requirement].

IR LETTER NEW AND 516 ITT TABLE

Table 6.2-1 of the Discharge Management Plan lists many surface discharges that are not incorporated into the WLBM. The WLBM application considers the discharges from the Tenas Control Pond, the Management Ponds, and the Rail Infrastructure Pond.

1. *For all other discharges, indicate where each is characterized in the Application, including: source term assessment; water quality predictions; frequency and duration of discharge; mitigation strategies (include liner permeability where applicable); identification of parameters of concern; and residual effects assessment.*
2. *For all unlined ponds and other discharges to ground, evaluate the discharge following the guidance in ENV's Authorizing Point and Non-point source discharges to ground.*

RESPONSE 507 ITT TABLE AND 516 ITT TABLE

This IR request stems from the fact that some of the sedimentation ponds that discharge to ground were not included as part of the WLBM in the EAC Application prepared by SRK and presented in **Appendix 1.0-E Water and Load Balance Modeling Report of the Environmental Assessment Certificate (EAC) Application**. Specifically, the following sedimentation ponds were not included in the overall WLBM:

- Explosive Facility;
- Explosive Magazine;
- Rock Quarry;
- Gravel Quarry 1 and 2; and,
- East and West TAC.

The Explosive Facility, and Rock Quarry sedimentation ponds are lined with impermeable geomembrane liners or equivalent while the remaining sedimentation ponds are unlined.

The reasons why these sedimentation ponds were not considered in the site WLBM when it was developed were:

- They are geographically separate from the EA Open Pit, management and control ponds, and material storage pile water management systems.
- These sedimentation ponds are small and were developed to manage very defined catchments which are not connected to overall water management system for the open pit and material storage structures and have very low flow rates compared to the discharge from mine components through the Tenas Control Pond.
- These sedimentation ponds are expected to only discharge during freshet and storm events as their watersheds are small and defined.
- These sedimentation ponds collect water from inert material such as gravels and soils currently exposed within their catchment area.
- Total Suspended Solids (TSS) is the main parameter of concern for majority of these sedimentation ponds excluding the Explosive Facility and Rock Quarry Sedimentation Ponds where nitrogen species are also potential parameters of concern.
- To control TSS, the sedimentation ponds have been designed according to BC ENV *Technical Guidance 7: Assessing Design Size and Operation of Sediment Ponds* (December 2015). The sedimentation ponds are designed to produce a monthly mean maximum TSS level of 35 mg/L to align with the proposed federal *Coal Mine Effluent Regulations* which is considered protective of the receiving environment.

POND DESCRIPTIONS

The Explosive Magazine Sedimentation Pond captures run off from a 50 by 50-metre (m) pad where the three (3) explosive magazine steel buildings are located. The pad is comprised of crushed gravel at a 1% grade leading to the sedimentation pond. TSS is the only parameter of concern for this pond as no blasting agents are being offloaded or loaded at this location. Furthermore, traffic volumes (4 to 6 trips on dayshift only) at this location will be low as only authorized personnel are permitted to access this location. Only packaged explosive products and blasting accessories are stored at this location inside weatherproof steel buildings and no bulk explosive products are delivered to this location so there is little chance of a spill releasing nitrogen species to the environment. The water discharged from this sedimentation pond will be to the ground via a controlled pumping system and from seepage from the floor of the pond itself.

The Explosive Facility Sedimentation Pond captures run off from a 100 by 100-m pad comprised of crushed gravel at 1 percent (%) grade leading to the sedimentation pond where the one (1)

silo of emulsion (35 tonnes) and one (1) silo of Ammonium Nitrate Prill (50 tonnes) are stored. A closed loop wash bay / maintenance building for washing and maintaining the explosive transport trucks provided by the authorized explosive vendor is also located at this pad. The two parameters of concern identified for this pond are TSS and nitrogen species from potential spills of ammonium nitrate (AN) prill and/or emulsion blasting agents on the pad. This sedimentation pond is lined with a bituminous liner or equivalent and will discharge to ground via a controlled pumping system. Monitoring of the water in the sedimentation pond will be completed in compliance with regulatory approvals and if nitrate/nitrite/ammonia concentrations are above permit approved limits the water will be pumped to the onsite evaporator which is part of the wash bay/maintenance building for the Explosive Facility for treatment. The precipitate will either be shipped offsite for disposal at an approved and licensed facility or combined with blasting agents for detonation as part of the blasting process. In the permitting phase the Explosive Facility Pad and Magazine Pad will be combined into one site with a size of 100 by 100-m thereby reducing the two sedimentation ponds in the EAC application to one for permitting.

The two (2) sedimentation ponds for the Gravel Quarry only collect contact water from activities involving disturbing overburden materials, sands, gravels, and water in contact with gravel from the existing approved Quarry. The two Gravel Quarry Sedimentation Ponds service distinct phases of the Gravel Quarry already approved by Ministry of Mines and Critical Minerals (MCMM) and operated by Telkwa Mining. The two Gravel Quarry Sedimentation Ponds service small catchment areas associated with two gravel pits that will produce approximately 35,000 cubic metres (m^3) of material over the life of the Quarries which is approximately 10 years. These two sedimentation ponds will not operate concurrently, rather the Gravel Quarry Sedimentation Pond 1 will operate for roughly four (4) years until the Gravel Quarry 1 area is exhausted and will be reclaimed and then the Gravel Quarry Sedimentation Pond 2 will operate for the remaining six (6) years until the Gravel Quarry 2 area is exhausted. Furthermore, these ponds will also not be used year around but will only be required during when the quarries are active between Jun and September of the first 10 years. Based on the static geochemical test work conducted for the Rock Quarry, Gravel Quarries, and Tenas Access Corridor (TAC), the overburden and rock materials draining to these sedimentation ponds are *non-PAG* material using an NPR cut off of 2 to 1; however, these materials will be subject to verification testing as detailed in the **Metal Leaching/Acid Rock Drainage (ML/ARD) Management Plan (S13.0-C12)** of the **EAC Application**. These ponds only operate during the first 10 years of the Operation Phase at which time both phases of the gravel quarry are exhausted and reclaimed including the sedimentation ponds.

The two (2) sedimentation ponds adjacent to Goathorn Creek are constructed in support of the **Construction Environmental Management Plan (CEMP) (S13.0-S4)** of the **EAC Application** to provide contingency sedimentation capacity for construction activities being undertaken in this valley on both sides of Goathorn Creek. Again, these two sedimentation ponds only service small

catchment areas on either side of Goathorn Creek (approximately 1 hectare [ha] on each side) and will treat contact water from cut and fill activities taking place if already implemented sediment and erosion control measures are insufficient. Again, TSS is the only parameter of concern as only surficial materials are being disturbed by improvements to the Forest Service Roads (FSRs) and no blasting is envisioned for road construction activities in the Goathorn Creek Valley. As these ponds are constructed primarily in highly permeably material, water discharge from these facilities will be to ground either from the base of the ponds. Once the Construction Phase is complete and the reclamation of the cut and fill slopes for the TAC is complete, these ponds will be decommissioned and reclaimed. The materials excavated and disturbed within the Goathorn Creek Valley have been evaluated and been determined to be *non-PAG* using an NPR cut off of 2.0 to 1; however, these materials excavated will be subject to verification testing as detailed in the **Metal Leaching/Acid Rock Drainage (ML/ARD) Management Plan (S13.0-C12)** of the **EAC Application**.

The Rock Quarry Sedimentation Pond services the catchment of Rock Quarry activities roughly 2.5 ha in size and located 7 kilometres (kms) west of the mine site. The materials have been evaluated and been determined to be *non-PAG* using an NPR cut off of 2.0 to 1. This material will be subject to verification testing of blastholes and/or free dig material as specified in the **Metal Leaching/Acid Rock Drainage (ML/ARD) Management Plan (S13.0-C12)** of the **EAC Application**. The Rock Quarry will only be developed once the gravel quarries are completed which is estimated to occur in Year 10 so the Rock Quarry and two Gravel Sedimentation Ponds will not be in operation concurrently. The two parameters of concern identified for this Rock Quarry were TSS and nitrogen species and it will also discharge to ground and is not lined. Roughly 45,000 m^3 of material will be excavated for road surfacing materials over its 12-year life. Monitoring of the water in the Rock Quarry Sedimentation Pond will be completed in compliance with regulatory approvals.

Table 2-1 below summarizes the operating periods of the various sedimentation ponds not included in the overall WLBM.

Figure 2-1 through **Figure 2-6** illustrate the location of the various sedimentation ponds during four time periods associated with the Project: Construction Phase, Operation Phase Years 1 to 4, Operation Phase Years 5 to 10, Operation Phase Years 11 to 21, Decommissioning and Reclamation Phase, and the Post-closure phase.

Table 2-1: Summary of Operating Timeframes for Sedimentation Ponds not Included in the WLBM

Period	Explosive Facility Sedimentation Pond	Explosive Magazine Sedimentation Pond	Goathorn East and West Sedimentation Ponds	Gravel Quary 1 Sedimentation Pond	Gravel Quarry 2 Sedimentation Pond	Rock Quarry Sedimentation Pond
Construction Phase	No	No	Yes	No	No	No
Years 0 to 4	Yes	Yes	No	Yes	No	No
Years 5 to 10	Yes	Yes	No	No	Yes	Yes
Years 11 to 21	Yes	Yes	No	No	No	Yes
Decommissioning and Reclamation Phase	No	No	No	No	No	No
Post-closure Phase	No	No	No	No	No	No

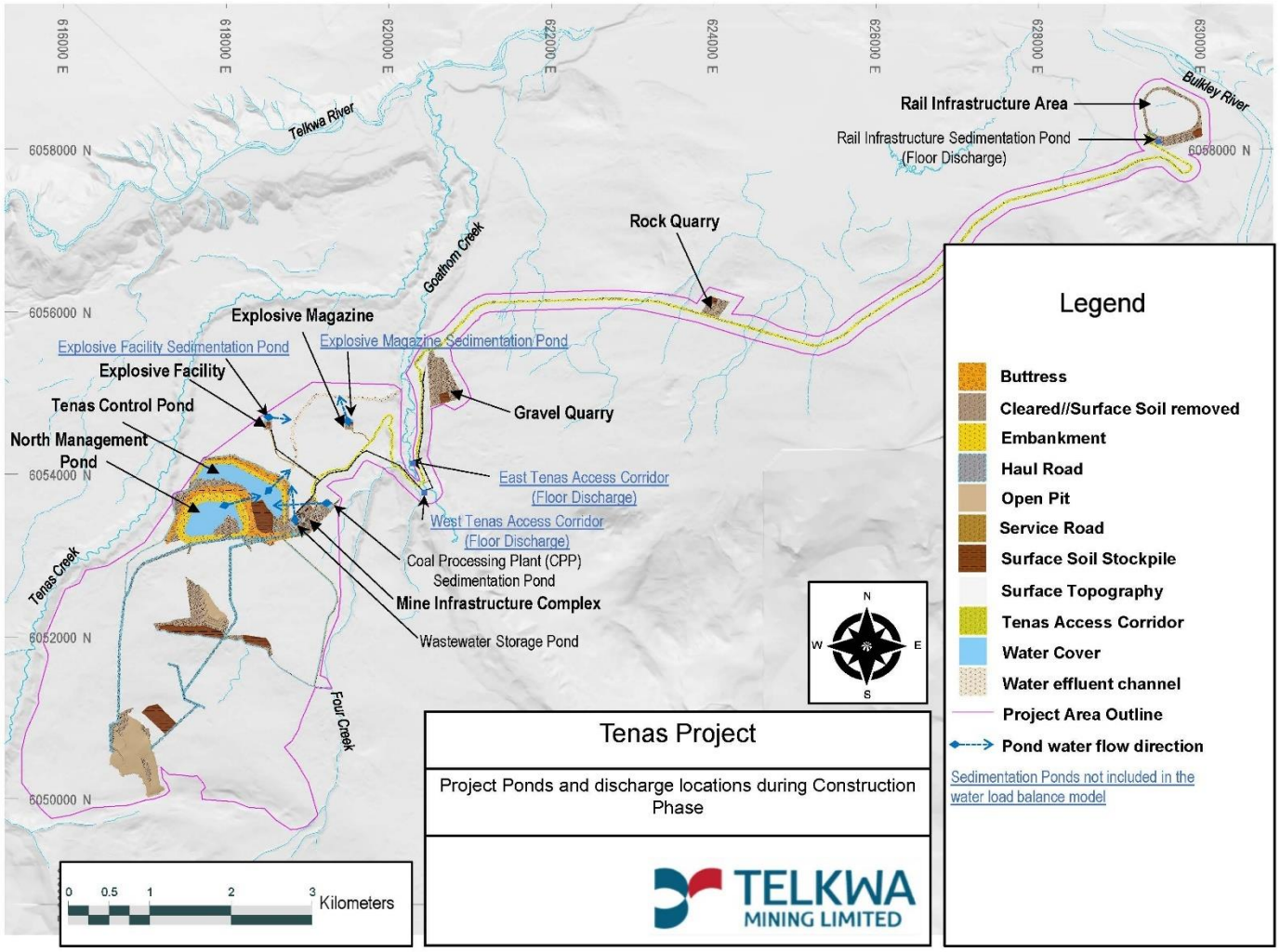


Figure 2-1: Sedimentation Ponds Location and Operation During Construction Phase not Included in WLBM

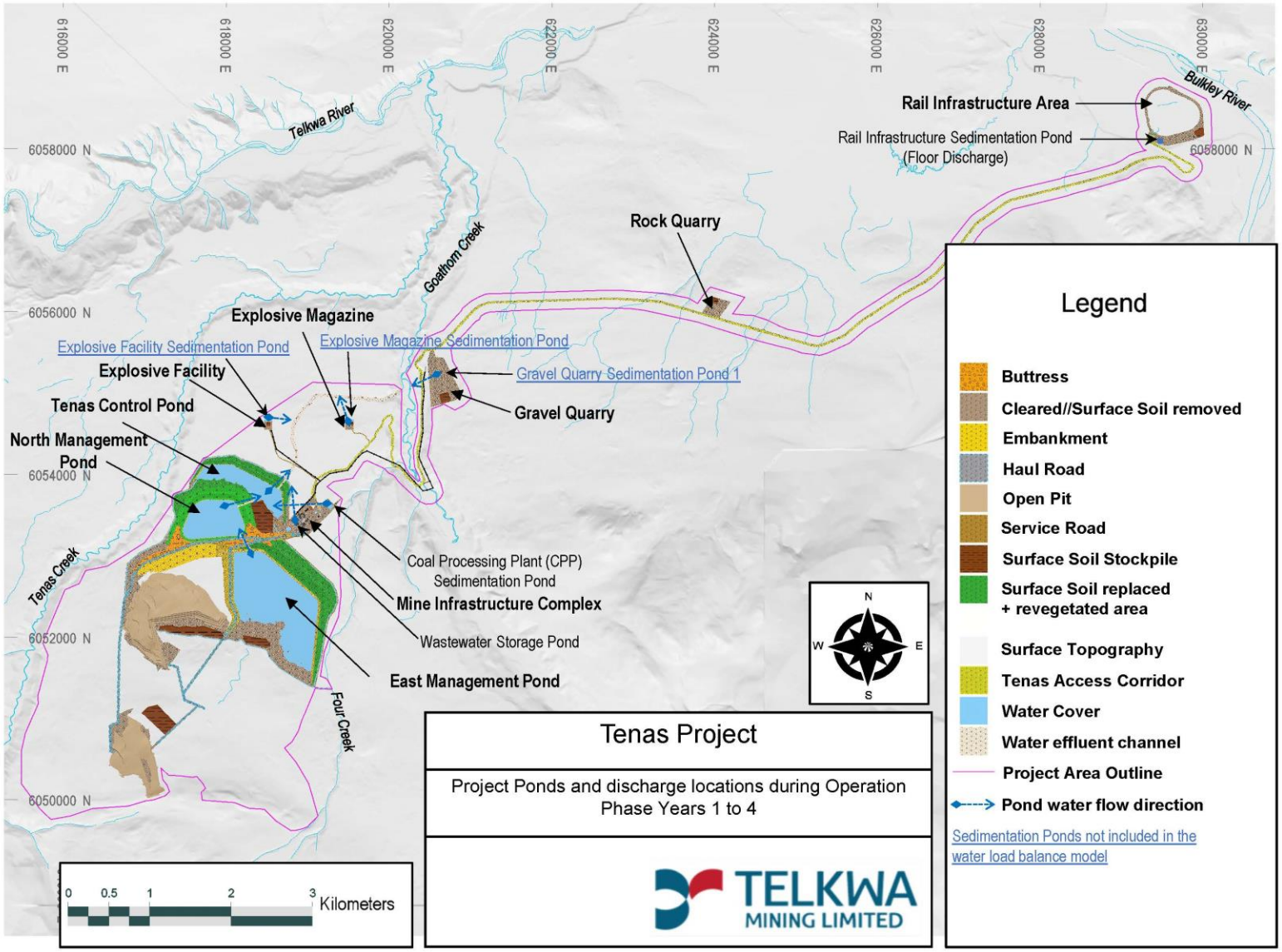


Figure 2-2: Sedimentation Ponds Location and Operation During Operation Phase Years 1 to 4 not Included in WLBM

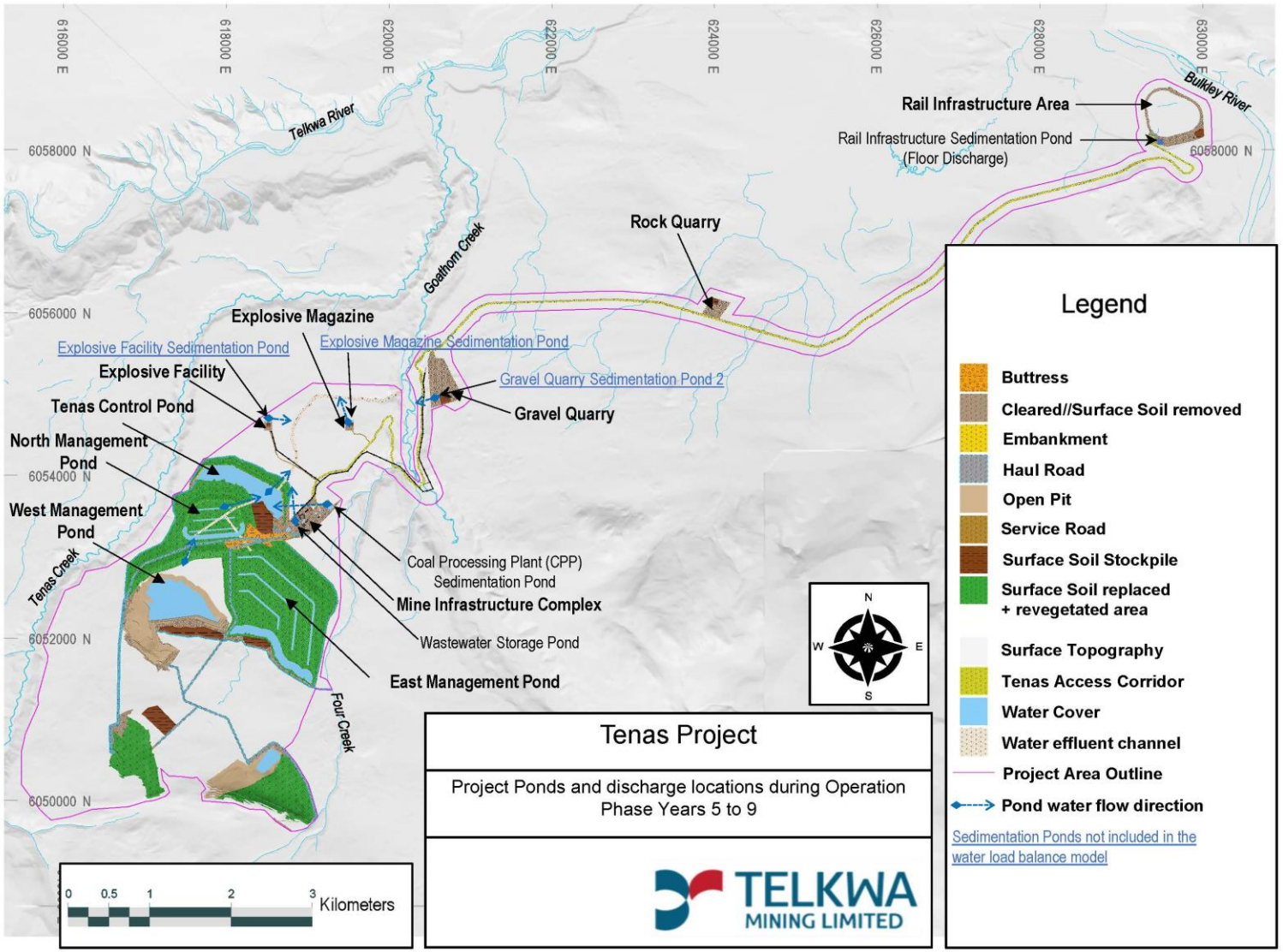


Figure 2-3: Sedimentation Ponds Location and Operation During Operation Phase Years 5 to 9 not Included in WLBM

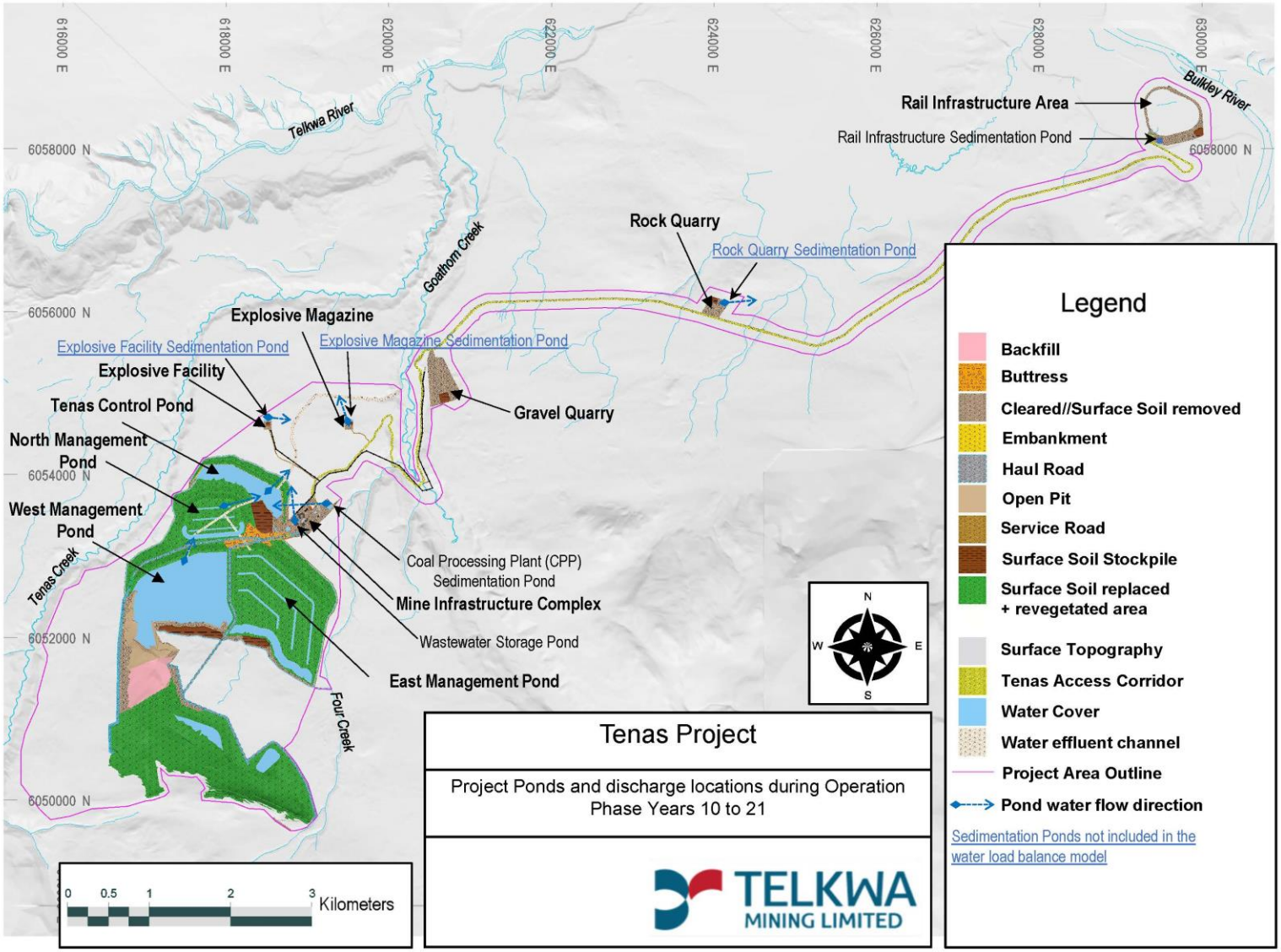


Figure 2-4: Sedimentation Ponds Location and Operation During Operation Phase Years 10 to 21 not Included in WLBM

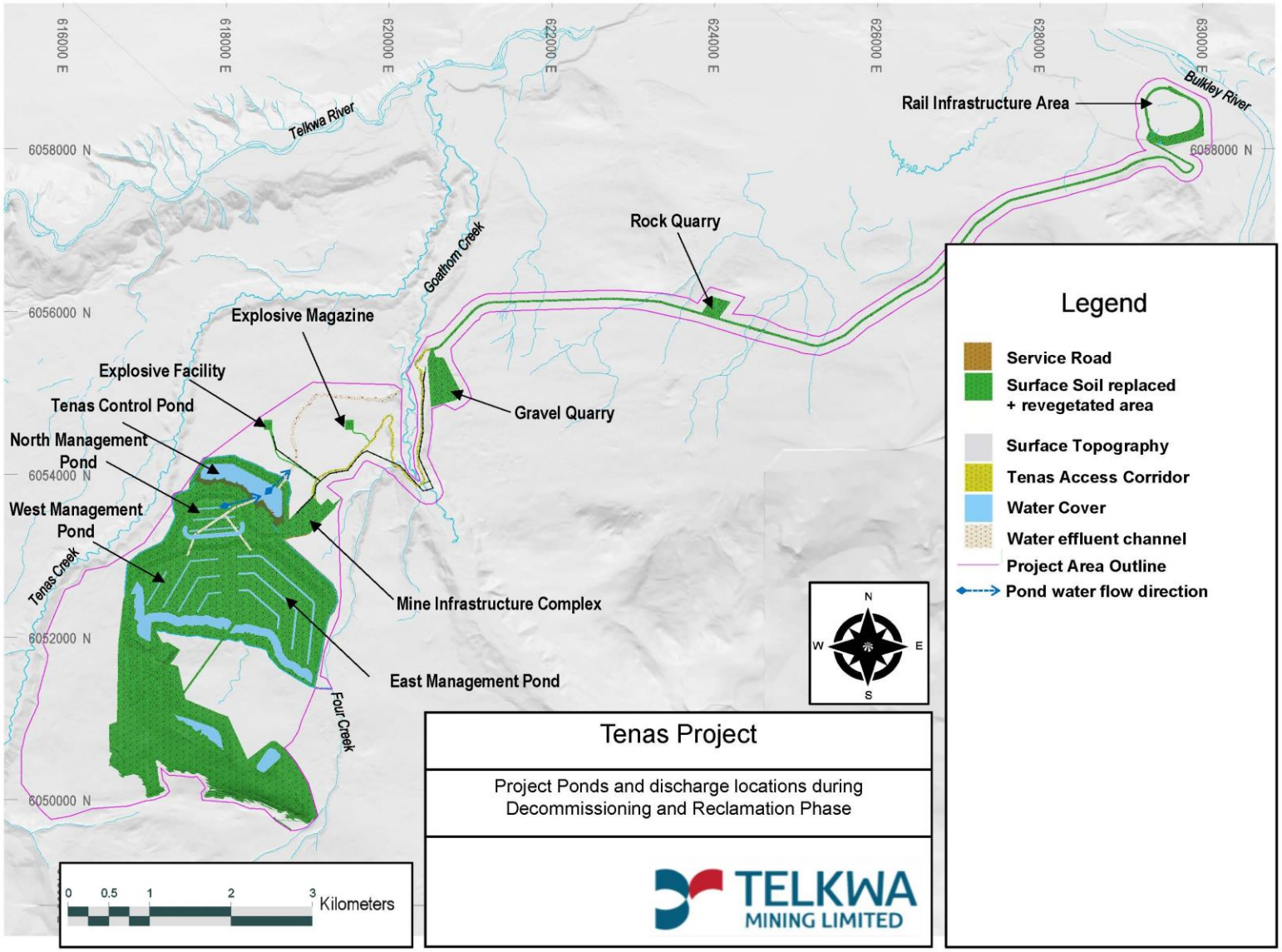


Figure 2-5: Sedimentation Ponds Location and Operation During Decommissioning & Reclamation Phase not Included in WLBM

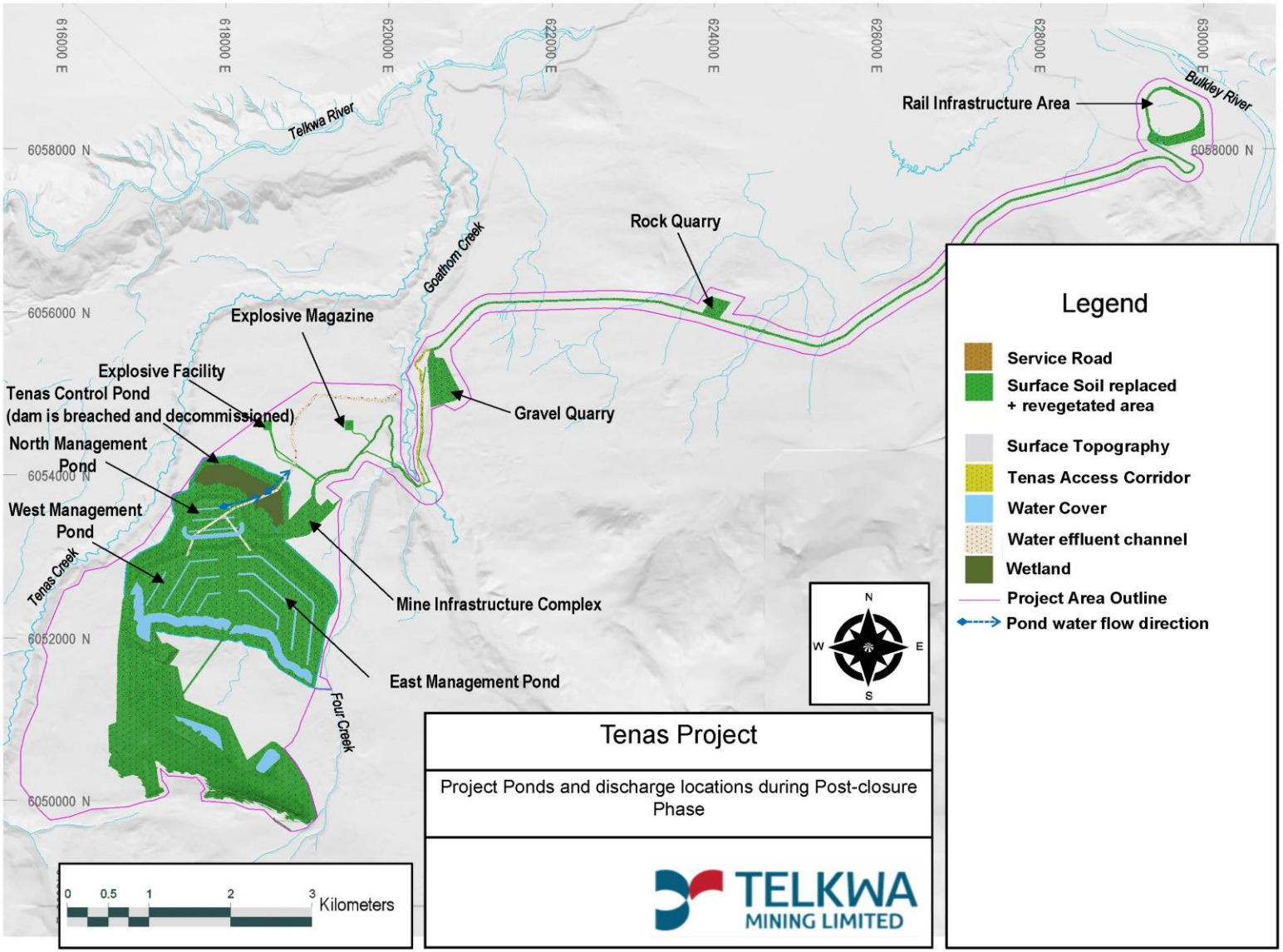


Figure 2-6: Sedimentation Ponds Location and Operation During Post closure Phase not Included in WLBM

Based on the above information the sedimentation ponds identified that the:

- Explosive Facility;
- Explosive Magazine;
- Rock Quarry;
- Gravel Quarry 1 and 2; and,
- East and West TAC

were not included in the overall WLBM completed by SRK for the EAC Application for the Project as including them would have no effect on the water quality and quantity modelled values presented for the prediction nodes nor on the subsequent effects assessments conducted for Surface Water Valued Component.

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by the BC Ministry of Environment (ENV) about the WLBM.

The following discharges have been accounted for in the WLBM:

- Tenas Control Pond;
- CPP Sedimentation Pond;
- Rail Infrastructure Sedimentation Pond;
- Potable Water Storage Pond; and,
- Wastewater Storage Pond.

The Tenas Control Pond is described in **subsections 1.9 Existing Infrastructure and Project Phases**, **1.10 Project Component Summary**, **1.16 Mine Infrastructure Complex (MIC)**, and **1.17 Water Management** in **1.0 Overview of Project Proponent Description** of the **EAC Application**. This pond is the main sedimentation pond for the Project and where mine impacted water is released during the open water season via a surface water discharge into an improved upon natural ephemeral water channel to prevent erosion and sediment release that leads into Goathorn Creek.

The CPP Sedimentation Pond is described in **subsections 1.9 Existing Infrastructure and Project Phases**, **1.10 Project Component Summary**, **1.16 Mine Infrastructure Complex (MIC)**, and **1.17 Water Management** in **1.0 Overview of Project Proponent Description** of the **EAC Application**. The EAC Application has water from the CPP Sedimentation Pond being pumped to the Tenas Control Pond and therefore this pond is not uniquely characterized but is combined with the discharge/seepage quality planned for the Tenas Control Pond. The CPP Sedimentation Pond is lined with a bituminous or alternate lining system. The CPP Sedimentation Pond will have a primary pumping system for pumping flows and a complete duplicate system to provide the

necessary redundancy for any potential pump failures. Furthermore, there will be a spare pump for each one of these systems in case of a pump failure and a backup diesel generator to run these pumps in case of grid power outages.

The discharge from the Wastewater Storage Pond is assessed as part of the overall surface flow discharge from the Tenas Control Pond. The Wastewater Storage Pond is lined with a bituminous or alternate lining system. The discharge from this pond will be via a pumped system to ensure a blending target ratio of 10 to 1 is maintained between flow from the Wastewater Storage Pond and the Tenas Control Pond. This pond has been sized to store a full year of treated wastewater from the sewage treatment plant.

The discharge from the Potable Water Storage Pond is non-contact water from water that is collected by the C02 Channel above the East Management Pond and EA Open Pit and directs this water to Four Creek or to the Potable Water Treatment Plant.

FOLLOWUP COMMENTS

FOLLOW UP 302 ITT TABLE

The discharge of effluent from sedimentation ponds for overland flow to downstream watercourses does not follow best management practices. Erosion resulting from the discharge has the potential to increase the primary POPC (TSS) to receiving waters. The cumulative effects of these additional discharges to the receiving environment have not been accounted for the IDZ study and need to be quantified. Will any mine contact water be directed to the sedimentation ponds [Clarification]?"

RESPONSE FOLLOW UP 302 ITT TABLE

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by ENV about the WLBM.

FOLLOWUP COMMENTS

508 ITT TABLE

This conceptual design brief and budgetary estimate does not state the effluent quality or discharge rate to the receiving environment. Please provide this information in a QP certified memo. If the sediment pond to which the effluent will be collected is not lined, please provide the infiltration rate. [Permitting Information Requirement]

RESPONSE 508 ITT TABLE

The Sewage Treatment Plant proposed is a secondary stage treatment plant and is targeting the following average monthly maximum discharge parameters in milligrams per litre (mg/L) at a maximum rate of 5,400 m^3 per year:

- 43 mg/L Nitrate, as nitrogen;
- 0.10 mg/L Nitrite, as nitrogen;
- 2.0 mg/L Ammonia, as nitrogen;
- 20 mg/L Biochemical Oxygen Demand (BOD); and,

- 20 mg/L TSS.

The Sewage Treatment Plant has been designed to allow it to be upgraded to a tertiary style plant in the future if discharge requirements change. The wastewater storage pond where the effluent will be collected from the Sewage Treatment Plant is lined with a bituminous liner or equivalent as is the channel transporting this wastewater to the overall mine discharge channel from the Tenas Control Pond at which point this wastewater is mixed with discharge from the Tenas Control Pond. The wastewater pond has been designed to store a complete year of effluent to provide adequate time for controlled releases from the Wastewater Storage Pond to get an adequate mixing target of approximately 10 to 1 in Goathorn Creek. Please see the attached report from Radloff Engineering and Bionest on the wastewater system in **Appendix 7: Water and Wastewater Treatment Design Report and BioNest Assurance Letter, Radloff**.

Telkwa Mining believes the details above address the requirements set forth in IR **Theme 5**.

THEME 2: SUBSTANTIALLY REVIEW THE WATER BALANCE MODEL. THE WATER BALANCE MODEL IS KEY TO ASSESSING MITIGATION AGAINST EFFECTS TO MANY VALUED COMPONENTS NOT ONLY WATER QUALITY

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

Model input values and resulting predictions for the same management structures are inconsistent between the WLBM and the Groundwater model.

509 ITT TABLE

Table 3-16 and Table 3-17 present groundwater connections to mining facilities throughout the life of mine for the expected case and high case. There are some notable differences between these tables and the corresponding tables in Appendix 4.4-A (Tables 6-6, 6-7 and 6-11). For example, the WBM does not appear to consider any groundwater connection to the NMP, while the Groundwater Model predicts seepage from the NMP throughout the life of mine. In other instances, the results appear to be different between the version of the groundwater model used in the WBM and the model presented in the application. For instance, the expected seepage rate from the WMP in Post Closure is 720 m3/d in Appendix 4.4-A while the prediction is 610 m3/d in Appendix 4.3-A. This could increase the predicted post-closure exceedances of selenium at WQS04 as both the NMP and WMP contribute to loadings at this location (based on Table 3-20 in Appendix 4.3-A). Conversely, predicted seepage from EMP in post-closure under the expected case are lower in the Appendix 4.4-A than in Appendix 4.3-A (277 m3/d vs 395 m3/d, respectively) which would reduced to the loading to the receiving environment through groundwater pathways, but may impact the expected surface discharge from the EMP, routed through the NMP and into Goathorn Creek. Please provide water balance and water quality results using inputs from the Groundwater Model provided as part of the application. [EA Information Requirement, QP Response Required].

IR LETTER NEW AND 517 ITT TABLE

There are several inconsistencies in values between Table 3-16 and Table 3-17 and the corresponding groundwater tables in Appendix 4.4-A (Tables 6-6, 6-7 and 6-11) which have provided contradictory information and predictions related to seepage throughout the life of mine, specifically related to selenium loading.

- *Have a QP provide water balance and water quality results using inputs from the Groundwater Model provided as part of the Application.*

RESPONSE 517 AND 509 ITT TABLE

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by ENV about the WLBM and **Appendix 8: Tenas Project, Hydrogeology Technical Report, SRK**.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

Significant uncertainty remains in WLBM calibration, preventing a scientifically defensible effects assessment.

510 ITT TABLE

Section 3.1.2 describes the stochastic model used in Alternative Case 6, but this section does not demonstrate that the stochastic model adequately reproduces the temperature and precipitation variation defined in the baseline characterization (Appendix 1-R).

a) *Please provide plots and tables showing the selected stochastic model parameters produce temperature and precipitation distributions that are representative of the baseline characterization.*

b) *Please provide a rationale to demonstrate 100 model realizations are sufficient to describe climate variability and indicate the range of return periods modeled by this set of realizations. [EA Information Requirement, QP Response Required]*

IR LETTER NEW AND 518 ITT TABLE

Section 3.1.2 describes the stochastic model used in Alternative Case 6, but this section does not demonstrate that the stochastic model adequately reproduces the temperature and precipitation variation defined in the baseline characterization (Appendix 1-R).

1. *Have a QP provide plots and tables showing the selected stochastic model parameters produce temperature and precipitation distributions that are representative of the baseline characterization.*
2. *Have a QP provide a rationale to demonstrate 100 model realizations are sufficient to describe climate variability and indicate the range of return periods modeled by this set of realizations.*

RESPONSE 518 and 510 ITT TABLE

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by ENV about the WLBM.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

Significant uncertainty remains in WLBM calibration, preventing a scientifically defensible effects assessment.

511 ITT TABLE

Please provide or indicate where in the application I can find, annual water balance tables for major mine facilities (Open Pit, EMP, NMP, WMP, Tenas Control Pond) quantifying all modeled inflows, outflows and storage for Operations and Post Closure under a range of climate conditions (average, wet and dry). [EA Information Requirement, QP Response Required]

IR LETTER NEW AND 519 ITT TABLE

Have a QP provide annual water balance tables for major mine facilities (Open Pit, East, West and North Management Ponds, Tenas Control Pond) quantifying all modeled inflows, outflows and storage for Operations and Post Closure under a range of climate conditions (e.g., average, wet and dry).

RESPONSE 511 and 519 ITT TABLE

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by ENV about the WLBM.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

Model nodes need to be appropriately located near planned discharge locations rather than many kilometers downstream.

IR LETTER NEW AND 515 ITT TABLE

a) Have a QP add additional model nodes to represent conditions at:

- *Tributary receiving discharge above confluence with Goathorn Creek.*
- *Goathorn Creek below confluence with tributary receiving discharge.*

Have a QP provide water quantity and quality results for these nodes over the life of mine for the following assessment cases:

- *Project Case*
- *Alternative Case 1, 2, 3, 4 and 5*

Have a QP provide water quality results in figures and table with comparison to relevant water quality guidelines, as provided in Appendix 6 & G of Appendix 4.3-A of the application.

IR LETTER OVERVIEW

Seasonal and monthly variability of background water quality concentrations may affect predicted water quality parameter concentrations.

IR LETTER NEW AND 515 ITT TABLE

b) Have a QP clarify if the background water quality inputs used in the model were annual median values or if monthly (or seasonal) median values were used (section 3.10.1 of Appendix 04.3-A, the Water & Load Balance Modeling Report). If monthly or seasonal background concentrations were used, please provide a table describing their values and ranges. If monthly or seasonal median values were not used, have a QP re-run the Project Assessment Case and Alternative Assessment Case 5 (see Table 2-3 in Appendix 04.3-A) to generate water quality predictions using either monthly (or seasonal) median background values or the annual 95th percentile of background; present results in a format similar to Appendix 6 of Appendix 04.3-A.

RESPONSE 515 ITT TABLE

The following prediction node have been added to the WLBM:

- WQEA1 which represents Goathorn Creek below confluence with tributary receiving discharge; and,
- A prediction node was not added for the tributary receiving discharge above confluence with Goathorn Creek as its quality has been assumed to be same as the end of pipe discharge due to the lack of water in this tributary.

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by ENV about the WLBM. In summary the background water quality inputs used in the EAC Project Case (August 2022) WLBM were monthly mean values while seasonal values are used in both the Updated and Final EAC Project Cases (2024).

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

Significant uncertainty remains in WLBM calibration, preventing a scientifically defensible effects assessment.

FOLLOW UP 293 ITT TABLE

"Thank you for the response. I note that the derived synthetic and measured site precipitation appear correlated, as demonstrated in the slides; however, the monthly linear relationships (pg 14) do not demonstrate a relationship approaching 1:1, which would indicate the synthetic approximates the measured data.

- *a) To clarify, were these monthly relationships used to further adjust the derived synthetic record to improve the fit to the measured data? [Clarification, QP response required]*
- *b) Please provide a figure showing concurrent cumulative precipitation records (i.e., double mass curve) and a table with monthly and annual precipitation from both the measured record and final derived/synthetic record(s) that was:*
  - *i. used as input to the water balance model, and*
  - *ii. used to characterize site precipitation and estimate extreme precipitation. If separate records were used, please present both. [EA information requirement, QP response required]"*

IR LETTER NEW AND NEW 293 ITT TABLE

Monthly linear relationships do not demonstrate a relationship approaching 1:1 which would indicate the synthetic approximates the measured data.

1. *Have a QP clarify if monthly relationships were used to further adjust the derived synthetic record to improve the fit to the measured data;*
2. *Have a QP provide a figure showing concurrent cumulative precipitation records (i.e., double mass curve) and a table with monthly and annual precipitation from both the measured record and final derived/synthetic record(s) that was:*

a. *used as input to the WLBM; and used to characterize site precipitation and estimate extreme precipitation (if separate records were used, present both).*

RESPONSE FOLLOW UP 293 ITT TABLE AND NEW 293 ITT TABLE

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by ENV about the WLBM.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

Significant uncertainty remains in WLBM calibration, preventing a scientifically defensible effects assessment.

FOLLOW UP 294 ITT TABLE

Thank you for the response. I'm struggling to understand why this linear regression (Figure 4-16) was selected by the QP as appropriate for this analysis, given the issues described in the response. Without being able to attribute the difference unit runoff/discharge from these similarly located stations to a physical attribute or rationalize an incremental unit runoff of roughly 80 l/s/km2 for the area between these stations, using a 0.8 or 0.85 ratio to scale the historic Goathorn WSC record to the site station represents flawed logic, in my opinion. In particular, the high flow regression is driven, in large part, by the extrapolated high flow section of the site rating curve, where the curve is not supported by stage-discharge measurements.

As Goathorn Creek is the receiving environment for surface discharge from the proposed project and seepage from the management ponds in Post-Closure, the selected regression could have a notable impact on water quality predictions in the receiving environment, thus introducing considerable uncertainty into the assessment of impacts from the proposed project. I understand that this synthetic record was used, in part, to calibrate the rainfall-runoff model used in the water balance model. Using an updated regression (scale by drainage area or refined with

published data), please describe, and quantify the bias that was introduced into the baseline characterization, model calibration and results and impact assessment by the selected regression. Please consider comments ID 295 and 296 in your response. [EA information requirement, QP response required]

294 IR LETTER

Given the minor difference in drainage area between Goathorn-Hydro and Goathorn (08EE008) (1% difference), the selected linear regression (Fig 4-16) describes a surprisingly large difference in unit discharge.
Have a QP use an updated regression (scale by drainage area or refined with published data) to describe and quantify the bias that was introduced into the baseline characterization, model calibration, and results and impact assessment by the selected regression.

RESPONSE 294 IR LETTER AND FOLLOW UP 294 ITT TABLE

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by ENV about the WLBM.

INITIAL COMMENTS

295 ITT TABLE

Please provide figures showing mean monthly measured and rainfall-runoff modelled streamflow for Tenas-Hydro, Goathorn-Hydro, and Telkwa-Hydro. It is hard to see the match of hydrograph shape and amplitude at moderate and low flows from the figures provided. As results from the GoldSim model are presented monthly, I am also interested in the visual match at a monthly timestep, over the daily timestep provided. [Information Request]

RESPONSE 295 ITT TABLE

See Attachment #295-1 for mean monthly streamflow from measured and modelled datasets. For measured streamflow, monthly average values were only calculated for months missing less than 5 days of data.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

Significant uncertainty remains in WLBM calibration, preventing a scientifically defensible effects assessment.

FOLLOW UP 295 ITT TABLE

Thank you for the plots. It appears the rainfall-runoff model underpredicts the freshet, particular in 2018, and typically predicts that the freshet peaks in June, rather than in April or May as shown in the measured record. In addition, the model appears to be underpredicting summer low flows, with the exception of 2018 at Tenas-Hydro only. As this model was used in the water balance model to predict runoff for unimpacted watersheds as well as reclaimed mine impacted areas, this calibration introduces considerable uncertainty into the water management and water quality predictions. In your response to the following questions, please consider comments ID 294 and 296.

a) *What sensitivity analysis was completed on this model calibration? Were other rainfall-runoff model frameworks attempted and shown to be worse? In particular, I'm interested to know if a model with a more dynamic infiltration/runoff component was considered given the model application.*

b) *If the model were better calibrated to freshet conditions, please describe, and quantify the impact this would have on predicted surface discharge quantity and quality over the life of mine and over a range of climatic conditions?*

c) *If the model were better calibrated to summer low flow conditions, please describe, and quantify the impact this model improvement would have on predicted water quality in the receiving environment during low flow periods over the life of mine over a range of climatic conditions.*

d) *What data collection efforts are underway to support refining/recalibrating/redeveloping this model?*

e) *Why was this calibration considered sufficient for impact assessment? I note the QP has "strongly suggested that this study be revisited and that the model be recalibrated when longer ... records are available... and when all WSC flow data are published".*

RESPONSE FOLLOW UP 295 ITT TABLE

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by ENV about the WLBM.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

Significant uncertainty remains in WLBM calibration, preventing a scientifically defensible effects assessment.

FOLLOW UP IR LETTER 295/296 AND 295 ITT TABLE

The rainfall – runoff model, used in the WLBM to predict runoff from unimpacted and reclaimed watersheds, appears to underpredict the median and range of flow conditions by a sizeable margin in Goathorn Creek, Tenas Creek and Telkwa River when compared to the synthetic records. The rainfall-runoff model also appears to poorly match the hydrograph shape, specifically the magnitude and timing of the freshet and the summer low flows when compared to the measured record. This poor calibration introduces considerable uncertainty into the water management and water quality predictions based on the WLBM results.

- *Have a QP provide a robust demonstration that the model is sufficiently calibrated to available measured and synthetic datasets with a focus on common flow conditions (the annual range of average flow conditions). Where modeled results deviate considerably from baseline characterization, describe and quantity the impact to predicted surface discharge quantity and quality, and predicted water quality in the receiving environment over the life of mine and for the applicable assessment cases caused by model bias.*

  OR

- *Have a QP recalibrate the rainfall-runoff model to provide the evidence outlined above. Describe the impact on surface water discharge quantity and quality, water management (waste management pond water levels), and receiving environment water quality over the life of mine. Provide revised results in a format consistent with Appendix 6 and G Appendix 4.3-A of the application for all assessment cases.*

RESPONSE FOLLOW UP 295 ITT TABLE

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by ENV about the WLBM.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

Significant uncertainty remains in WLBM calibration, preventing a scientifically defensible effects assessment.

FOLLOW UP IR LETTER 295/296 AND 296 ITT TABLE

Thank you for the plots. It appears the rainfall-runoff model underpredicts the median and range of flow conditions by a sizeable margin in Goathorn Creek, Tenas Creek and Telkwa River when compared to the synthetic records. The flows at the 50% probability of exceedance in Telkwa River appear to be underestimated by over 10 m3/s and the estimated mean annual discharge (MAD) at this location is 27.3 m3/s (Table 4-24). Based on the provided flow duration curve (FDC) figure in the response, MAD has a 70% probability of exceedance using the synthetic record while the modelled record gives MAD a 45% probability of exceedance. Similarly, for Tenas Creek, at the 50% probability of exceedance, the modelled record is roughly 0.1 m3/s lower than the synthetic record, and the estimated MAD at this location is 0.5 m3/s. Based on the FDC for Tenas, MAD has a 26% probability of exceedance using the synthetic record, and the difference between the synthetic and modeled is roughly 0.15 m3/s, indicating the MAD is modeled roughly a third lower than the synthetic record suggests. At Goathorn Creek, the modeled record underpredicts the synthetic, which is likely also underestimated (see ID 294).

a) Why was this calibration considered sufficient for impact assessment?

b) Please calibrate the model to the bulk of flow conditions and describe and quantify the impact on surface water discharge quantity and quality, water management (waste management pond water levels), and receiving environment water quality over a range a flow conditions over the life of mine.

[EA information requirement, QP response required]

RESPONSE FOLLOW UP 296 ITT TABLE

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by ENV about the WLBM.

Telkwa Mining believes **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** with the answers provided above addresses the requirements set forth in IR **Theme 2**.

THEME 1: DESIGN ALTERNATIVE TREATMENT OPTIONS WHICH ARE CAPABLE OF MEETING WATER QUALITY GUIDELINES (WQGS) NEAR APPROPRIATELY SITED DISCHARGE LOCATIONS

FOLLOWUP COMMENTS

175 ITT TABLE

EMLI is consulting with ENV on water quality monitoring and water management measures for this project. Telkwa Coal will need to propose conceptual design of management structures as part of the current application to demonstrate that the Project as proposed is capable of managing water not suitable for discharge and meeting WQGs.

176a ITT TABLE

EMLI understands that ENV's review of the surface water quality effects assessment and proposed water quality benchmarks is ongoing. EMLI notes that based on that review additional water quality mitigation for the Project may be required. Should water treatment or other mitigation measures be proposed for the Project, EMLI will review the information at that time. Telkwa Coal is encouraged to engage as soon as possible with EMLI on any proposed water treatment, especially if any passive or semi-passive technologies are proposed.

RESPONSE 176a ITT TABLE

Telkwa Mining understands if water treatment becomes a requirement that EMLI will need to be engaged with these technologies, whether they are passive, semi-passive or active. Telkwa Mining has started engagement with EMLI as of Q3, 2024.

LETTER IR 176 AND 176b ITT TABLE

1. *Provide conceptual design of alternative treatment options, mitigation measures, and management structures that can manage water not suitable for discharge and that meet BC WQGs.*

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

The Water and Load Balance Model (WLBM) is key to assessing the effectiveness of mitigation against effects to many VCs, including water quality.

- *Source control and mitigation or treatment options included in the WLBM do not demonstrate that Water Quality Guidelines (WQG) will be met near discharge locations and will lead to exceedance of WQGs over many kilometres of multiple watercourses.*

FOLLOW UP IR LETTER NEW AND 514 ITT TABLE

Provide design alternative treatment options which are capable of meeting WQGs near appropriately sited discharge locations. Describe the reliability, control-effectiveness, and treatment efficiency of each mitigation option including the currently proposed option – refer to BC ENV Best Achievable Technology (BAT) guidance. BAT assessments are required prior to the development of Initial Dilution Zones (IDZs) – also refer to BC IDZ development guidance.
When considering discharge standards, follow these best practices and minimum standards:

a) *The discharge must not be acutely toxic.*

Telkwa Mining completed a two-step process to determine if the discharges are potentially acutely toxic as follows:

1. A review was conducted of the end of pipe discharge concentrations versus the relevant BC Water Quality Acute Guidelines with any parameter having a concentration less than these guidelines not being acutely toxic; and,
2. For the few parameters that had end of pipe concentrations higher than the BC Water Quality Acute Guidelines, Borealis Environmental Consulting Inc was retained to review these concentrations versus the relevant acute toxicity limits for rainbow trout and Daphne Magna and determined that the modelled concentrations at end of pipe are not acutely toxic. Please see **Appendix 9: Evaluation of Acute Daphnia Magna and Rainbow Trout LC50 Toxicity Supporting Tenas Project Best Available Technology Assessment Study – Parameters of Concern: Nitrite, Iron (Total) and Iron (Dissolved)**.

Telkwa Mining commits to toxicity testing of final effluent discharges utilizing the methodology provided by BC government via Section F Toxicity Test Methods (https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/emre/manuals/environmental-lab-manual/2023-09-18-bc-elm-2022-section-f.pdf).

b) If the untreated effluent contains constituents that exceed 80% of an applicable WQG, BMPs and BAT must be applied. Chronic WQG for the protection of freshwater aquatic life are most typically used as the guideline. However, if more sensitive uses or values are downstream (e.g., drinking water, irrigation, livestock, wildlife) the most protective WQG will be applied.

c) If the effluent still does not meet WQGs, repeat step (b). Document this iterative process.

d) If the effluent still does not meet WQGs after all reasonable BMPs and BAT are applied, an IDZ may be considered during the permitting process. Some chronic toxicity may be tolerated in the IDZ, but water quality should meet WQGs at the end of the IDZ. An IDZ will not be considered during permitting without an adequate BAT assessment.

e) If the water quality at the end of the IDZ still exceeds chronic WQGs, an SPO may be considered during the permitting process. SPOs must be protective of the site-specific environment. An SPO will not be considered during permitting without an adequate BAT assessment.

514 ITT TABLE

Within the bounds of the above best practices and minimum standards, the proponent, and their qualified professionals (QPs) are normally best suited to consider which site-specific factors should be evaluated regarding feasibility, reliability, control effectiveness, and cost effectiveness. To improve efficiency, it may be useful to have a conversation with the ENV on the file once an outline for the BAT assessment has been developed. In practice, the depth and detail of the BAT assessment submittal will be proportionate to the projected effluent quality. If the selected BAT will achieve BC WQGs at the point of discharge, the submittal can be brief and will likely be readily advanced. If the selected BAT is not capable of meeting BC WQGs in the receiving environment, the submittal must be more substantial and will be subjected to a more intensive review, as it must justify the greater risk to the environment.

Some of the technologies TCL has proposed to consider during the BAT assessment are likely to be effective mitigation measures for the Tenas project. TCL may need to consider a set (a series or train) of technologies to address all contaminants of concern. During an EA process, technologies must be at a readiness level of 7 to be considered as primary mitigation. At permitting, technologies must be at a readiness level of 8 or 9 to be considered as primary mitigation. ENV and EMLI consider some of the proposed technologies to be below the appropriate technology

readiness level (TRL) for the Tenas project. The proponent may conduct a Technology Readiness Assessment (TRA) (refer to technical guidance 21 on the Mining and Smelting Guidance webpage) for consideration by ENV and EMLI to demonstrate the technological readiness of any proposed technology. TCL is encouraged to engage with ENV and EMLI prior to undertaking a TRA.

FOLLOW UP 353 ITT AND 355 ITT TABLE

As a result of the BAT conducted for waste rock and tailings management, the selected strategy (subaqueous storage) will provide a good degree of source control in terms of ML/ARD rate, thereby improving effluent quality. However, a BAT assessment is also required to consider appropriate strategies for the management of mine effluent that will be discharged to the environment.

Discharges to ground and non-point source discharges to the environment must be assessed in addition to discharges to surface water. Standard thresholds for discharges to ground are outlined in the ENV guidance document, which is located here: https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/7276_env_rob_dtg_factsheet.pdf

The water quality model predicts that, due to a slowly advancing groundwater plume, the project will result in WQG exceedances in Four and Tenas Creeks. Although these impacts may not occur until after the target coal has been extracted, they are predicted to persist for generations.

The response to the initial comment includes an explanation that assumes an Initial Dilution Zone (IDZ). Similar to the SPOs, an IDZ will not be assessed or authorized unless a BAT assessment is first conducted (following the ENV guidance document). Following BAT, these considerations (SPOs and IDZ) can be assessed through the permitting process under the Environmental Management Act but are not appropriate for inclusion in this review under the Environmental Assessment Act. [Permitting Information Requirement]

IR LETTER OVERVIEW

Reviewers have identified that the current Application shows potential for significant adverse effects to water quality and aquatic biota as there is insufficient water quality mitigation measures to protect the receiving environment.

- *The predicted water quality and the approach to use a few small watercourses as effluent conveyance will result in residual effects to aquatic valued components (VCs) that cannot be reliably managed in BC Environmental Management Act permitting.*

Alternative treatment options capable of meeting WQGs at appropriately sited discharge locations are missing from the Application.

Additional conceptual design of alternative treatment options, mitigation measures, and management structures are needed to prevent the discharge of water that is not suitable for release to the environment.

IR LETTER OVERVIEW

The Water and Load Balance Model (WLBM) is key to assessing the effectiveness of mitigation against effects to many VCs, including water quality.

- *Source control and mitigation or treatment options included in the WLBM do not demonstrate that Water Quality Guidelines (WQG) will be met near discharge locations and will lead to exceedance of WQGs over many kilometres of multiple watercourses.*

LETTER IR 350 AND 350 ITT TABLE

Provide additional mitigation measures to address the significant exceedance of WQGs in frequency and duration for selenium, nitrite, sulphate and dissolved cadmium in Four Creek and Tenas Creek.

RESPONSE IR 175, 176b, 514, 350, 353, and 355

Final EAC Project Case (2024) Development

Telkwa Mining considered incorporating multiple additional mitigation controls in developing the Final EAC Project Case (2024) consisting of the following additional mitigation controls/best management practices (BMP) and/or technologies:

- Management and Control Pond liner design modifications (technology);
- Additional use of water by the CPP (BMP);
- Blasthole Liners (BMP);
- Passive/Active Flocculation(technology);
- Storage and Use of Freshet Water (BMP);
- Water treatment for surface water flows (technology); and
- Water treatment of seepage flows (technology).

The Final EAC Project Case (2024) does not have exceedances in the receiving environment except for parameters that are already in exceedance for background/baseline conditions and a short duration (4 year) exceedance of cobalt in Four Creek which is likely not to occur if attenuation mechanisms in groundwater were accounted for in the water model.

The following sections provide a description of each additional mitigation control/technology and modelled parameter concentrations compared to the Updated EAC Project Case (2024). Please see **Appendix 10: Effect of Mitigation Controls on Water Quality and Quantity of the Tenas Project, SRK.**

Management and Control Pond Liner Modifications (technology)

Table 2-2 provides a summary of the liner systems presented in the EAC Application. These liners were incorporated into the various management and control ponds for the control of seepage from these structures primarily towards the downstream watercourses of Tenas, Four, and Goathorn Creeks.

Table 2-2: Environmental Assessment Certificate (EAC) Liner Designs

Location	Liner Type	Details
Tenas Control Pond	Bituminous	A bituminous liner installed on compacted existing overburden

Location	Liner Type	Details
North Management Pond (floor, embankment face)	Soil-Bentonite	30-centimetre (cm)-thick soil bentonite liner that is blended into existing overburden and compacted and then followed by a 16-ounce filter fabric protection layer all installed on top of compacted existing overburden
East Management Pond (floor, embankment face)	Soil-Bentonite	30-cm-thick soil bentonite liner that is blended into existing overburden and compacted and then followed by a 16-ounce filter fabric protection layer all installed on top of compacted existing overburden
West Management Pond (overburden floor, overburden in the pit and embankment face)	Soil-Bentonite	30-cm-thick soil bentonite liner that is blended into existing overburden and compacted and then followed by a 16-ounce filter fabric protection layer all installed on top of compacted existing overburden
West Management Pond (bedrock floor)	None	No liner prescribed
West Management Pond (bedrock south end EA Open Pit wall)	None	No liner prescribed

SRK completed an option analysis for Telkwa Mining on various liner modifications with the aim of reducing the potential impact of groundwater seepage to the receiving environment. **Table 2-3** provides two modified liner designs that were considered as a potential technology for BAT assessment provided in **Appendix 11: Tenas Project Best Achievable Technology Assessment Updated, SRK**.

Table 2-3: Revised Liner Designs Investigated

Location	Liner Type	Revised Liner Design Details
Tenas Control Pond	Soil-Bentonite with Bituminous Line Above	15-centimetre (cm)-thick soil bentonite liner that is blended into existing overburden and compacted and then followed by a bituminous geomembrane liner on top of this installed on compacted existing overburden.
North Management Pond (floor, embankment face)	Soil-Bentonite	56-cm-thick soil bentonite liner that is blended into existing overburden and compacted and then followed by a 30-cm thick layer of compacted overburden protection layer installed above the liner.
East Management Pond (floor, embankment face)	Soil-Bentonite with Bituminous	Option 1: 56-cm-thick soil bentonite liner that is blended into existing overburden and compacted and then followed by a 30-cm layer of compacted overburden protection layer installed above the liner. Option 2: 56-cm-thick soil bentonite liner that is blended into existing overburden and compacted and then followed by a bituminous geomembrane liner followed by

Location	Liner Type	Revised Liner Design Details
		a 30-cm layer of compacted overburden protection layer installed above the liner.
West Management Pond (overburden floor, overburden in the pit and embankment face)	Soil-Bentonite	56-cm-thick soil bentonite liner that is blended into existing overburden and compacted and then followed by a 30-cm layer of compacted overburden protection layer installed above the liner.
West Management Pond (bedrock floor)**	None**	No liner prescribed**
West Management Pond (bedrock south end wall)	None	No liner prescribed

Notes:

**There is still the possibility to introduce a soil-bentonite liner in the West Management Pond bedrock floor portions during the Operation Phase if parameters of concern are found to be higher in the North, and East Management Ponds than predicted in the EA.

The revised liners specified in **Table 2-3** above were incorporated into the groundwater model to determine seepage levels from these facilities with the revised technical report provided in **Appendix 8: Tenas Project, Hydrogeology Technical Report, SRK**. **Table 2-4** provides a summary of the changes in net seepage values achieved for the above structures.

Table 2-4: Seepage Values in m^3 per day with Revised Liner Designs at End of Mining for Options 1 and 2

CASE	WMP	NMP	EMP	TCP
Updated EAC Project Case (2024)	836	198	458	140
Option 1	373	87	277	8
Option 2	373	87	63	8

These revised seepage values were then used as inputs for the water and load balance model to look at potential mitigations compared to a base case without the use of liners. This was completed by SRK in Appendix 10: Effect of Mitigation Controls on Water Quality and Quantity of the Tenas Project, SRK with **Table 2-5** providing a summary of these results for relevant prediction nodes. Based on the information in **Table 2-5** it was decided to carry this mitigation control forward into the BAT assessment process to determine if this mitigation control is recommended to be incorporated into the Final EAC Project Case (2024).

Table 2-5: Water Quality (Maximum Monthly Mean) Results for Revised Liner Designs in Post-closure using Typical Source Terms and Average Hydrology at Relevant Prediction Nodes

Location Creek	Parameter	BC WQG (2024) (mg/L)	Updated EAC Project Case (2024) (mg/L)	Liner Option 1 (mg/L)	Liner Option 2 (mg/L)
WQSEA1 Goathorn Creek	Copper (d)	0.0013	0.0021	0.0021	0.0021
WQSO6 Goathorn Creek	Copper (d)	0.0013	0.0021	0.0021	0.0021
WQS03-DS Four Creek	Cobalt (t)	0.004	0.00068	0.00092	0.00050
	Nitrite (t)	0.020	0.015	0.0084	0.00027
	Sulphate (t)	309	33	18	6
	Selenium (t)	0.0020	0.00081	0.00045	0.00013
WQS04 Tenas Creek	Copper (d)	0.0026	0.0015	0.0015	0.0015
	Nitrite (t)	0.020	0.0090	0.0084	0.0080
	Sulfate (t)	218	24	22	20
	Selenium (t)	0.0020	0.00078	0.00072	0.00063

Notes: %=percent; BC=British Columbia; EAC=Environmental Assessment Certificate; mg/L=milligrams per litre; WQG=water quality guidelines.
Red text indicates exceedances of WQGs.
Please note that dissolved copper exceeds the WQGs under background conditions.

Additional Water Use by the CPP

The current EAC application has the CPP producing a dry (25% moisture) processed rock stream that is then hauled and placed into the management ponds. The primary reason for this was to limit water use by the Project. However, as the Project discharges water every year when in operation even during drought conditions there is an opportunity to go to a conventional wet slurry system for the processed rock stream by the CPP. This will increase the amount of water required by the CPP with the benefit of permanently tying up this water into the coarse and fine processed rock products. Water from the open pit would be used for this additional use and would improve water quality discharged by the Project. The change in water use by the CPP was incorporated into the WLBM report completed by SRK which is provided in **Appendix 10: Effect of Mitigation Controls on Water Quality and Quantity of the Tenas Project, SRK** with **Table 2-6** below providing a summary of these results for the relevant prediction nodes. Based on these

results and the increased water usage this mitigation control was not carried forward into the Final EAC Project Case (2024).

Table 2-6: Water Quality (Maximum Monthly Mean) Results for Additional Water Use by the CPP during Operation in Post-closure using Typical Source Terms and Average Hydrology at Relevant Prediction Nodes

Location Creek	Parameter	BC WQG (2024) (mg/L)	Updated EAC Project Case (2024) (mg/L)	Additional CPP Water Use (mg/L)
WQSEA1 Goathorn Creek	Copper (d)	0.0013	0.0021	0.0021
WQSO6 Goathorn Creek	Copper (d)	0.0013	0.0021	0.0021
WQS03-DS Four Creek	Cobalt (t)	0.004	0.00068	0.00069
	Nitrite (t)	0.020	0.015	0.015
	Sulphate (t)	309	33	34
	Selenium (t)	0.0020	0.00081	0.00085
WQS04 Tenas Creek	Copper (d)	0.0026	0.0015	0.0015
	Nitrite (t)	0.020	0.0090	0.0091
	Sulfate (t)	218	24	24
	Selenium (t)	0.0020	0.00078	0.00082

Notes: %=percent; BC=British Columbia; EAC=Environmental Assessment Certificate; mg/L=milligrams per litre; WQG=water quality guidelines.
Red text indicates exceedances of WQGs.
Please note that dissolved copper exceeds the WQGs under background conditions.

Blasthole Liners

Telkwa Mining has incorporated the use of blasthole liners for holes in rock requiring the addition of blasting agents into the Final EAC Project Case (2024) using a 75% effectiveness on the portion of nitrogen species being produced from blasting which is conservative compared to the actual 95% effectiveness observed at current operations in BC.

The change in nitrogen species was incorporated into the WLBM report completed by SRK which is provided in **Appendix 10: Effect of Mitigation Controls on Water Quality and Quantity of the Tenas Project, SRK**, with **Table 2-7** below providing a summary of these results for the relevant prediction nodes. Based on these results this mitigation control was incorporated into the Final EAC Project Case (2024).

Table 2-7: Water Quality (Maximum Monthly Mean) Results for Use of Blasthole Liners during Operation in Post Closure using Typical Source Terms and Average Hydrology at Relevant Prediction Nodes

Location Creek	Parameter	BC WQG (2024) (mg/L)	Updated EAC Project Case (2024) (mg/L)	Use of Blasthole Liners (mg/L)
WQSEA1 Goathorn Creek	Copper (d)	0.0013	0.0021	0.0021
WQSO6 Goathorn Creek	Copper (d)	0.0013	0.0021	0.0021
WQS03-DS Four Creek	Cobalt (t)	0.004	0.00068	0.00068
	Nitrite (t)	0.020	0.015	0.010
	Sulphate (t)	309	33	33
	Selenium (t)	0.0020	0.00081	0.00081
WQS04 Tenas Creek	Copper (d)	0.0026	0.0015	0.0015
	Nitrite (t)	0.020	0.0090	0.0060
	Sulfate (t)	218	24	24
	Selenium (t)	0.0020	0.00078	0.00078

Notes: %=percent; BC=British Columbia; EAC=Environmental Assessment Certificate; mg/L=milligrams per litre; WQG=water quality guidelines.
Red text indicates exceedances of WQGs.
Please note that dissolved copper exceeds the WQGs under background conditions.

Passive/Active Flocculation

The EAC Application had a target of producing a maximum TSS concentration for 35 mg/L discharging from sedimentation ponds. To reduce total concentrations of parameters such as Iron and Aluminium, passive and active flocculation can be added to the TCP to reduce the designed maximum TSS concentrations from 35 mg/L to 5 mg/L.

The change in TSS was incorporated into the WLBM report completed by SRK which is provided in **Appendix 10: Effect of Mitigation Controls on Water Quality and Quantity of the Tenas Project, SRK**, with **Table 2-8** below providing a summary of these results for the relevant prediction nodes. Based on the information in **Table 2-8** it was decided to carry this mitigation control forward into the BAT assessment process to determine if this mitigation control is recommended to be incorporated into the Final EAC Project Case (2024).

Table 2-8: Water Quality (Maximum Monthly Mean) Results for the Use of Passive/Active Flocculation During Operation in Post-closure using Typical Source Terms and Average Hydrology at Relevant Prediction Nodes

Location Creek	Parameter	BC WQG (2024) (mg/L)	Final EAC Project Case (2024) (mg/L)	Decrease TSS levels to 5 mg/L (mg/L)
Tenas Control Pond	Aluminum (t)	0.27	0.39	0.07
	Iron (t)	1.0	1.5	0.2

Notes: %=percent; BC=British Columbia; EAC=Environmental Assessment Certificate; WQG=water quality guidelines. Red text indicates exceedances of WQGs.

Storage and Use of Freshet Water

Telkwa Mining has investigated the storage and use of Freshet water from Channel C02 that diverts water around the Project into Four Creek. The use of water from the C02 channel is to improve the robustness of the water cover for PAG material in the management ponds especially the East Management Pond.

The change in the storage and use of freshet water was incorporated into the WLBM report completed by SRK which is provided in **Appendix 10: Effect of Mitigation Controls on Water Quality and Quantity of the Tenas Project, SRK**, with **Table 2-9** below providing a summary of these results for the relevant prediction nodes. Given the minor reductions in parameter concentrations in the receiving environment and that this option is inconsistent with the best management practice of keeping noncontact water out of the Project, this mitigation control was not carried forward into the Final EAC Project Case (2024).

Table 2-9: Water Quality (Maximum Monthly Mean) Results for the Storage and Use of Freshet Water at Relevant Prediction Nodes

Location Creek	Parameter	BC WQG (2024) (mg/L)	Updated EAC Project Case (2024) (mg/L)	Additional C02 Water to MPs (mg/L)
WQSEA1 Goathorn Creek	Copper (d)	0.0012	0.0021	0.0021
WQSO6 Goathorn Creek	Copper (d)	0.0012	0.0021	0.0021
WQS03-DS Four Creek	Cobalt (t)	0.004	0.00068	0.00056
	Nitrite (t)	0.020	0.015	0.011
	Sulphate (t)	309	33	26
	Selenium (t)	0.0020	0.00081	0.00063

Location Creek	Parameter	BC WQG (2024) (mg/L)	Updated EAC Project Case (2024) (mg/L)	Additional C02 Water to MPs (mg/L)
WQS04 Tenas Creek	Copper (d)	0.0026	0.0015	0.0015
	Nitrite (t)	0.020	0.0090	0.0079
	Sulfate (t)	218	24	22
	Selenium (t)	0.0020	0.00078	0.00065

Notes: %=percent; BC=British Columbia; EAC=Environmental Assessment Certificate; mg/L=milligrams per litre; WQG=water quality guidelines.
Red text indicates exceedances of WQGs.
Please note that dissolved copper exceeds the WQGs under background conditions.

Active Water Treatment

This mitigation control allows for the treatment of surface flows via various methods prior to water being discharged. This mitigation control was reviewed further using the subsequent BAT assessment process to select the appropriate technology for this Project and then determine if this technology was recommended.

Summary of BMP Assessment Process

Based on analysis above, **Table 2-10** below was generated which summarizes the results of the BMP Assessment process indicating which BMPs were selected for incorporation into the Final EAC Project Case (2024) and which technologies should be reviewed further in the BAT Assessment Process.

Table 2-10: Summary of the BMP Assessment Process

BMP / Technology	Incorporation into the Final EAC Project Case (2024)	Carried forward into the BAT Assessment Process	Comment
Additional use of water by the CPP	No	N/A	Not effective for the reduction of POCs in either seepage or surface discharge
Blasthole Liners	Yes	N/A	Incorporate into Final EAC Project Case (2024) as a source control technology
Storage and Use of Freshet Water	No	N/A	Not effective for the reduction of Parameters of Concern (POCs) in either seepage or surface discharges
Management and Control Pond Liner Modifications	N/A	Yes	Effective for reduction of seepage reaching downstream creeks
Passive/Active Flocculation	N/A	Yes	Effective for reduction some total parameter concentraions such as Iron
Active Water Treatment	N/A	Yes	Effective for reduction of POCs in surface water discharge to Goathorn Creek

BAT Assessment

As a reminder the Final EAC Project Case (2024) does not have exceedances in the receiving environment except for parameters that are already in exceedance for background/baseline conditions and a short duration (4 year) exceedance of cobalt in Four Creek which is likely not to occur if attenuation mechanisms in groundwater were accounted for in the water model.

As provided above the following mitigations were carried forward into the BAT process:

- Modified liners in the management and control ponds;
- Passive/Active Flocculation; and,
- Active water Treatment.

SRK identified several Parameters of Concern (POCs) based on the guidance definition provide by the Ministry of Environment for the Updated EAC Project Case (2024) WLBM using typical source terms. Potential water treatments could be applied to try and meet BC WQGs at the end of pipe and the receiving environment. To that effect, Telkwa Mining contracted SRK to complete a BAT assessment on available treatment technologies for these POCs using the guidance provided by the BC provincial government and SRK's full report is provided in **Appendix 11: Tenas Project Best Achievable Technology Assessment Updated, SRK**. A multi-step process that mirrored the 2024 guidance provided by BC ENV was followed as summarized by **Figure 2-7** below.

Table 2-11 below summarizes the results obtained by the MAA for the various water treatment technologies that were carried forward from screening analysis.

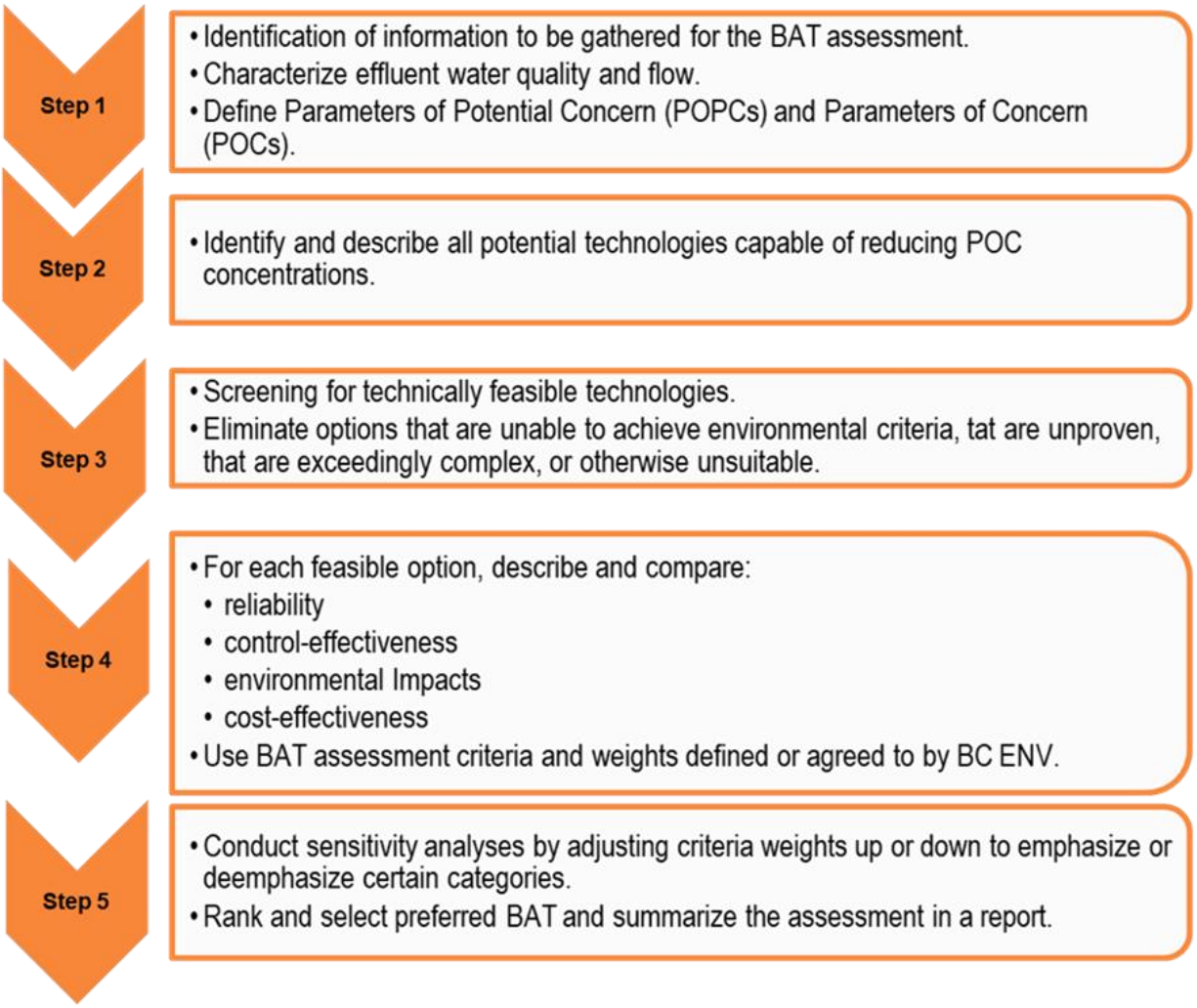


Figure 2-7: Bat Methodology Based on BC ENV's 2024 Guidance Document

Table 2-11: Summary of MAA Rankings for Active Water Treatment Technologies that Met Screening Requirements

		Base Case with BMPs	Passive/Active Flocculation	In-situ Active (GBR)	RO + MBBR	RO + MBBR + HDS Lime	RO + MBBR + Sulphide	RO + MBBR + Ferric	RO + MBBR + Ion Exchange	Zero Liquid Discharge	Modified Liners in Water Management Ponds
Assessment Criterion	**Weight**	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**	**Option 6**	**Option 7**	**Option 8**	**Option 9**	**Option 10**
Reliability	**20**	**17**	**16**	**14**	**15**	**14**	**14**	**15**	**14**	**12**	**16**
Risk Assessment	5	3	3	3	4	4	3	4	4	4	3
Robustness	5	5	3	3	4	3	4	4	3	4	5
Scalability	5	4	5	4	3	3	3	3	3	2	3
Long-term Viability	5	5	5	4	4	4	4	4	4	2	5
Control-Effectiveness	**30**	**13**	**13**	**20**	**20**	**22**	**22**	**20**	**26**	**28**	**13**
Pollutant Reduction	20	1	1	2.5	2.5	3	3	2.5	4	4.5	1
Toxicity Reduction	10	4.5	4.5	5	5	5	5	5	5	5	4.5
Environmental & Socio-Cultural Impacts	**25**	**23**	**23**	**22**	**20**	**17**	**17**	**17**	**17**	**10**	**22**
Energy Efficiency	5	5	5	4.5	3.5	3.5	3.5	3.5	3.5	1	5
Greenhouse Gas Emission	6	5	5	4.5	4	3.5	3.5	3.5	3.5	1	3.5
Footprint	4	5	5	4.5	4	3	3	3	3	3	5
Secondary Waste Production	5	5	5	4.5	4	3	3	3	2.5	1	5
Adherence to Yintah Management Directives	5	3	3	4	4	4	4	4	4	4	4
Cost-Effectiveness	**25**	**25**	**25**	**22**	**14**	**12**	**12**	**12**	**12**	**5**	**19**
Efficient Use of Existing Resources	3	5	5	4	2	2	2	2	2	1.5	3
Life Cycle Cost Analysis	22	5	5	4.5	3	2.5	2.5	2.5	2.5	1	4
Total	**100**	**78**	**77**	**78**	**69**	**65**	**65**	**64**	**69**	**55**	**71**

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/BAT Assessment/Telkwa BAT Tech Screening REV01.xlsx

Based on the above table, the top ranking of the water treatment technologies is:

1. In-situ Active GBR and Base Case with BMPS/BATS with no additional mitigations;
2. Passive/Active Flocculation;
3. Modified Liners in Management and Control Ponds;
4. RO + MBBR and RO + MBBR + Ion Exchange; and,
5. RO + MBBR + HDS Lime and RO + MBBR + Sulphide.

The modelled water quality output for two selected water treatment systems (Options 1 In-situ Active GBR and 5 RO + MBBR + HDS Lime) is provided in **Appendix 10: Effect of Mitigation Controls on Water Quality and Quantity of the Tenas Project, SRK**, with **Table 2-12** providing a summary of these results for the selected nodes. Given the results of the BAT assessment, and the impact on water quality in the receiving environment these two additional mitigations were not selected to be incorporated into the Final EAC Project Case (2024) as no exceedance was found in the receiving environment but rather these mitigations will only be incorporated via an approved Trigger Action Response Plan in permitting.

Table 2-12: Water Quality (Maximum Monthly Mean) Results for Active Water Treatment of Surface Flows in Post-closure using Typical Source Terms and Average Hydrology at Relevant Prediction Nodes

Location Creek	Parameter	BC WQG (2024) (mg/L)	Updated EAC Project Case (2024) (mg/L)	In-situ Active GBR Treatment (mg/L)	Active Treatment RO+MBBR+HDS Lime (mg/L)
WQSEA1 Goathorn Creek	Copper (d)	0.0013	0.0021	0.0021	0.0020
WQSO6 Goathorn Creek	Copper (d)	0.0013	0.0021	0.0021	0.0020
WQS03-DS Four Creek	Cobalt (t)	0.004	0.00068	0.00075	0.00069
	Nitrite (t)	0.020	0.015	0.010	0.015
	Sulphate (t)	309	33	44	34
	Selenium (t)	0.0020	0.00081	0.00066	0.00085
WQS04 Tenas Creek	Copper (d)	0.0026	0.0015	0.0016	0.0015
	Nitrite (t)	0.020	0.0090	0.0033	0.0091
	Sulfate (t)	218	24	36	24
	Selenium (t)	0.0020	0.00078	0.00033	0.00079

Notes: %=percent; BC=British Columbia; EAC=Environmental Assessment Certificate; mg/L=milligram per litre; WQG=water quality guidelines.
Red text indicates exceedances of WQGs.

Please note that dissolved copper exceeds the WQGs under background conditions.
Please note the current proposed configuration active water treatment does not affect groundwater seepage which is the causes of elevated POCs in Four and Tenas Creeks

Incorporation of Further Mitigations for the Final EAC Project Case (2024) based on the BAT and BMP Assessments

A review of the mitigation options was completed based on the BMP and BAT assessments completed above with the results summarized in the **Table 2-13** below to help guide how and when mitigations will be incorporated into the Final EAC Project Case (2024).

Table 2-13: Summary of Further Mitigations/Technologies Incorporated or Discarded for the Final EAC Project Case (2024) Based on the BAT and BMP Assessments

Mitigation	BAT or BMP	Recommendations
Management and Control Pond Liners	BAT	• Do not adopt in the Final EAC Project Case (2024). • Adopt as a contingency to be implemented via a Trigger Action Response Plan in permitting for West Management Pond. • Submit during Permitting phase for regulatory approvals.
Use of Blasthole Lines	BMP	• Adopt this option for the Final EAC Project Case (2024).
Use of passive/active flocculation in TCP and Rail Infrastructure Sedimentation Pond	BAT	• Do not adopt in the Final EAC Project Case (2024). • Adopt as a contingency to be implemented via a Trigger Action Response Plan in permitting. • Submit during Permitting phase for regulatory approvals.
Active Treatment of surface flows using RO+MBBR+HDS Lime	BAT	• Do not adopt in the Final EAC Project Case (2024). • Adopt as a contingency to be implemented via a Trigger Action Response Plan in permitting. • Develop Permit level Design. • Submit during Permitting phase for regulatory approvals.
Passive Treatment of surface and seepage flows via Gravel Bed Reactors	BAT	• Do not adopt in the Final EAC Project Case (2024). • Adopt as contingency to be implemented via a Trigger Action Response Plan in permitting. • Develop Permit Level Design. • Submit during Permitting phase for regulatory approvals.

Based on the above information the Final EAC Project Case (2024) will incorporate blasthole liners as a further BMP beyond those already provided in the Updated EAC Project Case (2024) and EAC Project Case (August 2022).

Contingency Mitigations, in accordance with a Trigger Action Response Plan

Following a meeting with EAO, BC Ministry of Environment, and BC Ministry of Mining & Critical Minerals on December 8, 2025, Telkwa Mining understands that the Province of BC is concerned

with potential uncertainty associated with the predictive modelling of water quality from greenfield mining projects and the use of In-situ Active GBRs as a primary mitigation means for addressing POCS. Telkwa Mining had SRK review and modify the BAT report to:

- Clearly recommend that RO+MBBR+HDS Lime is the primary mitigation to address future water quality concerns.

To deal with potential technology readiness concerns with the In-situ Active GBR water treatment technology, Telkwa Mining will commit to designing, permitting, and constructing a pilot In-situ Active GBR water treatment system in the CPP Sedimentation Pond or alternative pond as part of the Construction Phase so that this system is in place for monitoring its effectiveness for treating contact water and seepage from the Project to increase the technology level of this method to 8 or 9 for identified POCs (such as nitrogen species, selenium, metals).

Furthermore, to deal with potential uncertainty risks in the WLBM Telkwa Mining commits to designing both a permit level In-situ Active GBR and RO+MBBR+HDS Lime water treatment systems and applying for permit approvals for both contingency mitigations. By having permit approvals and permit level designs in place for constructing the In-situ Active GBR and/or the RO+MBBR+HDS Lime active water treatment systems will allow them to be constructed within approximately one year of making a final execution decision based on measured POC concentrations at the end of pipe, in the seepage, in the management and control ponds, and in the receiving environment during the Construction and Operation Phases prior to the POCs exceeding the BC WQGs in the receiving environment.

During annual monitoring specified during the permitting process, if it becomes evident that POCs will trend to be above the BC WQGs in the future, some or all the following additional contingency mitigations can be implemented for the Project based on a Trigger Action Response Plan that will be provided and approved during permitting:

- Implement water treatment for surface and seepage water flows using the In-situ Active GBR water treatment method in the management ponds as these ponds will be constructed with the necessary infrastructure already incorporated to allow for the construction of this water treatment process.
- Implement passive/active flocculation for the reduction of total parameter concentrations in sedimentation and control ponds.
- Implement RO+MBBR+HDS lime active water treatment into the Water Management Plan.
- As the liner for the WMP will not be constructed till after year 5 which allows the implementation of liner Modifications for the WMP prior to PAG being placed into the management pond if TARP indicates this is a requirement.

Construction and implementation of any of these contingency mitigations will be contingent upon, and in accordance with, an agreed upon consensus-based Trigger Action Response Plan (TARP) to be developed during the BC provincial permitting process. As an example, exceedances of defined parameter of concern concentrations measured by the water quality monitoring program at agreed upon locations, all as defined in the TARP, would trigger the construction of the RO+MBBR+HDS Lime (TRL 8 or 9) water treatment system. Construction of the water treatment system will not necessarily be during the Construction Phase or even during the Operation Phase of the Project, but rather will be based on monitoring of Parameters of Concern and modelling demonstrating that there will be exceedances of the identified permit limits in the future that will likely cause measured adverse impacts to aquatic receptors, and that the RO+MBBR+HDS Lime system would be able to treat. The TARP would have similar provisions for the other contingency mitigations noted above. This commitment is also contingent on the responsible permitting agencies agreeing to not incorporate the permitted water treatment facility (or other contingency mitigations) into bonding requirements until such time as the treatment facility (or other contingency mitigation) achieves commercial operation.

The Final EAC Project Case (2024) does not reflect the impact of adding these contingency mitigations to the predictions provided in the WLBM. However, TML had SRK investigate adding active water treatment technology **in Appendix 10: Effect of Mitigation Controls on Water Quality and Quantity of the Tenas Project, SRK** and is also included in **Appendix 12: Environmental Effects Assessment - Surface Water Valued Component** and provided in **Table 2-12** above. The Final EAC Project Case (2024) was included in the WLBM completed by SRK without active water treatment and is provided in **Appendix 1: Tenas Project, Water and Load Balance Modeling Report (Updated 2025), SRK**.

Summary of Final EAC Project Case (2024) Submitted

With the completion of the BAT assessment process and implementation of recommended additional mitigation controls the modelled effluent still does not meet all WQGs at discharge(end of pipe).

Telkwa Mining's and SRK's view is that all reasonable BMPs and BATs have been implemented for the Project and while the Project is not in the permitting phase, the implementation of an IDZ can be considered during the EAC application process for point source surface water discharges to provide modelled parameters in the receiving environment. After applying an IDZ which is provided in **Appendix 13, Tenas Project - Initial Dilution Zone Assessment (Final), SRK**, identified that POCs due to the Project meet the BC WQGs for the protection of aquatic life at the edge of the IDZ except for parameters that already exceed the guidelines under background/baseline conditions.

Table 2-14 below summarizes the results of the EAC Project Case (August 2022), and the Final EAC Project Case (2024) against the BC WQGs at selected prediction nodes after the application of an IDZ for surface water discharge into Goathorn Creek. The Final EAC Project Case (2024) is provided in **Appendix 10: Effect of Mitigation Controls on Water Quality and Quantity of the Tenas Project, SRK**.

Table 2-14: Water Quality (Maximum Monthly Mean) Results for EAC Project Case (August 2022), Updated EAC Project Case (2024), and Final EAC Project Case (2024) in Post-closure at Relevant Prediction Nodes

Location Creek	Parameter	BC WQG (2025) (mg/L)	EAC Project Case (August 2022) (mg/L)	Final EAC Project Case (2024) (mg/L)
WQSEA1 Goathorn Creek	Copper (d)	0.0013	Not Available	0.0016
WQS06 Goathorn Creek	Copper (d)	0.0013	0.0019	0.0016
WQS03_DS Four Creek	Cadmium (d)	0.00023	0.00026	0.000012
	Cobalt (d)	0.00050	0.00066	0.00063
	Nitrite (t)	0.020	0.038	0.0090
	Sulfate (t)	309	360	33
	Selenium (t)	0.0020	0.0058	0.00081
WQS04 Tenas Creek	Cobalt (d)	0.00045	0.00082	0.00029
	Copper (d)	0.0026	0.0031	0.0013
	Nickel (d)	0.0025	0.0031	0.00063
	Nitrite (t)	0.020	0.045	0.0056
	Sulfate (t)	218	260	24
	Selenium (t)	0.0020	0.0041	0.00079

Notes: %=percent; BC=British Columbia; EAC=Environmental Assessment Certificate; mg/L=milligram per litre; WQG=water quality guidelines.
Red text indicates exceedances of WQGs.
Please note that dissolved copper exceeds the WQGs under background conditions.

In the EAC Application, Telkwa Coal submitted water quality and quantity predictions based on a Project development scenario. Telkwa Mining, with support from SRK, then completed an assessment of implementing new mitigations requested by the ENV and EMLI to determine if POC concentrations can get closer and ideally below BC WQGs in the receiving environment. The additional mitigation of incorporating blasthole liners was incorporated into what is now considered the Final EAC Project Case (2024) for water quality and quantity predictions. This case does not have exceedances of any parameters in the receiving environment except for dissolved cobalt for a short duration (four years) at one of the downstream Prediction Node in Four Creek.

Dissolved copper was also in exceedances in Goathorn Creek, but this parameter was above the WQG in the background/baseline. The effects assessment on the Surface Water Valued Component was updated to reflect the results of the Final EAC Project Case (2024) and using a local study area which is provided **Appendix 12: Environmental Effects Assessment - Surface Water Valued Component**. In summary, there is no change to the conclusion that was presented in the EAC Application submitted in 2022 which stated "**no significant adverse residual effects**" from the Project on the Surface Water Valued Component are expected.

Telkwa Mining believes the information in the attached appendices and the above information addresses the requirements set forth in IR **Theme 1**.

THEME 4: CONDUCT ADDITIONAL WATER QUALITY PREDICTIONS USING RECENT SENSITIVITY ANALYSIS OF THE SEMI-PERMEABLE POND LINER

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

Recent sensitivity analysis of the semi-permeable pond liner to conduct additional water quality predictions is missing from the Application.

FOLLOW UP 1 - 356a ITT TABLE

Thank you for conducting the additional analysis and presenting the results at WQS03_DS and WQS04 at (post?) closure in the memo. Neither of these locations would be affected by the resultant increase in the surface discharge to Goathorn Creek, which was the concern underlying the original comment.

For discussion purposes, please consider Figure 4-8 of Appendix 4.3A: Water and Load Balance Modelling Report. Between 2045 and 2050, the cover water in the NMP has a higher selenium concentration than the pore water. Assuming a lower permeability liner, more cover water would be discharged to Goathorn Creek via the proposed surface discharge, commensurate with the reduction in pore water seepage under the ponds. This could result in an increase in selenium concentration in Goathorn Creek downstream from the discharge point.

Cover water concentrations also exceed pore water concentrations while the ponds are being actively loaded with the PAG material.

Using the 15% seepage reduction model (and commensurate increase in surface discharge), please provide a QP certified memo, including graphs predicting water quality (POCs only) at WQS06 from operations through post closure. Estimate water quality in Goathorn Creek at the effluent discharge point and WQS06. [EA Information Requirement]

IR LETTER 356 AND FOLLOW UP 2 – 356b ITT TABLE

Have a QP run three new WLBM scenarios:

- *Reduce the seepages through the management pond liners by 90% relative to the project case (with a commensurate increase in surface discharge). This scenario simulates blinding of the pond liners.*
- *Reduce the seepages through the management pond liners by 90% and assume low flow conditions (modified alternate case 5: 7Q10 low flow).*
- *Reduce the seepages through the management pond liners by 90% and assume high source term conditions (modified alternate case 2: high source terms).*

RESPONSE 356 ITT TABLE AND 356 ITT TABLE

This request is in relation to the request by ENV about the range in permeability that the soil-bentonite liner may experience due to construction variability which was provided during the round 1 IR as +/- 15%. Telkwa Mining has been requested to provide revised water quality predictions at EA1 assuming a 15% decrease in seepage under typical hydrology conditions, an 90% decrease in seepage under typical hydrology conditions, 90% decrease in seepage using 7Q10 low flows, and for a 90% decrease in seepage and high source terms under typical hydrology conditions.

While Telkwa Mining understands the need to review various scenarios, the 7Q10 scenario is not likely as during low flows the various management and control ponds will not be discharging to the environment as the Project will be keeping all water on site during this event to ensure the water covers are maintained for the various management ponds.

Table 2-15 below provides the summary of the results at relevant prediction nodes for the various parameters.

Table 2-15: Water Quality Results (Maximum Monthly Mean) for Seepage Scenarios at in Post-closure using Typical Source Terms and Average Hydrology at Relevant Prediction Nodes

Location Creek	Parameter	BC WQG (2025) (mg/L)	Final EAC Project Case (2024) (mg/L)	15% reduction in seepage and expected source terms (mg/L)	90% reduction in seepage and expected source terms (mg/L)	90% reduction in seepage, 7Q10 flows, and expected source terms (mg/L)	90% reduction in seepage and High source terms (mg/L)
WQSEA1 Goathorn Creek	Copper (d)	0.0013	0.0016	0.0016	0.0016	0.0016	0.0016
	Selenium (t)	0.0020	0.0013	0.0011	0.0020	0.0025	0.0032
WQSO6 Goathorn Creek	Copper (d)	0.0012	0.0017	0.0017	0.0017	0.0017	0.0017
	Selenium (t)	0.0020	0.0015	0.0011	0.0020	0.0025	0.0032
WQS03-DS Four Creek	Cadmium (d)	0.00023	0.000012	NA	0.0000079	0.000011	0.0000089
	Cobalt (d)	0.00056	0.00063	NA	0.00015	0.00060	0.00039
	Nitrite (t)	0.020	0.0090	NA	0.0016	0.0079	0.0049
	Sulphate (t)	309	33	NA	6.4	31	19
	Selenium (t)	0.0020	0.00081	NA	0.00013	0.00073	0.00048
WQS04 Tenas Creek	Cobalt (d)	0.00045	0.00029	NA	0.00025	0.00021	0.00072
	Copper (d)	0.0026	0.0013	NA	0.0013	0.0012	0.0013
	Nitrite (t)	0.020	0.0056	NA	0.0049	0.0039	0.016
	Sulfate (t)	218	24	NA	20	17	67
	Selenium (t)	0.0020	0.00079	NA	0.00063	0.00050	0.0024

Notes: %=percent; BC=British Columbia; EAC=Environmental Assessment Certificate; mg/L=milligram per litre; WQG=water quality guidelines.
Red text indicates exceedances of WQGs.
Please note that dissolved copper exceeds the WQGs under background conditions.

FOLLOWUP COMMENTS

IR LETTER 356 AND 356 ITT TABLE

Add a new node to the WLBM in Goathorn Creek, 100m downstream of the confluence with the tributary into which the effluent is discharged. For the 3 scenarios listed above, for each node where a parameter is predicted to exceed a chronic BC WQG PAL, graphically illustrate water quality (for the exceeding parameters only) at those nodes from baseline through to post closure. On each graph, show the chronic BC WQG for the most sensitive use or value.

RESPONSE 356 ITT TABLE

This prediction node has been added to the WLBM and is identified as WQSEA1. Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** which is a technical memo addressing the IR questions posed by ENV about the WLBM for a complete list of parameter concentrations and supporting graphs.

IR LETTER 356 AND 356 ITT TABLE

[Figures 2.2-2.4 of Appx 4.3 (WLBM report) show Four Creek joining Goathorn Creek at WQS05, instead of WQS06. Is this an error in the diagram? If so, has this error been incorporated into the model?]

Four Creek joins Goathorn Creek above WQSO6 (even above EA1) while Tenas Creek joins Goathorn Creek above WQS05 which has been verified as correct in the model. The figures have been corrected and included in **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK**.

Telkwa Mining believes the responses above in addition to those provided in the attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK** address the requirements set forth in IR **Theme 4**.

THEME 3: HAVE A QUALIFIED PROFESSIONAL IDENTIFY LENTIC AREAS IN THE RECEIVING ENVIRONMENT WHICH MAY RECEIVE SELENIUM FROM MINE OPERATIONS, AND ENSURE THAT BACKGROUND CONCENTRATIONS OF SELENIUM IN WATER, SEDIMENT, INVERTEBRATE, AND FISH TISSUES ARE COLLECTED AND COMPILED IN THOSE LENTIC AREAS

FOLLOWUP COMMENTS

IR LETTER NEW AND 520 ITT TABLE

Have a qualified professional identify lentic areas in the receiving environment which may receive selenium from mine operations, and ensure that background concentrations of selenium in water, sediment, invertebrate, and fish tissues are collected and compiled in those lentic areas.

RESPONSE 520 ITT TABLE

There are no lentic areas in the current receiving environment based on a review by Palmer Environmental as provided in **Appendix 14: Tenas Coal Mine Information Request # 498, 500-504, and 520 - Expert Advice Regarding Fish and Fish Habitat Within the Project Area, Palmer Environmental, Palmer Environmental** attached.

As part of permitting an Aquatic Effects Monitoring Program (AEMP) will be submitted describing the monitoring that will be completed in relation to all aspects of the Project including selenium concentrations and their species.

Telkwa Mining believes the responses provided above and in **Appendix 14: Tenas Coal Mine Information Request # 498, 500-504, and 520 - Expert Advice Regarding Fish and Fish Habitat Within the Project Area, Palmer Environmental, Palmer Environmental**, address the requirements set forth in IR **Theme 3**.

THEME 6: OTHER ITT TABLE COMMENTS

FOLLOWUP COMMENTS

FOLLOW UP 306 ITT TABLE

Due to the high consequence and likelihood of selenium speciation occurring as a result of reducing conditions commonly observed in lentic waters these processes should be included in the modelling. In addition, in order to have informative data to base impacts to the receiving environment on a water sampling node should be created a maximum of 100 meters downstream of the proposed discharge location. Currently, it appears that WQS06 is the nearest downstream node at approximately 4.3 km from the proposed discharge (refer to comment 319) [EA Information Requirement].

RESPONSE FOLLOW UP 306 ITT TABLE

Telkwa Mining acknowledges the comment and after discussion with EMLI in 2023 and QPs, the model cannot include the required modelling included in the model as it is difficult to predict with any degree of confidence what species of selenium produced and what concentrations might be present. It was agreed at the last meeting with the water sub-working group that this modelling would no longer be required.

Telkwa Mining has added a new prediction node labelled EA1 at point approximately 100 m from the discharge point into Goathorn Creek for the Project. As the selenium concentration in the Final EAC Project Case (2024) is below the BC WQGs no adverse effect is expected as the value in this guideline is protective for all selenium species as there is no distinction provided in the guidelines in terms of selenium species. The requirement of additional selenium and selenium species monitoring in the existing environment and during the Construction and Operation Phases can be made a condition of the EAC Certificate.

FOLLOWUP COMMENTS

FOLLOW UP 307 ITT TABLE

Due to the potential for impacts to aquatic biota and resident fish populations, these impacts should be considered in a local context [EA Information Requirement].

LETTER IR 307 AND FOLLOW UP 307 ITT TABLE

Consider the impacts of exceeded BC water quality guidelines (WQGs), particularly to aquatic biota and resident fish populations, at a local scale rather than regional scale.

RESPONSE FOLLOW UP 307 ITT TABLE

Please find the response for this ITT in the attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK**.

Telkwa Mining has implemented an additional mitigation use a pipeline to transport discharge from the Tenas Control Pond to Goathorn Creek in the Construction, Operation and Decommissioning and Reclamation Phases and will only use the existing channel once end of pipe parameter concentrations will not cause effects to fish and fish habitat in this channel.

In summary Telkwa Mining had SRK revise the effects assessment for the Surface Water Valued Component based on the Local Study Area versus the Regional Study Area and still found there were no significant adverse effects due to the Project on the Surface Water Valued Component.

FOLLOWUP COMMENTS

FOLLOW UP 310 ITT TABLE

It sounds like this stream will no longer provide any significant ecological function. This is an issue under the federal Fisheries Act and may need attention from MLWRS and/or DFO.

RESPONSE FOLLOW UP 310 ITT TABLE

The stream currently does not have flow for most of the year and only in major storm events and for a brief period in freshet is there any water flows present in this ephemeral channel, as its catchment is extremely limited under background/baseline conditions. Based on the background/baseline site assessment completed for fish and fish habitat as part of the EAC Application this tributary does not provide viable fish habitat according to QPs. The photo **(Figure 2-8 below)** below illustrates this stream during the October 2023 rainy season with no signs of water by the leaf debris left in the channel.



Figure 2-8: Tributary to Goathorn Creek During the October 2023 Rainy Season

FOLLOWUP COMMENTS

FOLLOW UP 319 ITT TABLE

Thank you for your response. It appears as though the closest downstream prediction node from the discharge location is WQS06, located approximately 4.3 km from the point of discharge. It would be useful to have a prediction node closer to the point of discharge, perhaps 100 meters downstream of confluence of unnamed tributary to Goathorn Creek and Goathorn Creek [EA Information Requirement].

RESPONSE FOLLOW UP 319 ITT TABLE

Telkwa Mining has added a new prediction node labeled EA1 at the point approximately 100 m from the discharge point into Goathorn Creek for the from the ephemeral tributary.

FOLLOWUP COMMENTS

FOLLOW UP 350 ITT TABLE

It appears that Water Quality Guidelines for selenium, nitrite, and sulphate (and dissolved cadmium in Four Creek) will be exceeded in approximately 4 or more kilometres of Four Creek, and 5 or more kilometres of Tenas Creek for up to half of the year (Nov-Apr) for more than ten years of the mine life. This is significant in magnitude, geographic extent, frequency, and duration. [Comment]

FOLLOW UP 350 ITT TABLE

Response for Comment 351 applies to this Round 1 Comment, however, Comment 351 remains unresolved, and that Round 1 Response does not address frequency and duration effects characteristics.

FOLLOW UP 351 ITT TABLE

I remain in disagreement with the scale at which effects to Valued Components are being assessed and, because of that, the residual effects characterization. TCL has changed this specific assessment metric to stream length, however, they still assess affects at the RSA scale. The fish, invertebrates and other VCs in Tenas and Four Creeks are predicted to be subject to potential impacts from multiple water quality constituents in more than 4 kilometres of creek (over 20 and 25% of the entire stream length per Attachment 351-1) during half of each year for 10 years of mine life. This is not low residual effects at the scale of the individual stream (most appropriate), or even at the scale of the entire Tenas Creek watershed (the LSA, more appropriate than the RSA).

RESPONSE FOLOW UP 351/350 ITT TABLE

Please find attached **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK**, for a signed and stamped response.

Telkwa Mining has implemented an additional mitigation use a pipeline to transport discharge from the Tenas Control Pond to Goathorn Creek in the Construction, Operation and Decommissioning and Reclamation Phases and will only use the existing channel once end of pipe parameter concentrations will not cause effects to fish and fish habitat in this channel.

In summary Telkwa Mining had SRK revise the effects assessment for the Surface Water Valued Component based on the Local Study Area versus the Regional Study Area and still found there were no significant adverse effects due to the Project on the Surface Water Valued Component.

FOLLOWUP COMMENTS

352 ITT TABLE

This section of App4.3-A indicated that total selenium exceedances are expected in both winter and summer months. The characterization of residual effects in 4.3 Surface Water Quality chapter contradicts this. Clearly indicate when total selenium will be exceeded. [EA Information Requirement]

FOLLOW UP RESPONSE 352 ITT TABLE

The Final EAC Project Case (2024) Model results in the downstream node in Four Creek (WQS03DS) show no exceedances of the WQG for selenium during any period. The maximum Final EAC Project Case (2024) maximum mean monthly modelled concentration through this period is 0.00081 mg/L.

Similarly, the Final EAC Project Case (2024) Model results for the downstream node of Tenas Creek (WQS04), show no exceedances of the WQG for selenium during any period. The maximum mean monthly modelled concentration through this period is 0.00015 mg/L for the Final EAC Project Case (2024).

FOLLOWUP COMMENTS

385/387 ITT TABLE

Table 5.2-1 provides the screening of water quality parameters to determine COPCs for wildlife, and ECCC notes that maximum modelled mean monthly values were used. ECCC recommends using a more conservative water quality statistic (e.g., maximum concentrations) to determine COPC values that would not be protective of acute effects during sensitive life stages for wildlife (e.g., amphibian egg and tadpole development).

385/387 ITT TABLE

Comment provided by Provincial ENV Reviewer: TCL's previous response is that a mean value is a maximum value ("the maximum modelled mean monthly value means the maximum concentration that is predicted."). I would ask them to have a QP confirm whether any single discrete sample is predicted to exceed an acute BC Water Quality Guideline for the protection of the most sensitive use/value (wildlife or avian in this case).

RESPONSE 385/387 ITT TABLE

Please see **Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK**.

FOLLOWUP COMMENTS

FOLLOW UP 388 ITT TABLE

Provincial Reviewer Response: Adequately addressed. Aquatic receptors are expected to be more sensitive to aluminum than avian spp or wildlife (ENV 2021. Reformat of 1988 Aluminum Water Quality Guidelines). Despite this, I would recommend they include aluminum in their residual effects characterizations.

RESPONSE FOLLOW UP 388 ITT TABLE

Aluminum was not carried forward into a residual effects characterization as Aluminum concentrations with the Project are within the natural variability of background/baseline conditions. This is demonstrated by the Telkwa River having exceedances of Aluminum under background/baseline conditions while upstream prediction nodes do not have exceedances from the Project for Aluminum. If monitoring indicates that Aluminum is trending above WQGs in

Goathorn, Four, and/or Tenas Creeks, Telkwa Mining will implement a water treatment strategy for this parameter. **Table 2-16** below summarizes the Aluminum results for selected prediction node.

Table 2-16: Water Quality Results (Maximum Monthly Mean) for Aluminum at Relevant Prediction Nodes for Updated EAC Project Case (2024)

Location Creek	Parameter (total)	BC WQG (2024) (mg/L)	EAC Project Case (August 2022) (mg/L)	Updated / Final EAC Project Case (2024) (mg/L)	Comments
WQSOEA1 Goathorn Creek	Aluminium	0.27	N/A	0.099	Upstream of WQS06 and WQS05 P50 background/baseline 0.034 P95 background/baseline is 0.66
WQSO5 Goathorn Creek	Aluminium	0.27	0.17	0.0089	Upstream of WQS09
WQS03_DS Four Creek	Aluminium	0.69	0.25	0.15	Upstream of WQSEA1 P50 background/baseline is 0.081 P95 background/baseline is 1.1
WQS04 Tenas Creek	Aluminium	0.35	0.10	0.068	Upstream of WQS05 P50 background/baseline is 0.047 P95 background/baseline is 1.7
WQSO9 Telkwa River	Aluminium	0.19	0.26	0.267 due to background/baseline conditions	P50 background/baseline is 0.12 * P95 background/baseline is 1.5
WQS011 Bulkley River Upstream	Aluminium	0.18	0.14	0.11	Downstream of Rail Loadout P50 background/baseline is 0.088 P95 background/baseline is 1.2
WQS012 Bulkley River Downstream	Aluminium	0.18	0.16	0.15	Downstream of confluence with the Telkwa River P50 background/baseline is 0.088 P95 background/baseline is 1.2

Notes: %=percent; BC=British Columbia; EAC=Environmental Assessment Certificate; mg/L=milligram per litre; WQG=water quality guidelines.
Red text indicates exceedances of WQGs.

FOLLOWUP COMMENTS

FOLLOW UP 389 ITT TABLE

Not adequately addressed. TCL's response is to argue why SPOs are appropriate thresholds for screening COPCs. ENV (and apparently ECCC) disagrees and believes unapproved SPOs are inappropriate to use in an EA process. Using WQGs to screen COPCs, we would screen, at the least, Aluminum, Cobalt, and Sulphate as parameters for further effects assessment and characterization, including for wildlife, avian and aquatic receptors.

RESPONSE FOLLOW UP 389 ITT TABLE

Table 2-17 (Table 5.2-1 from EAC Application) was revised based on the most stringent WQG available for fresh water/wildlife/avian and the Final EAC Project Case (2024) using the format of Table 5.2-1 from the EAC application. Please note Table 5.2-2 did not appear in the EAC Application.

Based on **Table 2-17** below no parameters were identified as Parameter of Interest in the receiving environment beyond Cobalt which as short-term exceedance (four years) of the WQGs. This parameter was also identified as POC in the BAT analysis provided in **Appendix 11: Tenas Project Best Achievable Technology Assessment Updated, SRK**. Based on this analysis no further mitigations are recommended beyond the best management practices and technologies already employed by the Project.

Table 2-17: (Table 5.2-1 in EAC application) Water Quality (Maximum Monthly Mean) Results for the Final EAC Project Case (2024) in Post Closure versus Relevant Guidelines

Parameter	Units	Final EAC Project Case (2024) (mg/L)	Location of Greatest Parameter Concentration	BC AWQG or BC WWQG (Aquatic, Livestock, or Wildlife)*, if none exist use CCME (mg/L)	Guideline Source	Exceedance Factor WQG (Final EAC Project Case (2024)) Maximum Modelled Result/Guideline
Aluminum (t)	mg/L	0.15	Four Creek, WQS03_DS	0.69	BC AWQG	0.22
Arsenic (t)	mg/L	0.0011	Four Creek, WQS03_DS	0.005	BC AWQG	0.22
Beryllium (t)	mg/L	0.00011	Four Creek, WQS03_DS	0.00013	BC WWQG	0.85
Boron (t)	mg/L	0.023	Four Creek, WQS03_DS	1.2	BC AWQG	0.020
Cadmium (d)	mg/L	0.000012	Four Creek, WQS03_DS	0.00023	BC AWQG	0.050
Chloride (t)	mg/L	0.47	Four Creek, WQS03_DS	150	BC AWQG	0.0030
Chromium (VI) (t)	mg/L	0.00074	Four Creek, WQS03_DS	0.001	BC WWQG	0.74
Cobalt (d)	mg/L	0.00063	Four Creek, WQS03_DS	0.00056	BC AWQG	1.1
Copper (d)	mg/L	0.0019	Four Creek, WQS03_DS	0.0047	BC AWQG	0.40
Fluoride (t)	mg/L	0.11	Four Creek, WQS03_DS	1.4	BC AWQG	0.080
Iron (d)	mg/L	0.12	Telkwa River, WQS09	0.35	BC AWQG (acute)	0.34
Lead (t)	mg/L	0.000060	Four Creek, WQS03_DS	0.0061	BC AWQG	0.0001
Manganese (t)	mg/L	0.012	Four Creek, WQS03_DS	1.1	BC AWQG	0.010
Mercury (t)	mg/L	0.0000038	Four Creek, WQS03_DS	0.000020	BC AWQG	0.19
Molybdenum (t)	mg/L	0.0012	Four Creek, WQS03_DS	0.034	BC AWQG (ruminant)	0.035
Nickel (d)	mg/L	0.0012	Four Creek, WQS03_DS	0.0047	BC WWQG	0.26
Nitrate (t)	mg/L	0.43	Four Creek, WQS03_DS	3.0	BC AWQG	0.14
Nitrite (t)	mg/L	0.0090	Four Creek, WQS03_DS	0.02	BC AWQG	0.45

Parameter	Units	Final EAC Project Case (2024) (mg/L)	Location of Greatest Parameter Concentration	BC AWQG or BC WWQG (Aquatic, Livestock, or Wildlife)*, if none exist use CCME (mg/L)	Guideline Source	Exceedance Factor WQG (Final EAC Project Case (2024)) Maximum Modelled Result/Guideline
Selenium (t)	mg/L	0.00081	Four Creek, WQS03_DS	0.002	BC AWQG	0.41
Silver (t)	mg/L	0.0000050	Four Creek, WQS03_DS	0.0015	BC AWQG	0.00
Strontium (t)	mg/L	0.33	Four Creek, WQS03_DS	2.5	ECCC FEQG for Aquatic Life	0.13
Sulfate (t)	mg/L	33	Four Creek, WQS03_DS	309	BC AWQG	0.11
Thallium (t)	mg/L	0.000013	Four Creek, WQS03_DS	0.0008	BC AWQG	0.016
Uranium (t)	mg/L	0.00025	Four Creek, WQS03_DS	0.0085	BC AWQG	0.030
Zinc (d)	mg/L	0.0025	Four Creek, WQS03_DS	0.014	BC AWQG	0.18

Notes: * = Wildlife and Aquatic guidelines were selected as there no plans on using the water from the Project for Irrigation Purposes.

* = WQG for stream with highest modelled concentration

BC=British Columbia; EAC=Environmental Assessment Certificate; mg/L=milligram per litre; WQG=water quality guidelines

Red text indicates exceedances of WQGs.

Telkwa Mining believes the details above and provided in attached appendices address the requirements set forth in IR **Theme 6**.

THEME 7: EMLI GEOSCIENCE CLARIFICATIONS

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

EMLI does not support the application of the concept that an entire zone can be designated potentially acid generating (PAG) or non-PAG based on an average weighed NPR. Application of an average weighed NPR implies that a portion of the material from that unit will become acid generating at some point in the future. Although the overall drainage from that storage area may be pH-neutral due to mixing with the non-PAG portion of the unit or non-PAG material from another unit, the current Management Plan does not address blending and the current source terms do not account for a blended non-PAG / PAG rock piles or covers that are exposed to allow advanced stage weathering and acidic hot-spots within the pile. Additional information should therefore be presented by the proponent to support this approach.

RESPONSE IR LETTER OVERVIEW

Telkwa Mining assumes the concern outlined in the statement above from EMLI is with *non-PAG* zones as the statement has no bearing on the PAG zones as the entire zone is submerged underwater as stated in the EAC Application section 1 even if portions of these zones are potentially *non-PAG* unless operational verification sampling provides evidence that portions of these zones could be managed as *non-PAG* based on operational NPR cut-off values and that they are also large enough to efficiently separate with the equipment available.

Telkwa Mining has identified that, even though an entire zone might be classified as *non-PAG* based on a comparison of its bulk composition to an NPR cut off of 2.0, that there might be a component of PAG rock both within the overall aerial extent of the zone and within the vertical thickness of the zone that may have to be managed appropriately to ensure ARD does not occur from separable PAG materials not being placed underwater. The source term for *non-PAG* material placement has assumed that appropriate segregation and mixing/blending has occurred within the vertical thickness during the mining process that a non-PAG landform (NPR > or equal to 2.0) is established for storage piles, embankments, and buttresses. If operational verification testing is conducted on PAG zones the same methodology will be used as what is used for *non-PAG* zones to identify any potential separable *non-PAG* material within PAG zones.

The following zone polygons can be identified as *non-PAG* using an NPR cutoff of 2.0 AP to 1.0 NP and their bulk geochemical properties:

- Overburden (Zone 0);
- Portions of Zone 1;
- Portions of Zone 4; and,
- Portions of Zone 8 (not mined as part of the EA Open Pit).

Table 2-18 summarizes the zone classification for materials at the Tenas Deposit based on their bulk geochemical properties.

Table 2-18: Material Zone Classification Based on NPR of 2.0

Material Zone Name	ARD Assignment in Mine Plan and EAC Application Based on an NPR of 2.0	Stratigraphic Location	Average Zone Weighted NPR
Zone 0 / Overburden	*non-PAG*	Till and overburden – topography to bedrock	17.5
Zone 1	*non-PAG* with potentially separable PAG zones	Bedrock surface to top of Seam e (minus Zone 1a)	3.1
Zone 1a	PAG	Select area above Seam e to bottom of Seam e	0.7
Zone 2 & 3	PAG	Bottom of Seam e to bottom of Seam c	0.8
Zone 4	*non-PAG* with potentially separable PAG zones	Bottom of Seam c to top of Seam b	2.6
Zone 5	PAG	Top of Seam b to top of Seam 1U	1.2
Zone 55	PAG	Top of Seam 1U to bottom of Seam 1L	1.9
Zone 6	PAG	Bottom of Seam 1L to bottom of Seam 1Lc	1.8
Zone 7**	PAG	Below Seam 1Lc to the bottom of Seam 1Ld	1.7
Zone 8**	*non-PAG* with potentially separable PAG zones	Below Seam 1Ld	5.0

** **Notes:** Zones 7 and 8 are not currently recovered within EA open pit design; (1) As understood all zones even bulk non-PAG zones contain some PAG material and in some cases these PAG materials could be large enough to segregate out during the mining process.

ARD=acid rock drainage; NPR=neutralization potential ratio; PAG=potentially acid generating

Figure 2-9 through **Figure 2-15** below illustrate the distribution of the average overall exploration drillhole weighted NPR values for rock zones mined within the EA Open Pit with polygons illustrated using an NPR cut-off of 2.0 with green exploration drillhole polygons being classified as *non-PAG* and red exploration drillhole polygons being classified as PAG.

Please note the **entirety** of Zones 1a, 2/3, 5, 55, and 6 were planned to be placed underwater in the EAC application and will continue to be planned to be placed underwater until verification testing is completed on blastholes demonstrate that *non-PAG* regions of a suitable size and thickness is present using an NPR cut off criteria of 2.0.

Please note this is for illustration purposes only as verification testing will be based on blastholes which will be completed on a much tighter spacing and be completed for every bench mined versus the entire length of an exploration drillhole.

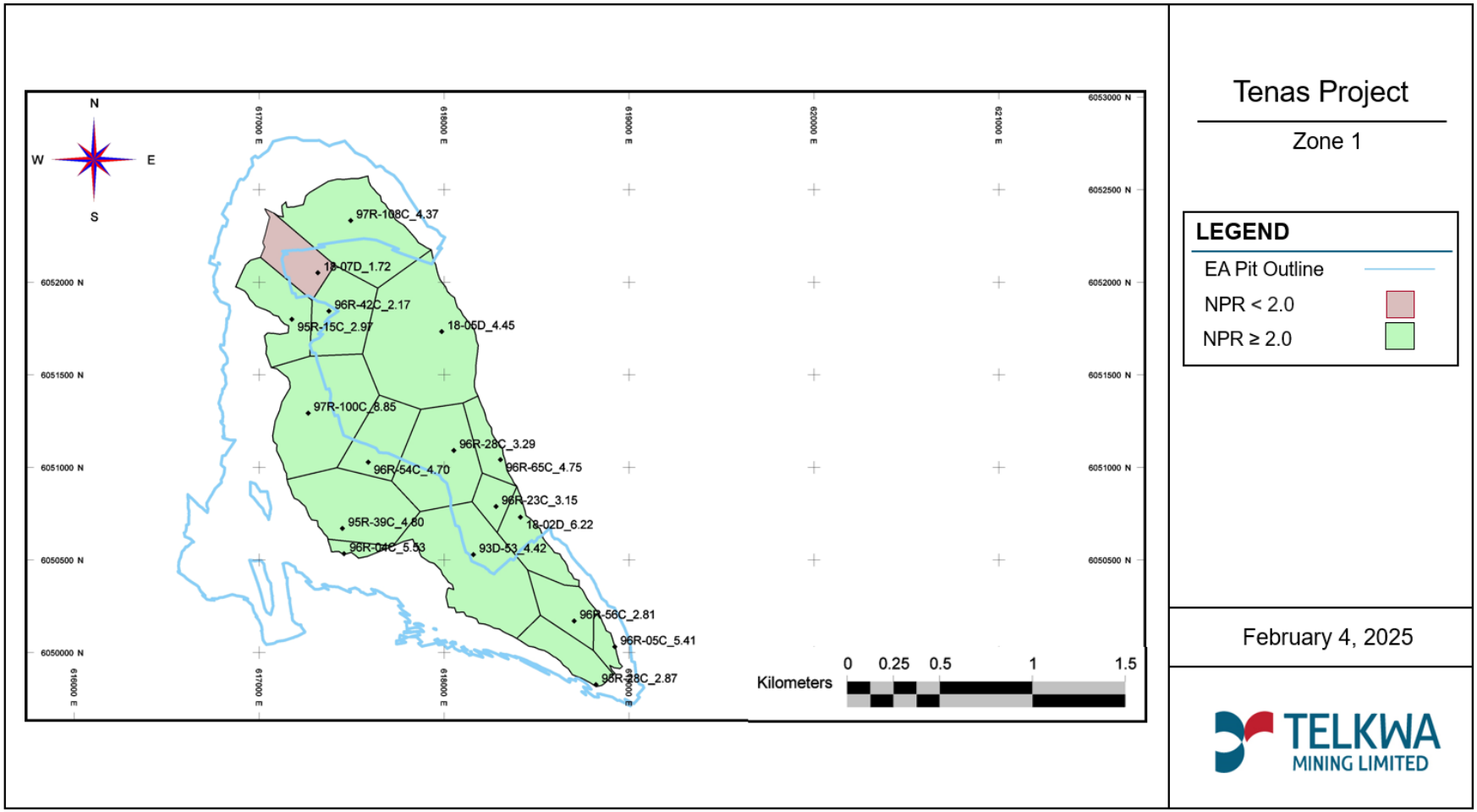


Figure 2-9: Zone 1 PAG and *non-PAG* Polygons Classified Against an NPR Cut-Off of 2.0, with Zones in Red Being Submerged Underwater in the EAC Application

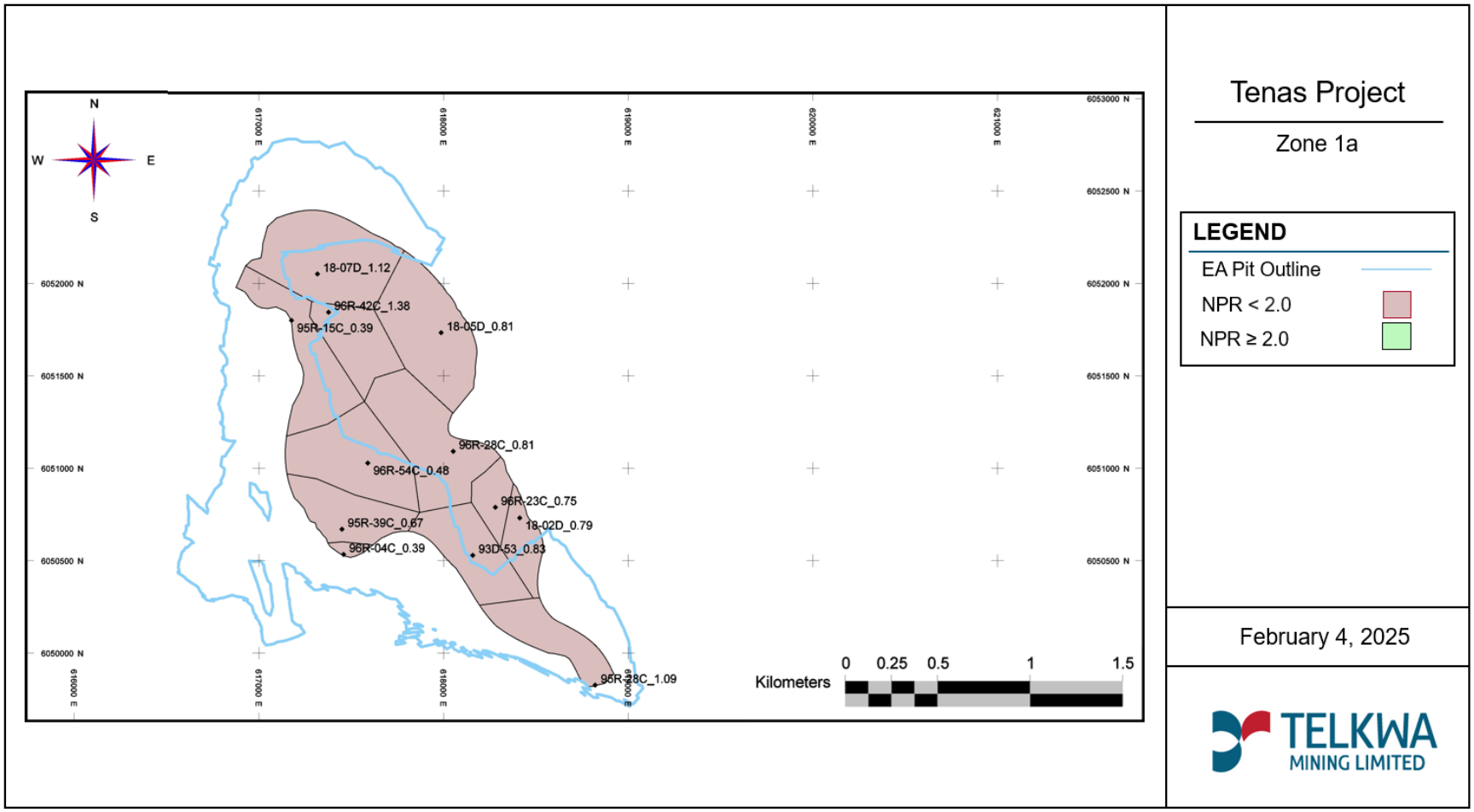


Figure 2-10: Zone 1a PAG and *non-PAG* Polygons Classified Against an NPR Cut-Off of 2.0, Entire Zone Treated as PAG in EAC Application and Submerged Underwater

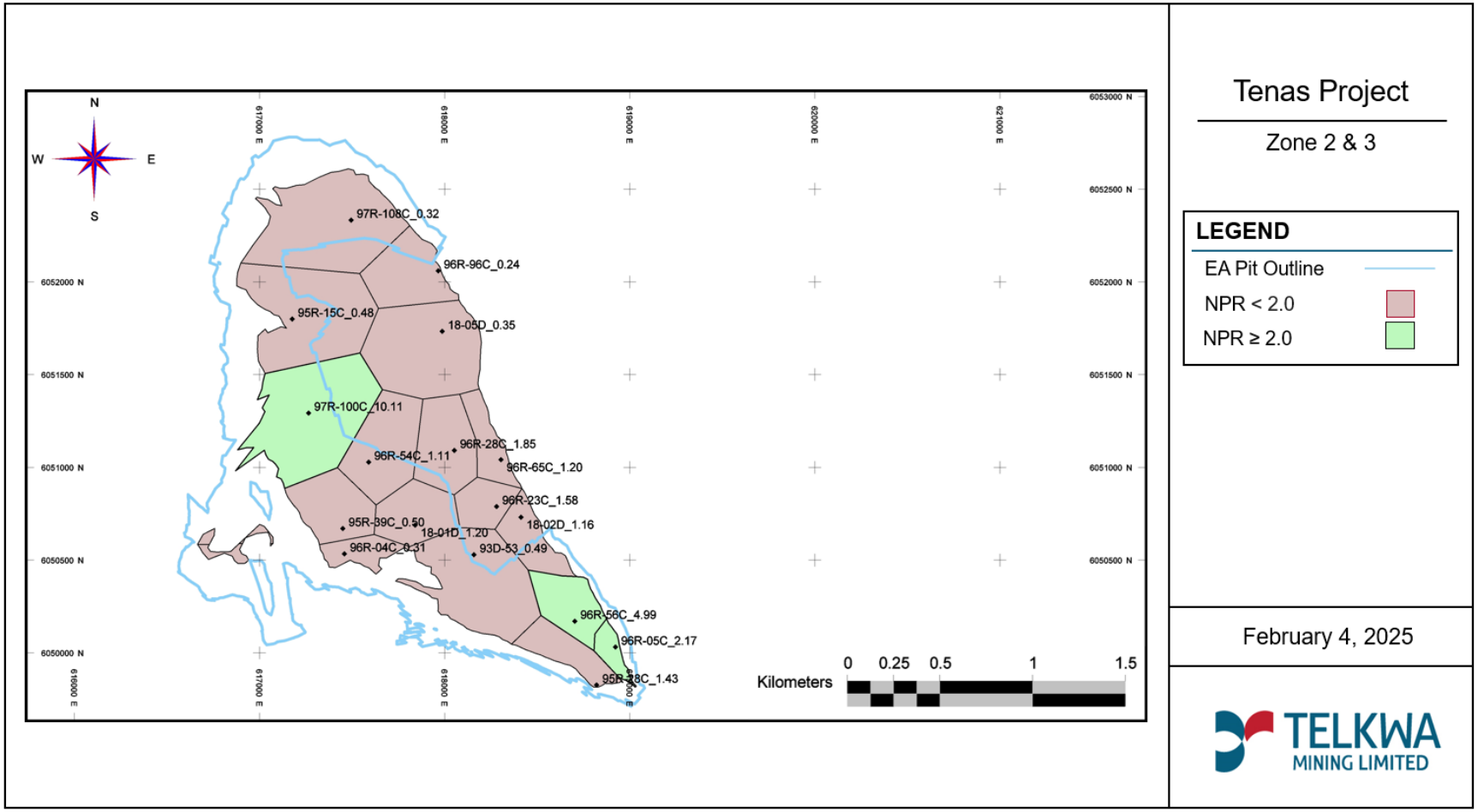


Figure 2-11: Zone 2/3 PAG and *non-PAG* Polygons Classified Against an NPR Cut-Off of 2.0, Entire Zone Treated as PAG in EAC Application and Submerged Underwater

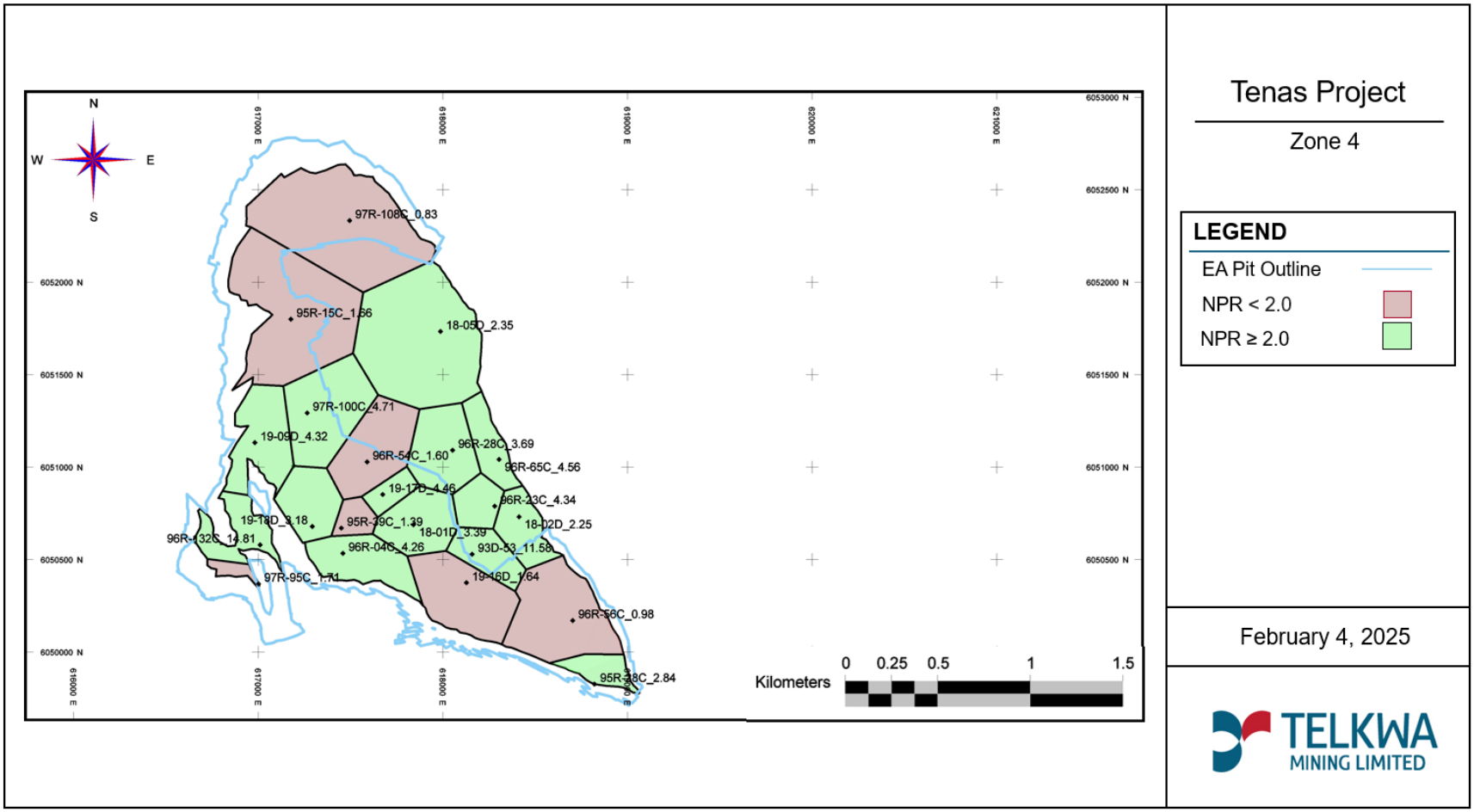


Figure 2-12: Zone 4 PAG and *non-PAG* Polygons Classified Against an NPR Cut-Off of 2.0, Red Polygons Submerged Underwater in the EAC Application

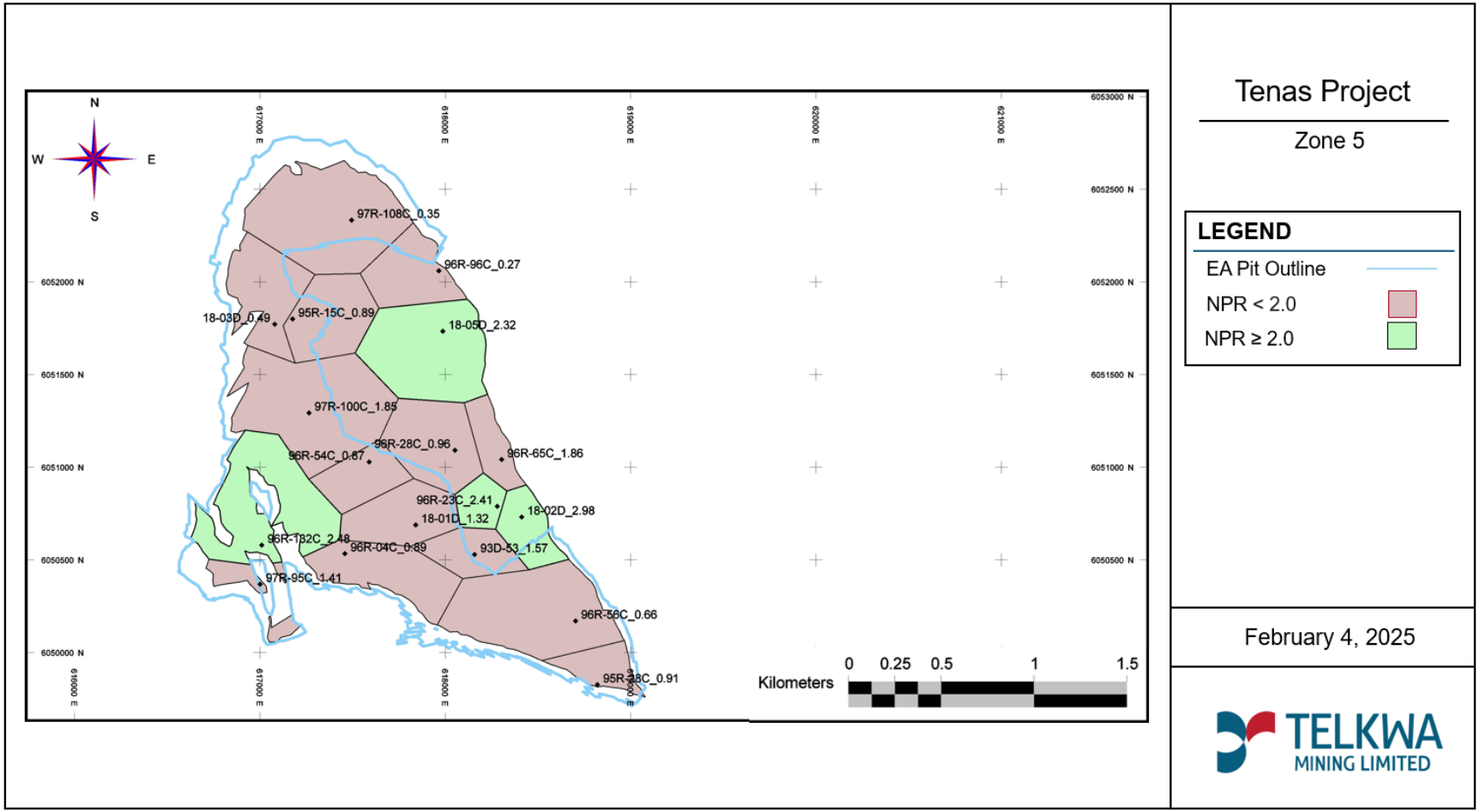


Figure 2-13: Zone 5 PAG and *non-PAG* Polygons Classified Against an NPR Cut-Off of 2.0, Entire Zone Treated as PAG in EAC Application and Submerged Underwater

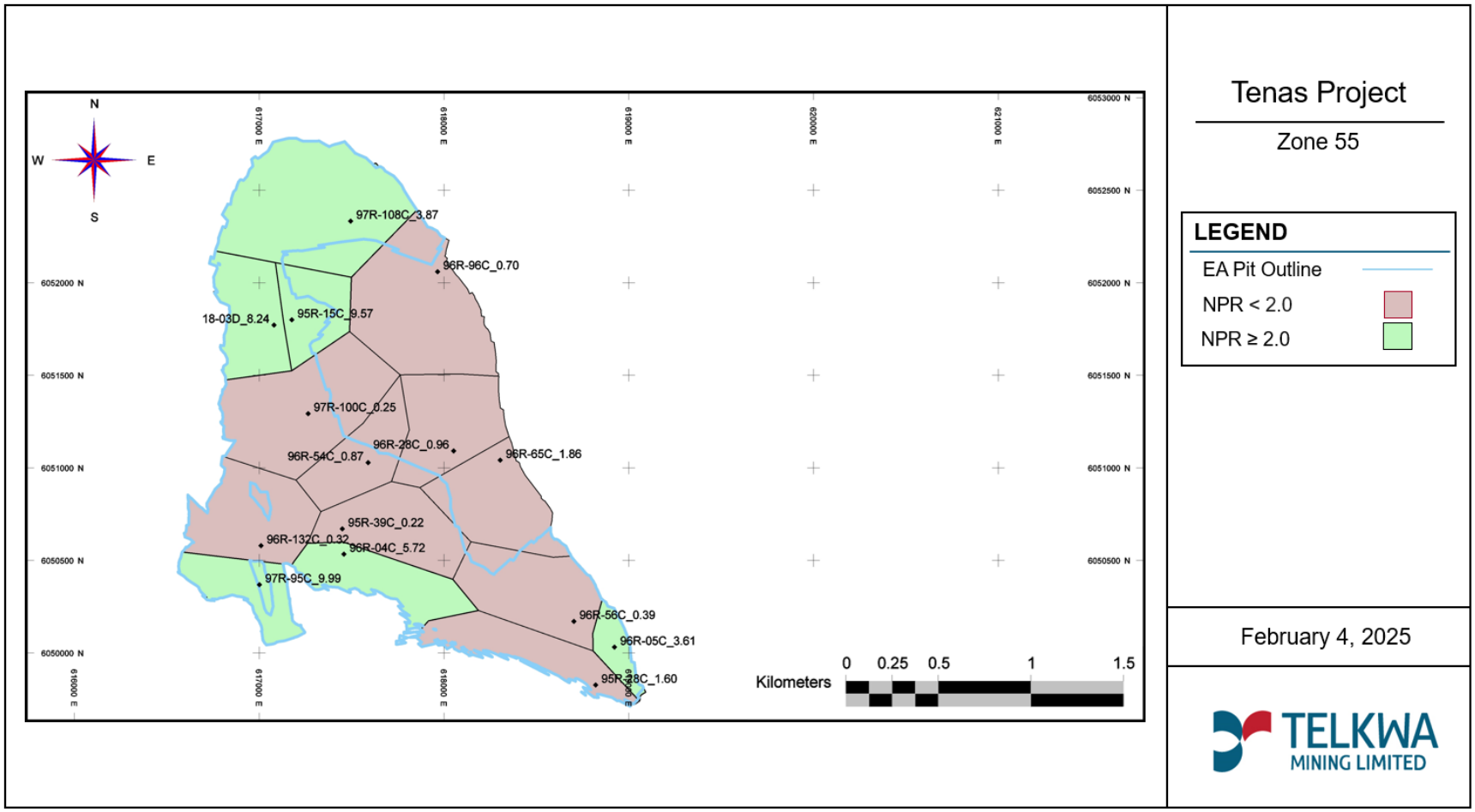


Figure 2-14: Zone 55 PAG and *non-PAG* Polygons Classified Against an NPR Cut-Off of 2.0, Entire Zone Treated as PAG in EAC Application and Submerged Underwater

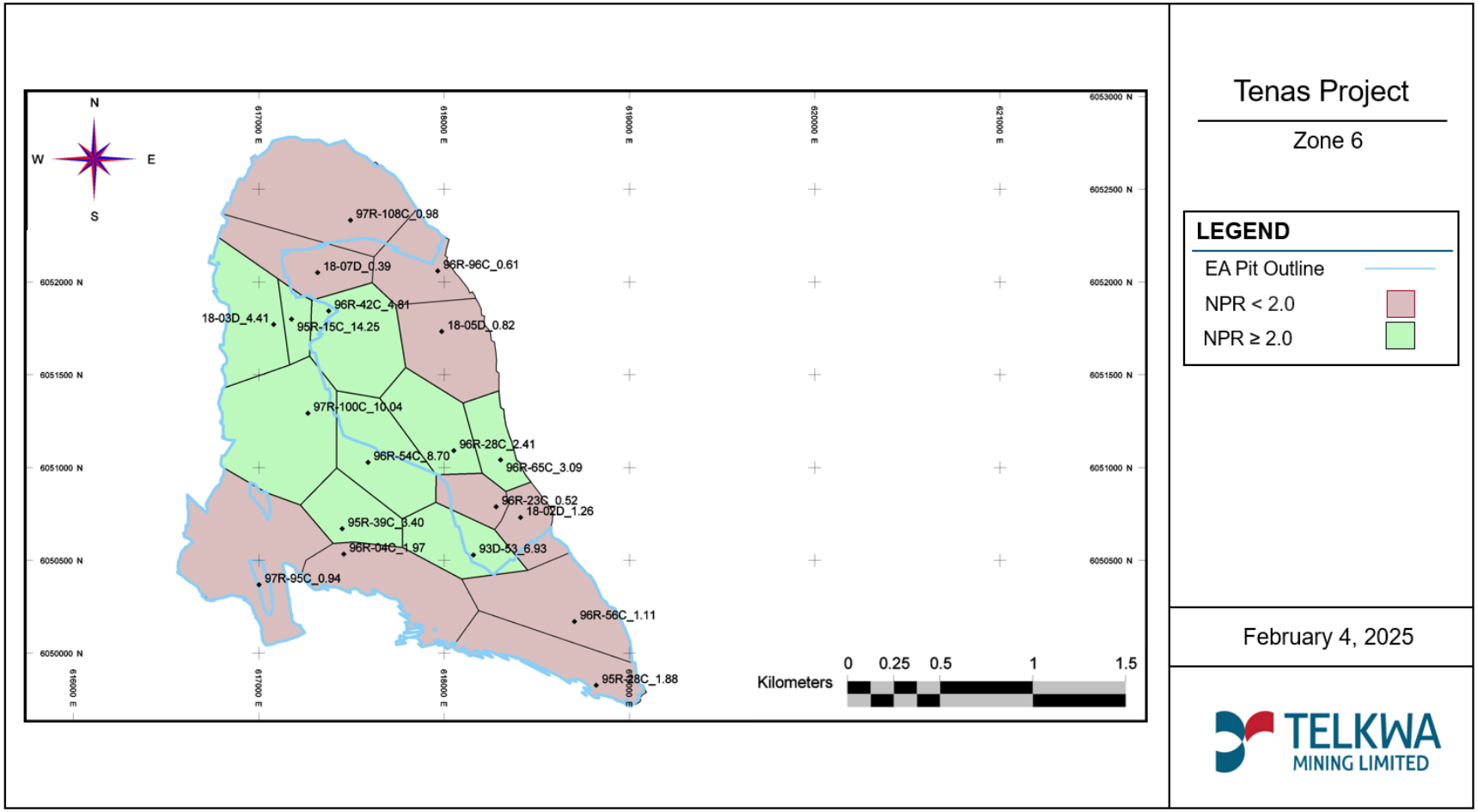


Figure 2-15: Zone 6 PAG and *non-PAG* Polygons Classified Against an NPR Cut-Off of 2.0, Entire Zone Treated as PAG in EAC Application and Submerged Underwater

As illustrated by the figures above, Zone 1 is the only zone that is almost entirely *non-PAG* on an aerial basis with only one exploration drillhole having an NPR less than 2.0 on an aerial extent (1.80) and Zone 1a is all PAG with no exploration drillholes having an NPR greater than or equal 2.0. Zones 7, and 8 have not been provided as there are no plans for mining of either of these zones and neither zone forms part of the EA Open Pit walls. Zones 1, 2/3, 4, 5, 55, and 6 have exploration drillholes that are both *non-PAG* and PAG based on the geochemical data collected using an NPR cutoff of 2.0. However, in the EAC application submission **all of zones 1a, 2/3, 55, 5, and 6 material** were classified as PAG and assumed to be placed underwater into the management ponds to be conservative for planning purposes while Zones 1, and 4 were demarcated into *non-PAG* and PAG polygons for the EAC Application based on the individual exploration drillhole NPR values on an aerial basis, distribution of material within the vertical column of exploration drillholes, and their locations respective to economic coal seams.

Note that these NPR values are only used for planning purposes and regulatory applications such as the EAC Application as the actual segregation of PAG from *non-PAG* will be based on field sampling and testing of blastholes with material being designated as PAG using a cutoff of an NPR 2.0 during the Construction and Operation Phases. The spacing of the blastholes will be on a much tighter spacing than exploration drilling can ever practically achieve.

Appendix 15: Tenas Project, Mine Material Management based on an NPR Cut-Off of 2.0, 1.80, 1.60, and 1.20, Telkwa Mining provides how Telkwa Mining would manage the various material zones would be managed if blasthole verification testing confirmed the exploration drillhole data and an NPR cut-off of 2.0 was used, or the EAC Application Methodology was used to classify PAG from *non-PAG* material. As demonstrated by **Table 2-19,** even when using an NPR value 2.0, a drillhole (exploration and/or blasthole) with a bulk property that would classify the entire drillhole polygon as *non-PAG* (NPR greater than 2.0) may have portions within the vertical length of a drillhole that may get placed underwater due to PAG intervals being present that can effectively be segregated (**Table 2-19**). **Table 2-19** indicates segregation is possible based on the drillhole interval NPR values.

Furthermore, some minor PAG units within an overall *non-PAG* drillhole polygon will become blended vertically within a polygon through the mining and blasting process into the surrounding *non-PAG* material so that the entire drillhole polygon can be considered *non-PAG* if these PAG zones are too small to be separated as illustrated by **Table 2-20**.

Finally, some geochemical zones in the EAC application that were classified as PAG might have polygons that could be managed as *non-PAG* during the Construction and Operation Phases. **Table 2-21** shows a Zone 6 exploration drillhole with a bulk NPR greater than 4.0 for this drillhole which could clearly be managed as *non-PAG* if confirmed by blasthole confirmation testing.

Table 2-19: Mining Plan for Zone 1 with a Bulk NPR of 3.29 for Drillhole T96R-28C

Hole-ID	Sample Depth and Thickness (m)			ABA Zones	Mine Plan Inputs				BULK ZONE NPR	EAC Application Plan	Mining Plan at NPR of 2.00
	From	To	Thickness		Sulfide	AP	NP	NPR			
T96R-28C	12.50	14.32	1.82	1	0.53	16.59	22.3	1.34		Place underwater	Place underwater
T96R-28C	14.32	14.68	0.36	1	0.71	22.12	9.73	0.44			
T96R-28C	14.68	15.08	0.4	1	3.79	118.57	47.42	0.40			
T96R-28C	15.08	17.07	1.99	1	0.79	24.7	23.2	0.94			
T96R-28C	17.07	17.86	0.79	1	1.48	46.31	19.6	0.42			
T96R-28C	17.86	18.40	0.54	1	1.02	32.03	7.04	0.22			
T96R-28C	18.40	19.66	1.26	1	1.10	34.36	21.4	0.62			
T96R-28C	19.66	20.11	0.45	1	0.26	8.1	29.5	3.62	3.29	non-PAG	non-PAG
T96R-28C	20.11	20.99	0.88	1	0.10	3	49	15.45		non-PAG	non-PAG
T96R-28C	20.99	26.93	5.93	1	0.23	7.3	36.7	5.05		non-PAG	non-PAG
T96R-28C	26.92	35.09	8.17	1	0.61	19.2	42.9	2.24		non-PAG	non-PAG
T96R-28C	35.09	35.93	0.84	1	0.31	10	416	43.38		non-PAG	non-PAG
T96R-28C	35.93	45.03	9.10	1	0.42	13.1	43.8	3.35		non-PAG	non-PAG
T96R-28C	45.03	47.83	2.80	1	0.24	7.6	43.8	5.80		non-PAG	non-PAG
T96R-28C	47.83	55.72	7.89	1	0.12	4	114	30.21		non-PAG	non-PAG
T96R-28C	55.72	63.86	8.14	1	0.27	8.4	44.7	5.31		non-PAG	non-PAG

Table 2-20: Mining Plan for Zone 6 with a Bulk NPR of 2.97 for Drillhole T96R-15C

Hole-ID	Sample Depth and Thickness (m)			ABA Zones	Mine Plan Inputs				BULK ZONE NPR	EAC Application Plan	Mining Plan at NPR of 2.00
	From	To	Thickness		Sulfide	AP	NP	NPR			
T95R-15C	6.50	7.62	1.12	1	0.129884	4.1	26.8	6.60		non-PAG	non-PAG
T95R-15C	7.62	7.92	0.30	1	-0.0183676	-1	473.6892	-825.26		non-PAG	non-PAG
T95R-15C	7.92	9.90	1.98	1	0.1802336	5.6	25.0	4.44		non-PAG	non-PAG
T95R-15C	9.90	11.34	1.44	1	0.2007464	6.3	48.3	7.70		non-PAG	non-PAG
T95R-15C	11.34	13.04	1.70	1	0.2016788	6.3	25.9	4.11		non-PAG	non-PAG
T95R-15C	13.04	14.18	1.14	1	0.2473664	7.7	22.3	2.88		non-PAG	non-PAG
T95R-15C	14.18	15.43	1.25	1	0.3452684	10.8	28.6	2.65		non-PAG	non-PAG
T95R-15C	15.43	17.05	1.62	1	0.2688116	8.4	25.0	2.97		non-PAG	non-PAG
T95R-15C	17.05	19.57	2.52	1	0.4711424	14.7	28.6	1.94	**2.97**	Blend into surrounding units	Blend into surrounding units
T95R-15C	19.57	21.51	1.94	1	0.7881584	24.6	51.9	2.11		non-PAG	non-PAG
T95R-15C	21.51	24.15	2.64	1	0.922424	28.8	30.4	1.05		Blend into surrounding units	Blend into surrounding units
T95R-15C	24.15	25.96	1.81	1	0.6016784	18.8	72.6	3.86		non-PAG	non-PAG
T95R-15C	25.96	27.30	1.34	1	0.5858276	18.3	32.2	1.76		Blend into surrounding units	Blend into surrounding units

Table 2-21: Mining Plan for Zone 6 with a Bulk NPR of 4.41 for Drillhole T18-03D

Hole-ID	Sample Depth and Thickness (m)			ABA Zones	Mine Plan Inputs				BULK ZONE NPR	EAC Application Plan	Mining Plan at NPR of 2.00
	From	To	Thickness		Sulfide	AP	NP	NPR			
T18-03D	17.500	17.650	0.15	6 Coal Cleaning					4.41	Place underwater	Place underwater
T18-03D	17.650	18.6	0.95	6	1.1	35.31	33.8	0.96			Blend into surrounding units
T18-03D	18.6	19.4	0.8	6	0.1	4.2	12.5	2.96			non-PAG
T18-03D	19.4	19.6	0.2	6	0.4	12.8	26.0	2.03			non-PAG
T18-03D	19.6	20.5	0.9	6	0.1	2.2	15.5	7.09			non-PAG
T18-03D	20.5	22.25	1.75	6	0	2	37	23.87			non-PAG
T18-03D	22.25	23.16	0.91	6	0	1	55	87.20			non-PAG
T18-03D	23.16	23.56	0.4	6	0	2	51	32.51			non-PAG
T18-03D	23.56	25	1.44	6	0	1	94	74.80			non-PAG
T18-03D	25	26.12	1.12	6	0	2	77	49.15			non-PAG
T18-03D	26.12	28	1.88	6	0.4	13.8	27.8	2.02			non-PAG
T18-03D	28	29.06	1.06	6	0.5	14.4	70.3	4.89			non-PAG
T18-03D	29.06	30	0.94	6	0.3	8.8	34.3	3.92			non-PAG
T18-03D	30	32.25	2.25	6	0.3	10.6	18.8	1.77			Blend into surrounding units
T18-03D	32.25	32.65	0.4	6	1.48	46.25	6.0	0.13			

As the material zones mined with excavators/shovels will occur in approximately 12-m benches and a ML/ARD verification process will be conducted in advance of mining, any potential PAG or *non-PAG* material will be identified at a bench scale (12 m) as the sample interval recovered will be based on the planned mining horizon for the rock units within a blasthole. If sampling identifies separable PAG units within a mining horizon that require active management that can be mined efficiently with an excavator/shovel they will be managed as per the procedure provided as follows:

- For any separable PAG rock within blasthole polygons (defined as 2 times the burden and spacing distances) identified with an NPR less than 2.0 will need to be placed underwater within an average of 6 months and no longer than 12 months to mitigate the generation of ARD;
- Rock resulting from coal cleaning will be treated as PAG even if surrounding materials is *non-PAG* due to the inclusion of coaly materials into the rock;
- Rock materials will be treated as *non-PAG* if verification testing shows an NPR greater than or equal to 2.0 within blasthole polygons (defined as 2 times the burden and spacing distances);
- For overburden, surface soils, processed rock, rock construction materials, and non-rock construction materials will be treated as PAG if their NPR is less than 2.0, and verification testing will need to be done for these materials if they are to be treated as *non-PAG* as per the **ML/ARD Management Plan (ML/ARDMP; S13.0-C12)**; and,
- If verification testing is not completed, rock and processed rock will be treated as PAG.

Operational sampling committed to under the **ML/ARD Management Plan (ML/ARDMP; S13.0-C12)** provides sufficient data for final decision making on material segregation and placement as it has the necessary density and sample frequency needed to provide the certainty required for the protection of water quality and downstream environmental integrity.

Furthermore, at least one confirmation sample will be taken for each blast pattern which will be sourced from the reserve samples kept from the blasthole samples from the blast pattern. This sample confirmation requirement applies if only one type of geochemical material is consistently present for the entire blast being mined (i.e., all PAG or *non-PAG*). If more than one material type is identified based on the NPR cut off of 2.0 within an individual blast pattern a confirmation sample will be taken from each identified geochemical material which will be identified by material type, geochemical classification, zone, bench, lift number, blasthole, and blast pattern identifiers.

Lastly, random quarterly *non-PAG* rock pile samples will be taken from active *non-PAG* rock lifts in areas where rock has been placed during the last quarter. The number of samples will be based on an approximate 200 by 200-m grid pattern and taking a sample on every node of this grid. The

same criteria will be used as for operational blasthole verification testing with material having an NPR less than 2.0 being designated as PAG, while materials with an NPR greater than 2.0 being designated as *non-PAG*. If PAG material is identified by these grid points additional sampling will be conducted on approximately 25-m offset concentric circles from this location until a *non-PAG* sample is measured as illustrated by **Figure 2-16** below.

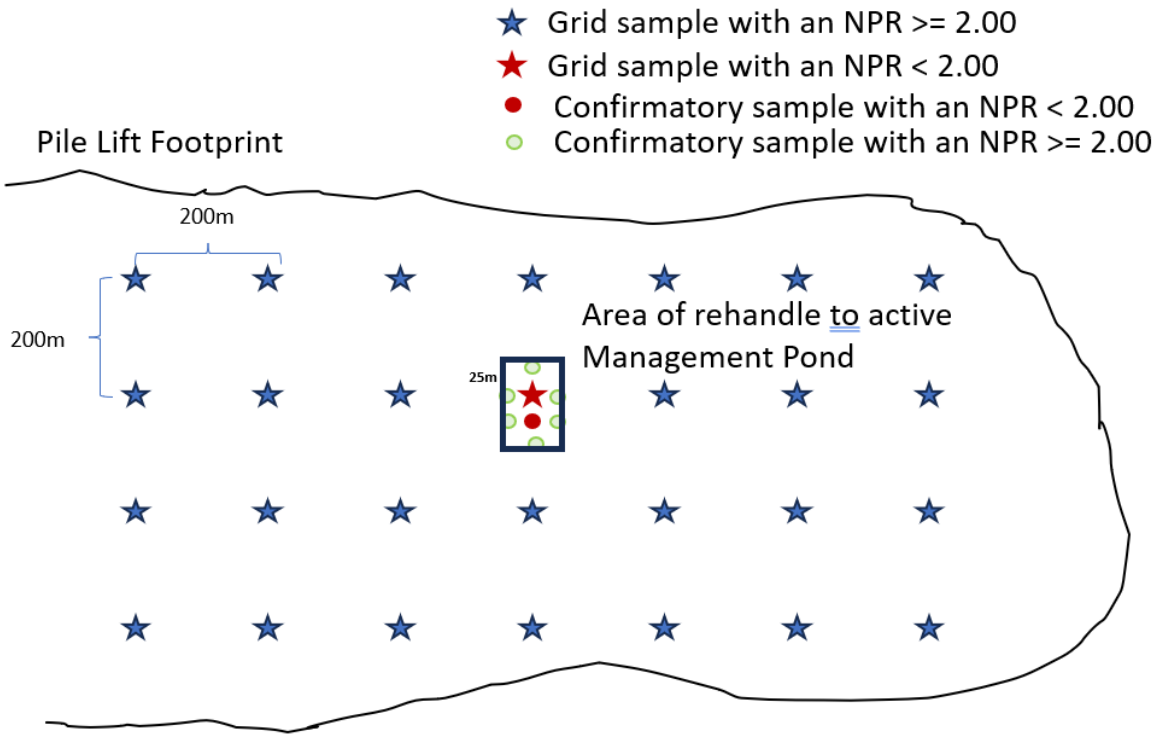


Figure 2-16: *Non-PAG* Pile Lift Material Confirmation Testing

Once the *non-PAG* rock pile lift area is defined by confirmatory testing and a bulk NPR and sulfur % has been calculated based on the sample testing completed; the following actions will be taken:

- If the bulk NPR for the sample is less than 2.0 an investigation will be completed, including a survey of the material's location and review of material that was placed there via the site electronic tracking system.
- Then a risk assessment will be conducted to determine if this this material will be rehandled and placed underwater in one of the active management ponds.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

The current sampling frequency does not provide adequate information to define or refine PAG volume estimates beyond what they have specified in the ML/ARD Management Plan. Monitoring the geochemical characterization of ore, waste, and overburden must be based on proper sampling frequency representative of the proportional volume of sampled materials.

LETTER IR 136 AND 136 ITT TABLE

Indicate what additional sampling and characterization studies are planned to meet BC ML/ARD Guidelines. For instance, Zone 4 is underrepresented in the static test database.

2 Available from: https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/permitting/ml-ard

RESPONSE LETTER IR 136 AND 136 ITT TABLE

SRK has provided responses to this geoscience IR in **Appendix 16: Telkwa Coal Tenas Project Environmental Assessment Application – Responses to 2022 Supplemental Geochemistry Information Requests from the Ministry of Energy, Mines and Low Carbon Innovation, SRK**.

FOLLOWUP COMMENTS

OVERVIEW IR LETTER

The metal leaching/acid rock drainage (ML/ARD) Management Plan in Section 6.4 specifies that all materials excavated from zones 1a and 2/3 will be managed as potentially acid generating (PAG). Material from zones 5, 55, and 6 were characterized as non-PAG but will be initially classified and managed as PAG unless testing can demonstrate otherwise. To facilitate the shorter turnaround times that are required to make operational decisions for placement of blasted rock, rejects, and other materials, the results of the geochemical characterization are used to develop operational proxies for determining NP and AP in an onsite laboratory that will be equipped with a Leco furnace. Section 6.1.3 of the ML/ARD Management Plan specifies an NPR of 1.2 is proposed to classify PAG mine rock at the Project. Clarifications and justifications on the ML ARD management plan and use of NPR 1.2 and 2 criteria as cutoff for verification and planning purposes should be provided.

IR LETTER 140, 142, 143, 146 and 148 AND 140a ITT TABLE

The ML/ARD Management Plan Section 6.4 specifies that all materials excavated from zones 1a and 2/3 will be managed as PAG. Material from zones 5, 55, and 6 were characterized as non-PAG but will be initially classified and managed as PAG unless testing can demonstrate otherwise. To facilitate the shorter turnaround times that are required to make operational decisions for placement of blasted rock, rejects, and other materials, the results of the geochemical characterization are used to develop operational proxies for determining NP and AP in an onsite laboratory that will be equipped with a Leco furnace. Section 6.1.3 of the ML/ARD Management Plan specifies an average weighted NPR of 1.2 is proposed to classify PAG mine rock at the Project.

1. *Provide clarifications and justifications for the proposed ML ARD management plan and use of weighed average NPR 1.2 and 2 criteria as cutoff for verification and planning purposes.*

RESPONSE 140a ITT TABLE

SRK has provided a response to this geoscience IR in **Appendix 16: Telkwa Coal Tenas Project Environmental Assessment Application – Responses to 2022 Supplemental Geochemistry Information Requests from the Ministry of Energy, Mines and Low Carbon Innovation, SRK.**

Telkwa Mining contracted SRK to provide a scientifically defensible NPR criterion for segregating *non-PAG* material from PAG material for the planning/regulatory and operational verification phases based on site-specific data for the Tenas Deposit and best practices provided in the MEND (2009) prediction manual for drainage chemistry from sulphidic geologic materials.

SRK determined that a site-specific NPR cut off criteria of 1.20 for this deposit was appropriate to characterize blasthole rock as PAG (NPR less than 1.2) or *non-PAG* (NPR greater than or equal to 1.2). However, Telkwa Mining has elected to use a more conservative NPR criterion of 2.0 as a cut off versus the site-specific value of 1.20 to identify exploration drillhole and blasthole rock as PAG and non-PAG. This criterion was selected to ensure that Telkwa Mining will not classify PAG rock as *non-PAG rock*. This criterion will be reviewed as additional information is gathered for the permitting application at which point if the data supports it, Telkwa Mining will apply to revise the proposed NPR criterion.

The following provides a clear definition for the NPR cut off criterion used for the Tenas Project.

Planning, Regulatory, and Operational Stages

For mine planning processes, regulatory submissions such as the EAC application and operational verification testing, an NPR cut off criteria of 2.0 will be used to segregate *non-PAG* from PAG in exploration drillhole and/or blasthole. All rock with an NPR value less than 2.0 will be designated as PAG while rock having an NPR >= 2.0 will be classified as *non-PAG* based on verification testing specified in the ML/ARD management plan attached in **Appendix 17: Metal Leaching/Acid Rock Drainage Management Plan, SRK**.

Non-rock materials such as surface soils, overburden, processed coal, processed rock, and run-of-mine coal were characterized as PAG or *non-PAG* also using a cut-off of 2.0.

The justification to use an NPR cutoff of 2.0 for the planning, regulatory submission and operational stages for rock and non-rock materials is based on other deposits in BC, and an understanding of the site-specific geochemical information for this Project. The NPR criterion of 2.0 is also supported by the static geochemical testing results which showed that positive correlation of calcium and magnesium to the modified-NP indicating carbonate minerals are available to neutralize acid production (SRK 2024b).In addition, as noted above, kinetic testing results (SRK 2024b) indicate that an NPR of 1.2 is sufficient to identify rock as PAG or *non-PAG*. Selection of an operational NPR greater than the site-specific value is therefore suitable for identifying rock as PAG or *non-PAG*.

FOLLOWUP COMMENTS

IR LETTER 140, 142, 146 and 140a ITT TABLE

2. *Clarify what NPR criterion of 1.2 or 2 will be applied to manage waste material from zones 5, 55, and 6 and define them as non-PAG or PAG.*

RESPONSE 140a ITT TABLE

An NPR criterion of 2 will be applied to manage rock material from all zones including zones 5, 55 and 6.

SRK has provided a response to this geoscience IR in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

FOLLOWUP COMMENTS

148 ITT TABLE

Please provide an updated management plan that addresses comments discussed in comments EMLI 140, 142, 143, and 146

IR LETTER 140, 142, 146 and 148 AND 140a ITT TABLE

3. *Based on responses to comments EMLI 140, 142, 143, and 146 indicate if updates to the proposed Metal Leaching (ML) Acid Rock Drainage (ARD) management plan are needed to address blending of material.*

RESPONSE 140a ITT TABLE

No blending beyond what is provided through the normal mining process is planned for this Project.

The ML/ARDMP has been updated to reflect the proposed change in NPR criterion and is attached in **Appendix 17: Metal Leaching/Acid Rock Drainage Management Plan, SRK**.

SRK has provided a response to this geoscience IR in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

The ability to maintain a consistent water cover and to coordinate staged flooding and PAG placement was not demonstrated within the WLBM inputs or through contingencies in the waste management plan or mine plan.

168 ITT TABLE

The model assumes that all rock will be submerged underwater within 6 to 12 months. Please provide the contingencies in the waste management plan or mine plan to ensure maintenance of a consistent water cover and to coordinate staged flooding and PAG placement.

IR LETTER 140, 142, 146 and 148 AND 140a ITT TABLE

4. *Provide contingencies in the waste management plan or mine plan to maintain a consistent water cover and to coordinate staged flooding and PAG placement.*

RESPONSE 140a ITT TABLE

SRK has provided a response to this geoscience IR in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

FOLLOWUP COMMENTS

LETTER IR 140, 142, 143, 146, and 145, AND 140b ITT TABLE

To address overestimation of available NP, please specify the best-fit linear regression of the data in Figure 8 and do not fix the line through the origin. A review of Figure 8 of Appendix 1.0-M that illustrates the relationship between TIC-Fe Corrected and Modified NP also indicates that the Modified NP may on occasion overestimate available NP and as a result, revising the NPR criterion to the minimum NPR cut-off value of 1.2 may result in PAG rock being managed as Non-PAG mine rock.

a) *Provide a greater range of percentile values in Table 2-4 and provide discussion of how spatially extensive a full PAG interval would be encountered for each zone in the pit.*

Regulatory Clarification provided via email from Morgan Dyas on February 9th, 2024

The request to "provide a discussion of how spatially extensive a full PAG interval would be encountered for each zone in the pit" is based on the implications stemming from the statement in Appendix 1.0 M (SRK, 2022) that a unit is NPAG based on an average NPR > 1.2. The characterization results indicate that the Tenas Project geologic units contain both PAG and NPAG strata. For example, more than 10 of the 20 boreholes that intersected Unit 5 have NPR < 1.2, thus over ½ of the strata in this unit is PAG. By stating that overall a unit is NPAG implies that the mixing and blending associated with the standard mining procedures of a unit will prevent localized ARD from forming within a waste rock pile. To prevent localized ARD, published blending studies (Andrina, 2009; Mehling, 1998) indicate that blended quantities greater than 1:1 are required. This could not be achieved for Unit 5 without active management and may be difficult for units such as Unit 6 or Unit 7 that have median NPR of 1.7 and 1.6, respectively.

An understanding of the spatial distribution of PAG and NPAG within a stratigraphic unit would be required to allow effective blending to occur. The request to provide the spatial distribution of PAG strata was to determine if there is currently enough data to support that units designated as NPAG could actually be handled and placed as NPAG. Handling the entire zone for units 1a, 2/3, 5,55 and 6 as PAG and placing them in permanent flooded storage the average thickness and aerial map extent of each unit within the pit limits is adequate. However, if another type of PAG management is considered, more detailed characterization and identification of NPAG zones would be requested.

Information required for units 1 and 4 where NPAG is proposed to be segregated from PAG provide a map with average thickness and extent of the PAG and NPAG zones within the pit limits and show data points that were used to define the zones. This information would be helpful to inform additional characterization that may be required to allow segregation decisions to be made during permitting and/or operations.

Reference:

Andrina, J., 2009. Physical and Geochemical Behaviour of Mine Rock Stockpiles in High Rainfall Environments. A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in the Faculty of Graduate Studies (Mining Engineering), the University of British Columbia.

Mehling, P. 1998. BLENDING AND LAYERING WASTE ROCK TO DELAY, MITIGATE OR PREVENT ACID ROCK DRAINAGE AND METAL LEACHING: A CASE STUDY REVIEW MEND Project 2.37.1 April 1998.

RESPONSE 140b ITT TABLE

SRK has provided responses to this geoscience IR in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

To clarify, SRK (2022) does not state that zones whose bulk properties are *non-PAG* will be mined as *non-PAG*. SRK (2022) states that all zones contain both PAG and *non-PAG* zones. The classification on the bulk properties was completed to provide an estimate of the *non-PAG* and

PAG quantities for the purpose of mine planning. As described in the ML/ARD Management Plan, verification will be conducted for *non-PAG* zones and separable PAG intervals in *non-PAG* zones will be segregated and submerged in the management ponds, in the same manner as rock from zones that were characterized as PAG based on their bulk quantities.

Telkwa Mining has stated that no blending is occurring for *non-PAG* units on a horizontal aerial basis to achieve a higher NPR, rather *non-PAG* areas will not be placed underwater while PAG areas will be placed underwater. The only blending that will occur is within the vertical horizon of a mining bench of 12 meters which is expected to occur from drilling/blasting and mining activities within the dig face.

Figure 2-17 shows how Zone 5 would be segregated if verification testing agreed with the exploration drillhole polygons and an NPR cut-off of 2.0 was used with blocks in green being treated as *non-PAG* while blocks in red and yellow are treated as PAG. The above methodology follows a very similar and proven process used in metal mines to designate ore from mine rock, with this Project is using it to designate PAG from *non-PAG* rock. However, in the EAC Application the entire Zone 5 was classified as PAG and placed underwater. The same exercise could be completed using a different NPR criterion value if Telkwa Mining were successful in amending the NPR value of 2.0 being used in the EAC application.

Zones 5 and 6 are both entirely placed underwater in the EAC application so there is currently no segregation of polygons above an NPR of 2 versus below 2 so the statement above is not applicable to the EAC application. As stated earlier, Zones 7 and 8 are not mined within the EA open pit so the reference to Zone 7 above is not relevant to this application, however it would be subject to the same verification testing as other zones if it were to be encountered and to be treated as non-PAG.

Figure 2-18 and **Figure 2-19** illustrate how zones 1, and 4 were split into PAG and *non-PAG* zones for the EAC application using a cut off of 2.0. Polygons coloured in red and yellow were treated as PAG while polygons colored green were treated as *non-PAG*.

The methodology proposed is like that used to define ore and non-ore at a metal mine based on the blastholes and blending is currently not planned to occur.

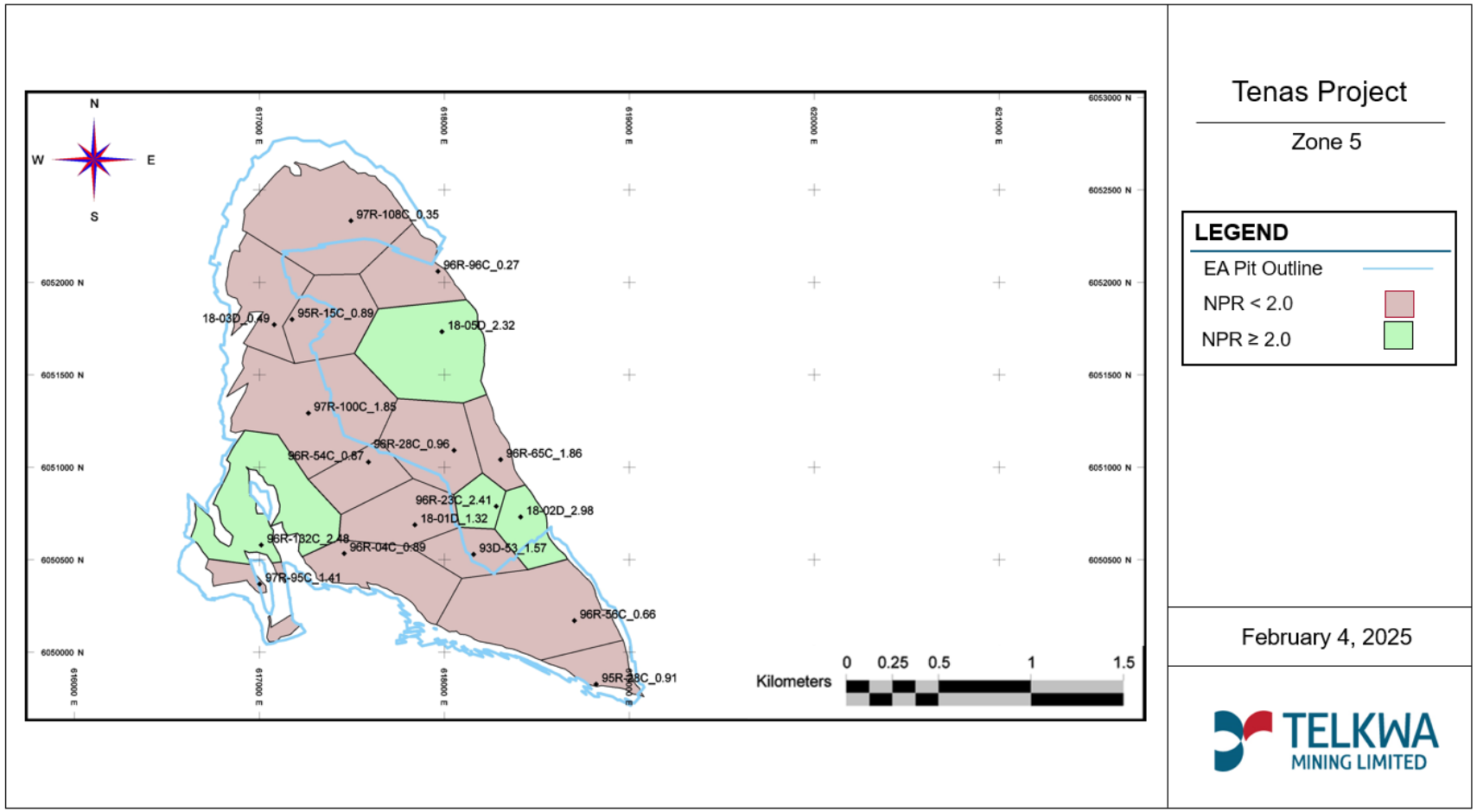


Figure 2-17: Zone 5 Classification Based on Using an NPR Cutoff of 2.0 with Red Polygons Being Classified as PAG and Green Polygons Being Treated as *non-PAG*

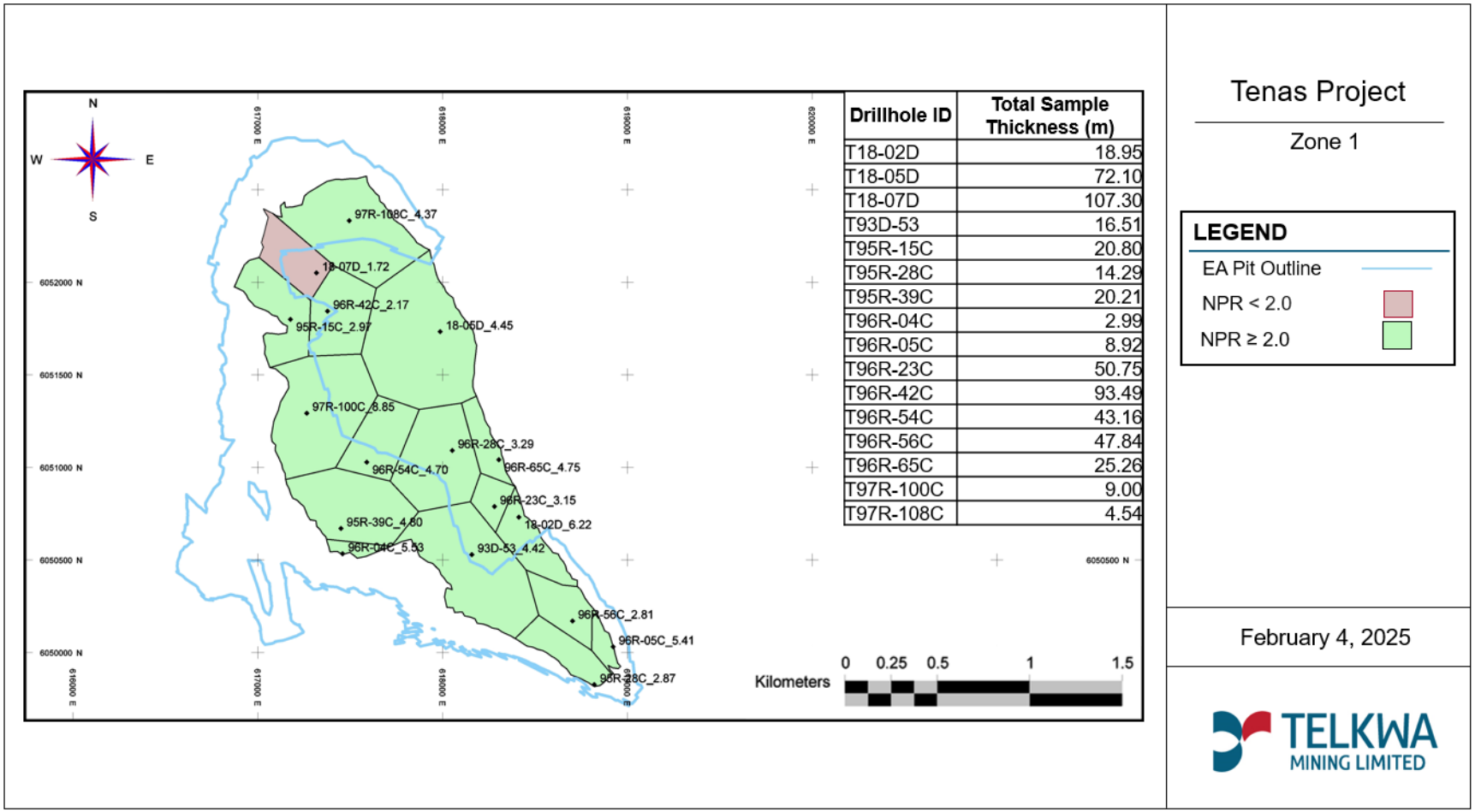


Figure 2-18: Zone 1 PAG and non-PAG Polygons Classified Against an NPR Cut-Off of 2.0, with Zones in Red Being Submerged Underwater in the EAC Application

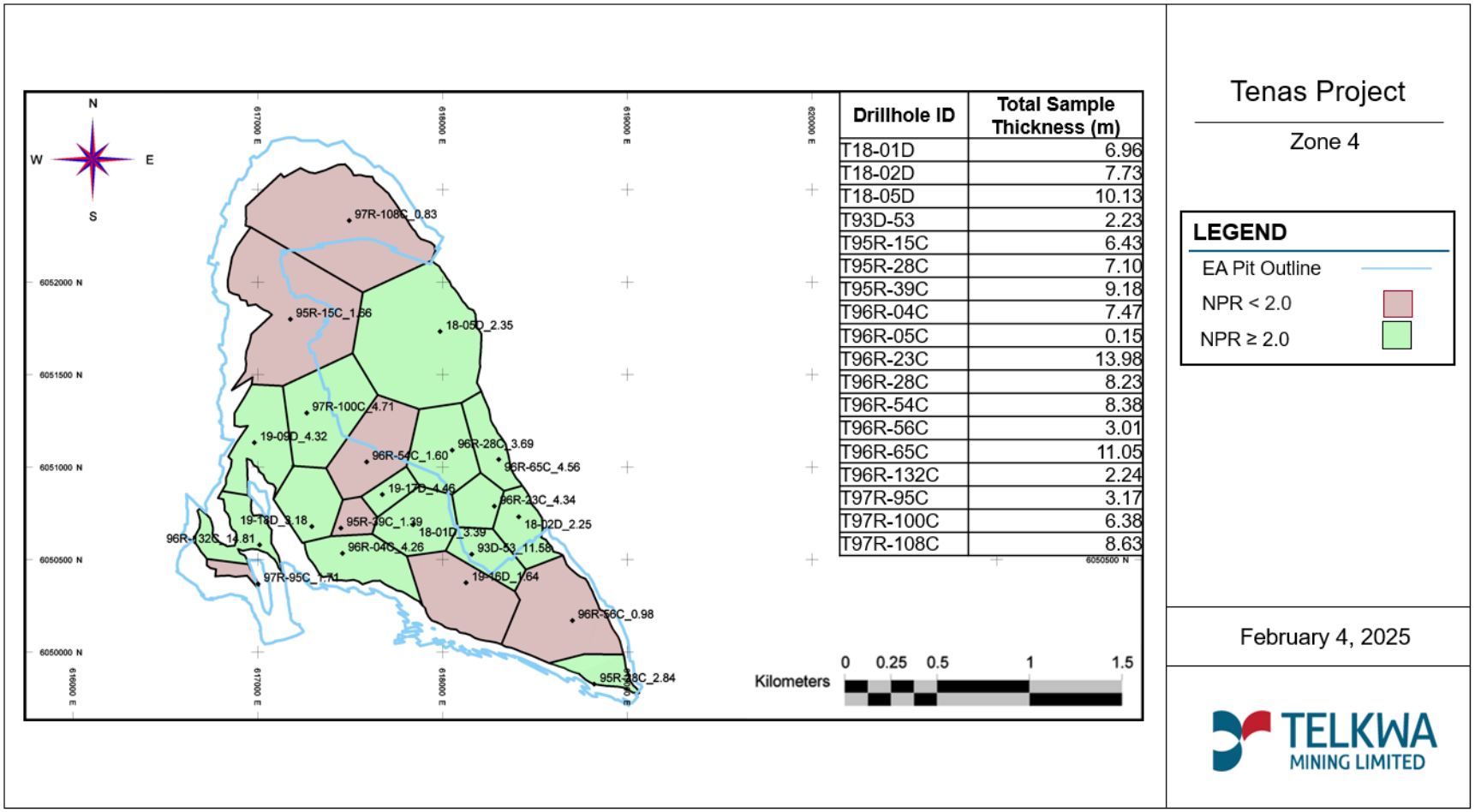


Figure 2-19: Zone 4 PAG and non-PAG Polygons Classified Against an NPR Cut-Off of 2.0, Red Polygons Submerged Underwater in the EAC Application

Table 2-22 below summarizes the zone distribution and volumes within the EA Open Pit.

Table 2-22: Summary of Zone Thicknesses, Extents, and Volumes with the EA Open Pit

Zone	Average Thickness (m)	Aerial Extent (m^2)	Volume (kbcm)
0 *non-PAG*	8.1	2,650	21.409
1 PAG	12.1	115	0.538
1 *non-PAG*	18.1	1,200	21.501
1a PAG	1.8	1,250	2.197
2/3 PAG	9.2	1,350	12.427
4 PAG	7.4	600	4.948
4 *non-PAG*	7.0	1,000	7.205
5 PAG	3.8	1,940	7.380
55 PAG	1.2	1,725	2.110
6 PAG	5.2	1,815	2.228
PAG Rock	**Variable**	**Variable**	**31,828**
Non-PAG Rock	**Variable**	**Variable**	**28.706**
Non-PAG Overburden	8.1	2,650	21.409

FOLLOWUP COMMENTS

142 ITT Table

Carbonate molar ratio (CMR) is a critical assessment because it has implications on estimates for the time to onset of ARD, the volume of PAG rock that requires management and the design of the ARD management facilities at site. As noted in the TCL response, the flattening of the CMR vs. sulphate trend shown on Figure 14 represents the minimum NPR cut-off as the CMR evaluation does not account for other factors that need to be accounted for when assigning NPR criteria such as NP availability and other factors as outlined in MEND 2009 ARD Prediction Manual. It is the opinion of the reviewer that assigning a NPR cutoff criteria solely based on the CMR and not taking into account other factors that may affect the on-set of ARD, such as available NP, is not supported by the presented data and contributing factors at a mine scale. This comment is related to Comment #140 #143, and #146.

RESPONSE 142 ITT TABLE

SRK has provided responses to this geoscience IR in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

FOLLOWUP COMMENTS

FOLLOW UP 143 ITT TABLE

EMLI understands that the average weighted NPR of 1.2 did not account for other factors that may affect the onset of ARD, such as blended PAG and non-PAG strata in an unsaturated embankment or pile. EMLI understands that the NPR cutoff of NPR = 1.2 did not account for other factors that may affect the onset of ARD, such as available NP. The proponent should therefore provide an extended evaluation of these other factors if they wish to apply for an average

weighted NPR less than 2.0. Until this demonstration is done the Proponent should use a uniform approach based on NPR criterion of 2 to designate zoning of material as PAG or non-PAG and ensure their ML ARD management plan is updated accordingly.

OVERVIEW IR LETTER

The geochemical characterization report defines non-PAG material based on weighed NPR of 1.2. If the application of a weighted average NPR of 1.2 to define non-PAG and PAG zones is not conservative, it may impact the quantity of PAG waste rock to manage and configuration of the project during the life of mine. Additional information should therefore be presented by the proponent to demonstrate the conservativeness of this approach.

- *EMLI understands that the neutralization potential ratio (NPR) cutoff of NPR = 1.2 did not account for other factors that may affect the on-set of acid rock drainage (ARD), such as available NP blended PAG and non-PAG strata in an unsaturated embankment or pile. An evaluation of these other factors with an average weighted NPR less than 2.0 was not provided.*

LETTER IR 143 AND 143 ITT TABLE

EMLI understands that the weighted NPR cutoff of NPR = 1.2 to define non-PAG zones 5, 55, and 6. This did not account for other factors that may affect the on-set of ARD, such as available NP blended PAG and non-PAG strata in an unsaturated embankment or pile.

1. *Provide an extended evaluation of these other factors if an average weighted NPR less than 2.0 is applied.*
2. *Provide a demonstration of the conservativeness of application of an average weighted NPR of 1.2*

RESPONSE 143 ITT TABLE

SRK has provided responses to this geoscience IR in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

The metal leaching potential of overburden may not be driven by the same processes as sulphidic mine rock ARD and as a result, basic static testing [e.g., acid base accounting (ABA) and metal content] alone may not quantify the risk associated with overburden. The proposed geochemical characterization and monitoring program must also include testing methods to assess the metal leaching potential.

LETTER IR 145 AND 145 ITT TABLE

Conduct a geochemical characterization and monitoring program using methods to assess the ML potential.

a) Specify what additional methods will be employed as part of the geochemical characterization and monitoring program to characterize the metal/contaminant leaching potential at the expected pH of the material on the mine site.

b) b) Evaluate the metal/contaminant leaching potential and duration at the expected pH from the samples already collected to characterize the overburden.

RESPOSNE 145 ITT TABLE

SRK has provided responses to this geoscience IR in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

FOLLOWUP COMMENTS

Follow up to 146 ITT Table

Please propose a more conservative development of the Tenas mine rock NP designation and the ARD criterion of NP/AP = 1.2 based on responses to comments EMLI 140, 142 and 143.

LETTER IR 140, 142, 143, 146, and 145, AND 140b ITT TABLE

a) *Propose a more conservative development of the Tenas mine rock NP designation and the ARD criterion of NP/AP = 1.2.*

EMLI Clarification provided on April 18, 2024

The EMLI request is requesting the proponent to determine a more conservative approach to define PAG strata for the Tenas Project. The request is based on the individual IRs provided in the Round 2 EMLI Geoscience IRs 140, 142, 143 and 146. The request may be fulfilled by revising the approach to calculate available NP and/or revising the NP/AP criterion for PAG strata. It may be best summarized by point 3 of IR 143 outlined below.

SRK has provided responses to this geoscience IR in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

Telkwa Mining contracted SRK to provide a scientifically defensible NPR criterion for segregating *non-PAG* material from PAG material for the planning/regulatory and operational verification phases based on site-specific data for the Tenas Deposit and best practices provided in the MEND (2009) prediction manual for drainage chemistry from sulphidic geologic materials.

SRK determined that a site-specific NPR cut off criteria of 1.20 for this deposit was appropriate to characterize blasthole rock as PAG (NPR less than 1.2) or *non-PAG* (NPR greater than or equal to 1.2). However, Telkwa Mining has elected to use a more conservative NPR criterion of 2.0 as a cut off versus the site-specific value of 1.20 to identify exploration drillhole and blasthole rock as PAG and *non-PAG*. This criterion was selected to ensure that Telkwa Mining will not classify PAG rock as *non-PAG* rock. This criterion will be reviewed as additional information is gathered for the permitting application at which point if the data supports it, Telkwa Mining will apply to revise the proposed NPR criterion.

The following provides a clear definition for the NPR cut off criterion used for the Tenas Project.

Planning, Regulatory, and Operational Stages

For mine planning processes, regulatory submissions such as the EAC application and operational verification testing, an NPR cut off criteria of 2.0 will be used to segregate *non-PAG* from PAG in exploration drillhole and/or blasthole. All rock with an NPR value less than 2.0 will be designated as PAG while rock having an NPR >= 2.0 will be classified as *non-PAG* based on verification testing specified in the ML/ARD management plan attached in **Appendix 17: Metal Leaching/Acid Rock Drainage Management Plan, SRK**.

Non-rock materials such as surface soils, overburden, processed coal, processed rock, and run-of-mine coal were characterized as PAG or *non-PAG* also using a cut-off of 2.0.

FOLLOWUP COMMENTS

FOLLOWUP COMMENTS LETTER IR 153 AND 153 ITT TABLE

EMLI understands that precipitation of these mineral phases, and the predicted concentrations, will be validated through operational water quality monitoring.

1. *Specify how the minerals or other attenuation processes identified through speciation modelling will be confirmed by mineralogical or geochemical characterization of the material.*

RESPONSE 153 ITT TABLE THEME #1

SRK has provided responses to this geoscience IR in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

FOLLOWUP COMMENTS

LETTER IR 153 AND 153 ITT TABLE

2. *Describe the field or laboratory studies that will be conducted to validate these assumptions (e.g., field barrel program).*

RESPONSE 153 ITT TABLE THEME #2

Telkwa Mining initiated a field barrel program in October of 2019 and includes a discussion of the available results up to October 2023 which is four years of data. The report is provided in **Appendix 3: Geochemical Field Barrel Results Interpretation, SRK**. Key findings of this program are:

- After four plus years of testing only one barrel has gone acid using material from the drill program.
- Source terms for some parameters were updated in the Final EAC Project Case (2024) to reflect what the monitoring has shown to date.

Telkwa Mining will continue monitoring the barrel samples for the foreseeable future with SRK providing a follow up analysis every 2 to 3 years.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

Additional sensitivities are needed to refine the water quality modelling predictions:

- *Exposed PAG rock in the management pond during a period of early closure;*
- *PAG rock exposures on pit wall;*
- *Upper-case prediction that is representative of challenging blasting conditions that could lead to higher nitrogen loading to blasted rock.*

LETTER IR 154, 157, AND 161 AND 154a ITT TABLE

1. *Prepare a sensitivity within the WLBM to evaluate how a 4-meter thickness of PAG rock left exposed in a management pond during a period of early closure would affect water quality.*
2. *Provide a sensitivity in the water quality model to allow PAG exposures on pit wall to understand how exposure of PAG may affect downstream water quality.*
3. *Develop an upper-case prediction that is representative of challenging blasting conditions that could lead to higher nitrogen loading to blasted rock.*

RESPONSE LETTER IR 154, 157, AND 161 AND 154a ITT TABLE

SRK has provided responses to this geoscience IR in **Tenas Project – Water and Load Balance Modeling Report (Updated 2025), SRK**.

FOLLOWUP COMMENTS

LETTER IR 154, 164 AND 154, 164 ITT TABLE

1. *Clarify what loading rates were used for developing mine rock source terms, including differences in Table 2-6 and Attachment 2 and Table A-4.*
2. *Provide annual non-PAG material quantities required to construct the embankments and the location of where this material will be sourced.*

RESPONSE LETTER IR 154, 164, AND 154, 164 ITT TABLE

SRK has provided responses to this geoscience IR in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

EMLI understands that the App 13.5 reports that calcite precipitation is likely to occur in seepage from mine site facilities and in site water management ponds in varying degrees during operations, closure, and post-closure. However, predictions indicate that calcite precipitation is not expected to occur downstream of the proposed project footprint based on current observations and baseline concentrations. Additional information should be provided on:

- *The demonstration that calcite precipitation is not expected to occur downstream of the proposed project including all seepage and surface pathways.*
- *The mechanisms that might lead to calcite precipitation.*
- *Proposed calcite monitoring, management plan, and contingency measures to prevent or treat the onset of calcite precipitation downstream of the project discharge.*

174 LETTER IR AND ITT TABLE

EMLI understands that, based on the conclusions made in Appendix 13.5-K, calcite precipitation is likely to occur in seepage from mine site facilities and in site water management ponds in varying degrees during operations, closure, and post-closure. However, predictions indicate that calcite precipitation is not expected to occur downstream of the proposed project footprint based on current observations and baseline concentrations.

1. *What are the uncertainty and gaps around the current assessment that calcite precipitation is not expected to occur downstream of the proposed project footprint based on current observations and baseline concentrations? Please describe how the baseline observations and related conclusions relate to the projected load from the mine and propose recommendations to address these uncertainties and gaps.*
2. *Please update the calcite conceptual model provided in App 13.5K to include seepage pathways through groundwater or provide a rationale for its omission.*
3. *Provide clarifications on the mechanisms and likelihood of calcite precipitation in the immediate downstream environment including all pathways (i.e., surface and groundwater) below the end-of-pipe discharge location in Goathorn Creek.*
4. *Provide details of the calcite monitoring and management plan to prevent onset of calcite precipitation downstream of the project discharge and contingency measures to be implemented if specific triggers on the mine site are reached.*

RESPONSE 174 ITT TABLE

SRK has provided responses to this geoscience IR in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

FOLLOWUP COMMENTS

175 ITT TABLE

EMLI is consulting with ENV on water quality monitoring and water management measures for this project. Telkwa Coal will need to propose conceptual design of management structures as part of the current application to demonstrate that the Project as proposed is capable of managing water not suitable for discharge and meeting WQGs.

176a ITT TABLE

EMLI understands that ENV's review of the surface water quality effects assessment and proposed water quality benchmarks is ongoing. EMLI notes that based on that review additional water quality mitigation for the Project may be required. Should water treatment or other mitigation measures be proposed for the Project, EMLI will review the information at that time. Telkwa Coal is encouraged to engage as soon as possible with EMLI on any proposed water treatment, especially if any passive or semi-passive technologies are proposed.

IR LETTER OVERVIEW

Additional conceptual design of alternative treatment options, mitigation measures, and management structures are needed to prevent the discharge of water that is not suitable for release to the environment.

LETTER IR 176 AND 176b ITT TABLE

1. *Provide conceptual design of alternative treatment options, mitigation measures, and management structures that can manage water not suitable for discharge and that meet BC WQGs.*

RESPONSE 176 ITT TABLE

This was previously addressed by IR **Theme 1 RESPONSE IR 175, 176b, 514, 350, 353, and 355** above.

Telkwa Mining believes the details above and the attached appendices address the requirements set forth in IR **Theme 7**.

THEME 8: EMLI GEOTECHNICAL CLARIFICATIONS

FOLLOWUP COMMENTS

IR LETTER OVERVIEW

The proponent does not identify the processed rock waste as tailings and does not identify the North, East, and West Management Ponds as tailings storage facilities (TSFs). As per the Health, Safety and Reclamation Code for Mines in British Columbia (the Code), the definition of "tailings" is: "the residue remaining from the preparation of a concentrate of minerals or coal;" and a "tailings storage facility" (TSF) is: "a facility that stores tailings." As per these definitions, the "processed rock" described in the Application is considered tailings and the North, East and West Management Ponds are TSFs.

- *TSFs have different minimum requirements than water dams in BC, including, but not limited to, minimum factors of safety, minimum design requirements for larger flood (return event and duration) and seismic events, downstream slopes, and many other requirements related to water management, performance, monitoring and surveillance, governance, etc.*

RESPONSE IR LETTER OVERVIEW

Telkwa Mining and SRK classified the management ponds as water holding ponds versus tailings storage ponds due to the following reasons:

- Embankment construction does not use tailing materials as a construction material but rather used engineered specified materials from mining activities;
- The ratio of PAG rock to processed rock (tailings) is approximately 11.25 to 1 on a volume basis so PAG rock will be the predominant material dictating performance of the materials contained within the embankment;
- Processed rock did not match definition of tailings provided by Vick; and,
- Processed rock is dewatered to less than 25% moisture prior to placement within the management ponds.

However, even though Telkwa Mining and SRK did not classify the management and control ponds as tailings storage facilities, due to the size of the management and control ponds, closeness to population centers such as the Village of Telkwa, and fish habitat Telkwa Mining/SRK utilized the guidelines for design requirements that matched the tailings pond design guidelines as these were the most conservative parameters to reference as summarized by **Table 2-23** below.

Table 2-23: Canadian Dam Association Guidelines for Design of Tailings Dams[1]

Dam Class	Annual Exceedance Probability - Floods[2]	Annual Exceedance Probability - Earthquakes	Minimum Static Factor of Safety			Downstream Slope No Steeper Than
			End of Construction	Long Term	Full or Partial Drawdown	
Low	1/3 between 1/975 and PMF	1/2,475	1.5	1.5	1.5	2H:1V
Significant	1/3 between 1/975 and PMF	1/2,475				
High	1/3 between 1/1,000 and PMF	1/2,475				
Very High	2/3 between 1/1,000 and PMF	½ between 1/2475 and 1/10,000 or MCE				
Extreme	PMF	1/10,000 or MCE				

Notes:

1. Adapted from CDA Dam Safety Guidelines, 2013. Further context and guidance provided there.
2. The Code required that a facility that stores the inflow design flood use a minimum event duration of 72 hours.

Source: BC MEMLI 2022

MCE=Maximum Credible Earthquake; PMF=probable maximum flood.

Telkwa Mining has adopted a more conservative approach to the design of the management ponds than is required for even some of the parameters for a Tailings Storage Facility (TSF).

For example, the Factor of Safety (FOS) that Telkwa Mining has put in place is 1.60 for all periods versus 1.50 provided in **Table 2-23** above and a downstream slope no steeper than 3H to 1V and an upstream slope no steeper than 2.5H to 1V versus 2H to 1V downstream requirement specified by **Table 2-23** above.

Given their proximity to the Village of Telkwa, the more stringent requirements of TSF embankments will be applied to management and control pond embankments regarding but not limited to the following parameters:

- minimum FOS;
- minimum design requirements for larger flood (return event and duration);
- seismic events;
- downstream and upstream slopes;
- water management;

- performance;
- monitoring and surveillance;
- governance;
- emergency response plan; and,
- etc.

Please find additional information on this IR provided in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

FOLLOW UP COMMENTS

LETTER IR 171 AND 171 ITT TABLE

The report FINAL Tenas Project Dam Breach Assessment Report dated April 2021, by SRK (Canada) Ltd., included as Appendix 1.0-AA of the Application, has not been appropriately sealed in accordance with Engineers and Geoscientists BC requirements. Provide appropriately sealed documents, as required, including the Dam Breach Analysis included as Appendix 1.0-AA of the Application.

RESPONSE 171 ITT TABLE

Please find attached **Appendix 19: Tenas Project Dam Breach Assessment Report, SRK**.

FOLLOW UP COMMENTS

IR LETTER OVERVIEW

Completion of an alternative means of undertaking the proposed project with respect to options for tailings management that considers technology, siting, and water balance has not been demonstrated.

LETTER IR 178 AND 178 ITT TABLE

Applications must include an alternatives assessment for the Management Ponds/Tailings Storage Facilities and the alternatives assessment completed should be consistent with the Guidelines for the Assessment of Alternative for Mine Waste Disposal.

1. Provide a detailed review of tailings storage alternatives assessed to support the proposed mine plan
3. Available from: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/environmental-assessments/guidance-documents/eao-guidance-tailingsmanagement.pdf
4 Available from: https://www.canada.ca/en/environment-climate change/services/managing-pollution/publications/guidelines-alternatives-mine-waste-disposal/chapter- 1.html

RESPONSE 178 ITT TABLE THEME #1

Based on the geochemical work conducted, processed rock has been classified as PAG material and as such placement of this material underwater is the recommended management strategy for this material to prevent potential ARD in the future. This was the conclusion of **Tenas Project PAG Management Alternative Means Assessment for managing this material, SRK**, provided by SRK with the EAC Application and included again as **Appendix 20: PAG Management Alternatives Assessment, SRK** with this response.

This requirement influences all future decisions with respect to this material, which is why this assessment was completed first. In response to this IR, SRK completed an **PAG Alternative Materials Storage Assessment** using the guidelines provided by Environment and Climate Change Canada *Guidelines for the Assessment of Alternatives for Mine Waste Disposal, July 2014* which is provided in **Appendix 21: Tenas Project Potential Acid Generating Material Storage Alternatives Assessment, SRK**. Based on the guidelines a multiple-stage process was completed as follows:

1. Step 1 involved completing a screening exercise to determine potential viable location for the storage of materials.
2. Step 2 involved completing a Multiple Accounts Analysis (MAA) for the identified preferred locations and configurations to identify the preferred option going forward.
3. Step 3 involved completing a sensitivity analysis to determine if the preferred option was robust enough to remain the preferred option under several conditions.

Figure 2-20 and **Figure 2-21** below illustrate the results of the MAA and sensitivity analysis which demonstrated that the option submitted in the EAC Application was the preferred option to carry forward into detailed design during the permitting phase of the Project.

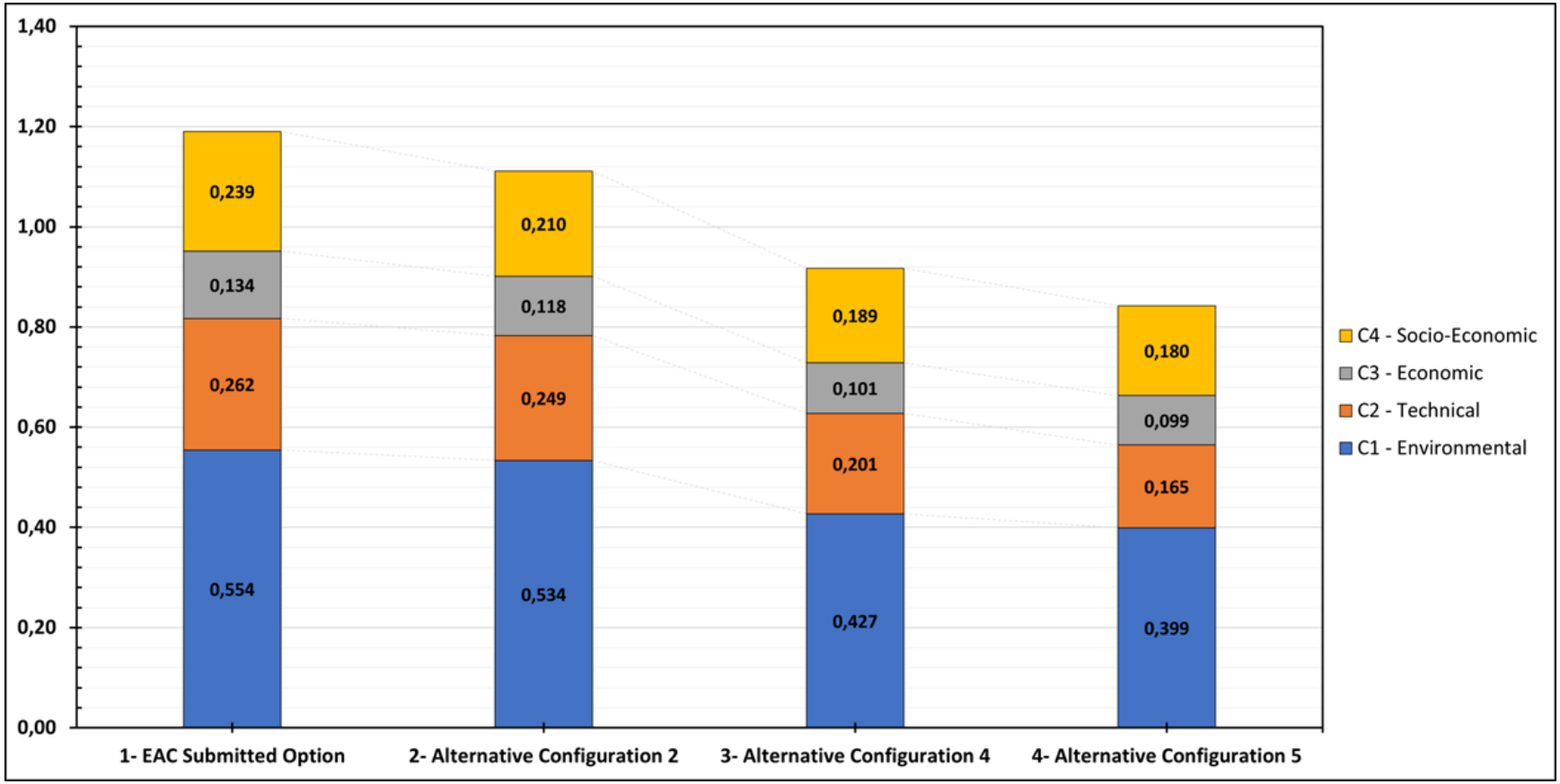


Figure 2-20: Multiple Accounts Analysis Results of the Final EAC Project Case (2024) Location versus Alternatives

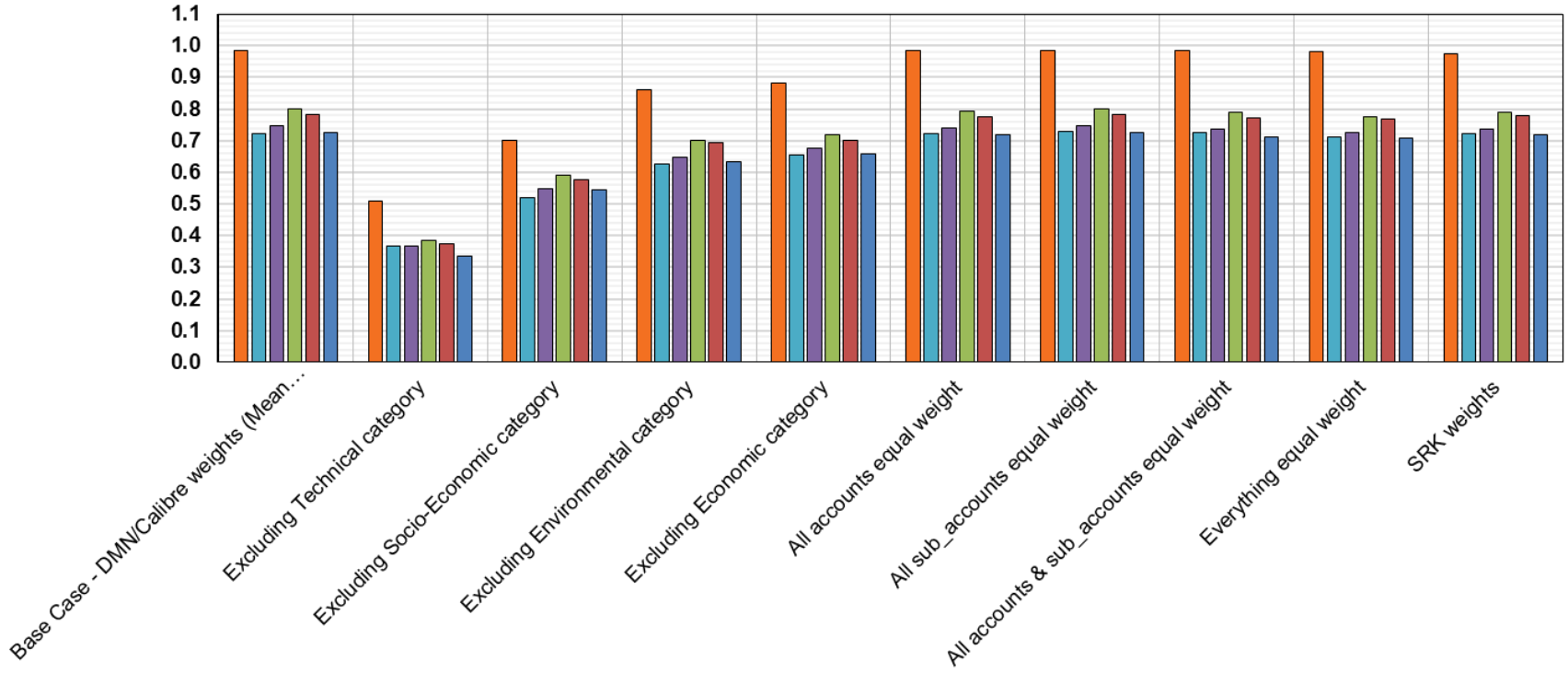


Figure 2-21: Multiple Accounts Analysis Sensitivity Results of the Final EAC Project Case (2024) Location versus Alternatives

Please find additional information on this IR provided in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

FOLLOWUP COMMENTS

OVERVIEW LETTER IR

Results of the Dam Breach Analysis (DBA) does not clearly support the selected Consequence Classification Ratings for Dams or the seismic design criteria required by the Code given that the DBA reports that over 100 people could be impacted or at risk in the event of a breach of one of more of the management pond embankments. The Consequence Classification and seismic design criteria are lower than what is anticipated from the results of the Dam Breach Analysis, which could result in use of design criteria that are not consistent with regulatory requirements or accepted industry practice.

LETTER IR 181 AND FOLLOW UP 181 ITT TABLE

1. *Provide justification for the selection of the failure scenarios considered, including descriptions of the findings of all cascading failure modes/scenarios assessed.*
2. *Provide justification for selection of a "Very High" Consequence Classification given the findings of the Dam Breach Analysis that over 100 people could be impacted or at risk in the event of potential failure or breach of one or more of the management pond embankments.*
    a. *Include the relevant TSF regulations and guidelines that support this determination.*
    b. *Indicate what evaluation of possible environmental impacts due to the release of the contents of the North, West or East Management Ponds was used as a basis for selection of Consequence Classification. The environmental impacts should be consistent with the current understanding of the project (PAG tailings, etc.) and include appropriate references to the sources of information considered.*
3. *Provide justification for selection of the TSF design flood events (Inflow Design Flood and Environmental Design Flood). Include the relevant TSF regulations and guidelines that support this design event selection.*
4. *Provide justification for selection of an earthquake with a return period of 1 in 2,475 years for the Management Ponds/TSFs stability assessment. Include the relevant TSF regulations and guidelines that support this design event selection.*

RESPONSE FOLLOW UP 181 ITT TABLE

Please find additional information on this IR provided in **Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK**.

Telkwa Mining believes the details above and provided in attached appendices address the requirements set forth in IR **Theme 8**.

3. FIRST NATION FEEDBACK

The Office of the Wet'suwet'en (OW) provided comment on these submissions on February 28, and March 12, 2025, which are summarized in

Table 3-1 below. Responses have been provided in **Appendix 22 Tenas Project Information Request Responses from Office of the Wet'suwet'en – Final, SRK**.

Telkwa Mining is expecting further input could be provided from Wet'suwet'en during their Assessment Process. Where modifications or clarifications of responses are appropriate Telkwa Mining will provide supplemental information to both the EAO and OW.

Table 3-1: February 28, March 12, and May 15, 2025, Comments from OW

Comment ID	Master ITT Comment ID (BC EAO)	OW Comment from Feb 28 or Mar 12 Letters/Report	OW Recommendations from Feb 28 or Mar 12 Letters/Report
OW-011	175, 176, 307, 350, 353, 355, 356, 514	As mentioned, a presentation from TML is welcome. However, OW has its own priorities and objectives related to protecting aquatic resources in the territory. OW is working to identify Project-related issues related to water quality, water and load balance modeling, water treatment, and hydrology.	To address this IR, the Proponent should: • Provide all the information requested in OW's forthcoming responses to TML's IR responses. • Consider forthcoming information from OW regarding how all concerns related to Project impacts on aquatic resources have been identified and characterized. • Consider forthcoming information from OW regarding whether monitoring and mitigation plans are adequate to address adverse impacts to aquatic resources. Impacts to water may also be considered in the RIA being conducted by OW. This IR will remain open until OW is satisfied with how information from the RIA and the outcomes of OW's review of TML documents and engagement with TML on this issue are incorporated into Project monitoring, mitigation, and adaptive management plans.
OW-038	350 and 351	The Proponent provides 11 mitigation options (6 single treatment options and 5 that are combinations of 3 or more of the single treatment options) and models the results. The results show options for reduction of max monthly concentrations and reduction of WQG for Four Creek and Tenas Creek. All of the viable options for reduction include a combination of multiple treatments and would result in some periods of time of reduced downstream natural streamflow.	The Proponent provides viable options for reducing concentrations of selenium, sulfate, cadmium, and nitrate/nitrite including a combination of multiple treatments. In some cases (Table 9), exceedances still occur (e.g., selenium, nitrate) at the end of pipe, even when multiple treatments are applied, particularly from the Tenas Control Pond. While the right combination of mitigation treatments will definitely improve downstream water quality, there are impacts to local streamflow and in some cases other constituents (e.g., increases in selenium). The most concerning reductions in streamflow for both Tenas and Four Creek are during late summer months (August) and winter baseflows. It doesn't appear that these reductions in streamflow have been modelled within the Water Load Balance Model to predict how the lower flows will impact downstream WQ at prediction nodes, although reduced concentrations in surface and groundwater should help, reduced water flow could end up balancing that reduction and total constituent loading may ultimately not change much. This warrants further investigation. To resolve these issues, TML must: • Provide more information on how the reduction of water flow in the Tenas and Four Creek is involved in mitigations for reducing concentrations of selenium, sulfate, cadmium, and nitrate/nitrite; • Provide data for how this reduction is incorporated into the Water Load Balance Model to predict how the lower flows will impact water quality downstream, especially during late summer months (August) and winter baseflows; • Provide more information on the proposed water mitigations, including the reliability and risks of each option associated with failure of effective treatment, in addition to the expected beneficial change and the expected consequences of each treatment option;
OW-039	350 and 351	As above, the Proponent provides 11 mitigation options and describes aspects of treatment efficiency and effectiveness for each option, including modelled water quality outcomes. The Proponent provides information on the expected beneficial change and the expected consequences of each treatment option but does not provide risks associated with failure of effective treatment.	The reliability and risks of each option are not discussed, and very little information is provided on situations where the mitigation option may be less effective/ ineffective (i.e., high, or low run off conditions, liner failure, etc.). The water treatment plan option (Control 5) appears to be one of the most effective options, particularly when combined with other options. However, the design details of the water treatment plant have not been developed (which the proponent acknowledged in the document), and the reductions in constituent concentrations are only assumed. This would require additional storage and appropriate treatment rates, along with additional energy and waste disposal costs. As water treatment, in combination with other approaches, is the most effective way of reducing exceedances from the ponds, this option should be pursued but TML must provide more information on the details of that process (including detailed operations of the treatment facility over time, energy and water use, and efficiency of treatments, etc.). TML must provide further information on alternative treatment plans and outcomes that describe how the water treatment facility would be designed, what standards would be used, the operation, and the duration.
OW-040	356	The Proponent developed a new node (WQSEA1) of water quality measures for the Water and Load Balance Model (WLBM), 100 m downstream of the confluence with the unnamed tributary for Project discharge on Goathorn Creek. The Proponent developed and ran new WLBM scenarios to review the impacts of changes in seepage rates on expected water quality and says, "Water quality results will be presented at the new node (WQSEA1), WQS06, WQS05, WQS04, and WQS03_DS with the Final EA Water and Load Balance results". We have been unable to find the aforementioned document containing the results. There were some errors in the figure from the WLBM report (Fig 2.2-2.4 of App 4.3) that showed incorrect connections of the three creeks (Four	We are unable to find the documents containing the results of this IR response, "Final EA Water and Load Balance results", or Attachment IR 356-1 as the IR response does not provide further information regarding where these documents are located. We are unable to find any documents with that name in the review materials provided to us and therefore could not review the IR. Please provide these documents, including figures for each of the requested scenarios in the IR (Tributary receiving discharge above confluence with Goathorn Creek, and Goathorn Creek below confluence with tributary receiving discharge); projected water quality from baseline through to post-closure; and updated figures from the WLBM report (Fig 2.2-2.4 of App 4.3) that showed incorrect connections of the three creeks (Four Creek, Tenas Creek, Goathorn Creek).

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		Creek, Tenas Creek, Goathorn Creek), but the proponent claims the errors in the figure were NOT incorporated into the model and that the model correctly accounts for the mixing of streams. There are final figures presented in Attachment IR 356-1; however, we also cannot find this document as the attachment with that name at the end of App F contains no information. We are also unclear whether this is the location of the other results the authors describe (e.g., figures for each of the requested scenarios and projected WQ from baseline through to post-closure). Because we were unable to locate this document, we could not completely review the response to the IR.	
OW-041	NEW	Same comment as previous. The Proponent developed a new node (WQSEA1) of water quality measures for the Water and Load Balance Model (WLBM), 100 m downstream of the confluence with the unnamed tributary for Project discharge on Goathorn Creek. The Proponent developed and ran new WLBM scenarios to review the impacts of changes in seepage rates on expected water quality and says, “Water quality results will be presented at the new node (WQSEA1), WQS06, WQS05, WQS04, and WQS03_DS with the Final EA Water and Load Balance results”. We have been unable to find the aforementioned document containing the results. There were some errors in the figure from the WLBM report (Fig 2.2-2.4 of App 4.3) that showed incorrect connections of the three creeks (Four Creek, Tenas Creek, Goathorn Creek), but the proponent claims the errors in the figure were NOT incorporated into the model and that the model correctly accounts for the mixing of streams. There are final figures presented in Attachment IR 356-1; however, we also cannot find this document as the attachment with that name at the end of App F contains no information. We are also unclear whether this is the location of the other results the authors describe (e.g., figures for each of the requested scenarios and projected WQ from baseline through to post-closure). Because we were unable to locate this document, we could not completely review the response to the IR.	We are unable to find the documents containing the results of this IR response, “Final EA Water and Load Balance results”, or Attachment IR 356-1 as the IR response does not provide further information regarding where these documents are located. We are unable to find any documents with that name in the review materials provided to us and therefore could not review the IR. Please provide these documents, including figures for each of the requested scenarios in the IR (Tributary receiving discharge above confluence with Goathorn Creek, and Goathorn Creek below confluence with tributary receiving discharge); projected water quality from baseline through to post-closure; and updated figures from the WLBM report (Fig 2.2-2.4 of App 4.3) that showed incorrect connections of the three creeks (Four Creek, Tenas Creek, Goathorn Creek).
OW-042	NEW	The IR document says, "In summary, the background water quality inputs used in the EAC Project Case (August 2022) were monthly mean values while seasonal values are used in both the Updated and Final EAC Project Cases (2024)". However, in Appendix F, Section 4.18.2, SRK says "The EA WLBM used statistics from the full water quality baseline monitoring record, including the 50th percentile and 95th percentile for each stream. Monthly or seasonal background source terms were not used". This is relatively confusing as responses in the IR in different locations are providing different answers to the initial question. In Appendix F, they follow up by saying they generated new baseline statistics for the Final EAC Project Case (2024) based on updated data, including a new 50th percentile for the winter months and a 50th percentile for the "rest of the year" (May to October). They say the Final EA Water and Load Balance Report will include the seasonal source terms for background concentrations on the in-stream water quality conditions, so we assume this is the 50th percentile or the median. However, it is unclear if this will be presented as the main WQ prediction scenario or alternative assessment scenario(s). We were unable to locate the document referred to as Final EA Water and Load Balance Report to further review.	Reporting the use of different time scales is troublesome, especially in a region with high seasonal variability. The caching of all "open water" months into one "summer season" is not appropriate as there are very different climate and ecosystem processes influencing or influenced by spring vs summer vs fall water quality dynamics. The use of one seasonal value may be skewed by over-represented high or low values that occur during more months, and therefore not representative of periods exhibiting seasonally low or high values. Monthly values would be more appropriate to capture full seasonal variability. Please provide this information. In addition, we were unable to fully review this IR because we could not locate the referenced document "Final EA Water and Load Balance Report". Please provide this information.
OW-043	NEW	Some of the sedimentation ponds that discharge to the natural ground were not included as part of the WLBM in the EAC application (the proponent lists 6). Four of the ponds are lined with impermeable geomembrane liners or equivalent and the remaining 2 are unlined. They were not considered in the site water and load balance model when it was developed because: 1) they are geographically separate from the EA Open Pit, management and control ponds, and material storage pile water management systems, 2) they are small and manage very defined catchments with low flow rates compared to discharge from mine components through Tenas Control Pond, 3) TSS is the main POC for most of these ponds but some also include nitrogen species, 4) they are designed to produce TSS well below the BC (35 vs 50 ppm) requirement so deemed protective of aquatic environment, 5) the remaining pond doesn't discharge to the environment it gets pumped	The organization of various ponds and their connectivity, as well as the lack of data associated with each pond is an obvious source of confusion in the application. This theme arises in many comments throughout the proponent’s IR response. Discharges from sedimentation ponds (excluding Tenas Control Pond/North Management Pond and Rail Infrastructure Pond) are directed towards natural ground. The Proponent plans to convey this water along natural flow pathways to eventually reach downstream watercourses. Despite use of pumps and other structures for controlled release, there is risk of overflow and higher amounts of release during high rain events, which may increase downstream erosion potential. The Proponent must provide a clear map of the location and connectivity of each pond along with an associated table that includes all the requested information from the IR.

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		to the Tenas Control Pond, and 6) they describe how they deal with material from the Explosive Magazine Pond.	
OW-044	NEW	The only discharge that will be directed into a stream is the Tenas Control Pond (and North Management Pond after closure). An IDZ study was prepared to evaluate discharge from Tenas Control Pond, which found that discharge would not be acutely toxic. This discharge was simulated in the Water and Load Balance Model to quantify the expected effect in streams. They do not reference the IDZ study used to evaluate discharge, so we were unable to review in the context of this IR. The Proponent ensures that when the ponds are discharging, they will be monitored on a “regular basis” (frequency not mentioned) and monthly when not discharging. Monthly monitoring proposed with various (3) "action steps" proposed to address WQ exceedances if they should occur. Some of these involve reactions to chemical parameter exceedances of BC WQG over a "period of months".	Note that an IDZ will not be considered during permitting without an adequate BAT assessment. Given that a new BAT assessment has been performed with alternative treatment options, the IDZ study would need to be redone to account for water quality differences derived from various different treatment options. The comment does not address the need to also evaluate cumulative effects around the IDZ. In addition, the proposed frequency of monitoring for exceedances is inadequate given the risk to downstream fish. These ponds will be monitored monthly to evaluate toxicity results against authorized limits for lethality of Rainbow Trout. If exceedances exist, a number of actions are proposed to reduce exceedance, but given the frequency of monitoring (monthly) and the amount of time required for implementation of the proposed actions, it is possible exceedances (and downstream negative effects) could persist for a substantial amount of time (months) before any resolution. This presents a considerable prolonged threat to fish and ecosystem health. TML must correct these discrepancies.
OW-045	520	There are no lentic (i.e., lakes or ponds) water bodies located in the near-field or far-field receiving environments of the Project.	The concern here is sedimentation and conversion of selenium species, so there may be opportunities for this in micro-lentic environments such as back channels and pool environments along the stream course, but according to the proponent in this local study and regional study region there are no lentic environments.
OW-046	176	Mitigation control scenarios are discussed and compared, including the pros and cons of expected changes in water quality. The most effective treatments for reduction of selenium and nitrate-nitrite in both control ponds are combinations of multiple mitigation strategies, many of which include the strategy of water quality treatment (listed as "mitigation control 5").There are no plans or outcomes developed that describe how the water treatment facility would be designed or operate, some of the benefits are based on assumed targets met through treatment.	However, there are no actual plans or outcomes developed that describe how the water treatment facility would be designed or operate, some of the benefits are based on assumed targets met through treatment. This is acceptable but should be fleshed out further, and it should be confirmed that these targets can actually be met if this is considered a feasible option. The Proponent is also assuming the water quality treatment would persist past the end of closure as the model shows results out to 2100. Additional information on water treatment facility is needed (design, standards, operation, and duration) and should not be assumed if this is considered as an option, in conjunction with other mitigation strategies (it is included on the list of combined best options). There are also effects on streamflow in Four and Tenas Creek, which should be explored more with the water load balance model. Goat Creek was not included in the model outputs, although this is acknowledged by the authors. Impacts on Goat Creek should be included in additional assessment of further mitigation strategies.
OW-047	154, 157, 161	The Proponent claims that the evaluation of how a 4-meter thickness of PAG left exposed in a management pond would affect water quality is not possible because of the way the pumping system is set up and that the management ponds are always built ahead of PAG placement to ensure that the PAG is below water level. We are concerned that the Proponent dismissed this request saying that under properly managed scenarios this would not be a concern. "	We are concerned that the Proponent dismissed this request saying that under properly managed scenarios this would not be a concern. However, it doesn't provide information on the effects of exposed PAG to water quality under scenarios where the management pond techniques fail, such as failure of a pond dam or failure of the pumping system to work as designed. The Proponent must provide this information and include scenarios in the water quality model for estimating impacts where management actions fail, to provide a clear picture of the downstream impacts of PAG under less-than-ideal conditions, but conditions that could possibly occur if there are situations where proper management cannot occur (failure of pumping system or pond dam, or some other instance where a 2m cover of water cannot be maintained).
OW-048	154, 157, 161	It is unclear where the information is associated with this IR. Within App D they cite a ""SRK 2024a"" (page 16) with the results of the model output using the various source terms but the reference is not included at the end of the document under ""References"". Appendix A- Water Balance Report. contains source terms but has not been updated to include a sensitivity like requested in the IR.	We were unable to review this IR responses as we were unable to find the supporting information. Please provide this information.
OW-049	174	The predictions provided in SRK (2022d) indicate that calcite is not expected to form in downstream tributaries since predicted alkalinity, calcium and magnesium concentrations are like existing conditions and there is currently no visual evidence of calcite precipitation even though surface water in these drainages is supersaturated with respect to calcite under baseline conditions. Because of this, they suggest that site-specific Saturation Indices (SI) may need to be developed once sufficient monitoring data are available. They describe how if calcite formation is identified as part of the operational monitoring program, TML will develop a mitigation plan that will be submitted to EMLI for approval. The most common calcite prevention mitigation strategy is	1. The response to the IR states that the estimated SI do not suggest calcite precipitation, but detailed discussion is not in the reference. They do not specify what additional monitoring data is required for site-specific calculation of site-specific SIs for calcite. Is TML referring to monitoring data from this post-project operations, or baseline data? It is unclear where in the referenced SRK (2022d) document they specifically address calcite, as the term “calcite” only appears once in the document. TML must update the Discharge Management Plan and provide further information on how operation and a post-closure increase in conductivity in ponds and the receiving environment will affect the SI for calcite and predictions for precipitation. 2. Higher pCO2 in groundwater will be more likely to precipitate calcite at possible groundwater seepage locations (contact with atmosphere). Some accounting for this should be included in the conceptual model.

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		addition of antiscalant to site effluent. This would be the most likely mitigation strategy should it be required. They also say there is no need to include groundwater seepage in the conceptual model as there is no reason for CO2 off-gassing to occur along groundwater pathways at the Project, and calcite is therefore not expected to precipitate in groundwater pathways.	3. Within the referenced SRK 2022d (Tenas Project Water and Load Balance Modeling Report REV1), we cannot find discussion of calcite precipitation, including mechanisms, contributing factors, predictions, etc. The response to the IR states that the estimated SI do not suggest calcite precipitation, but detailed discussion on this topic is not in the reference. According to the IR response, "predictions provided in SRK (2022d) indicate that calcite is not expected to form in downstream tributaries since predicted alkalinity, calcium and magnesium concentrations are like existing conditions". However, there are multiple examples of increases in alkalinity and magnesium (in particular) in the load model. Therefore, TML must explore conditions in terms of potential for calcite precipitation. 4. There is no plan, other than including calcite in the surface water quality monitoring program. If calcite formation is observed, then they will develop a mitigation plan. This plan will likely include mitigation using antiscalants. The proponent does not discuss this option further but should include considerations and possible impacts and interactions of the use of antiscalant for reducing calcite precipitation considering the high background conditions of aluminum in these watersheds.
OW-050	181	The statement "The effect of the rainy-day breach on aquatic habitat is low given the PMF/Q200 conditions already present" is not supported given the discharge at the mouth of Tenas Creek is estimated to be 1100 m^3/s in comparison to a PMF of 168 m^3/s, and that maximum water velocity and rate of discharge increase from a flood wave are not accounted for. However, we do agree that the risk to aquatic life for a breach of the East Dam or West Dam should be 'Very High' due to the likelihood of major long-term deterioration of critical steelhead spawning habitat. We believe that the 'Very High' classification would be more appropriate for a breach of the North or Tenas Dams as well given the likelihood of major long-term deterioration of critical steelhead spawning habitat in Tenas and Goathorn Creeks.	Given the likelihood of major long-term deterioration of critical steelhead spawning habitat in Tenas and Goathorn Creeks, a 'Very High' risk classification should be used for a breach of the North Dam or Tenas Dam.
OW-118	NEW	To help OW better assess how TML is protecting the Environmental Flow Needs, provide details on how and/or TML will manage flows to avoid high risk levels and maintain environmental flow needs (reduction of <10% of mean average by season) during operation. To help OW better assess how TML is protecting the Environmental Flow Needs, provide details on how and/or TML will manage flows to avoid high risk levels and maintain environmental flow needs (reduction of <10% of mean average by season) during operation.	Commit to appropriate planning for contaminant areas, which requires a proactive approach to mitigating contaminant leakage (rather than attempting to mitigate once problems have been identified);
OW-120	NEW	To help OW better assess how TML is protecting the Environmental Flow Needs, provide details on how and/or TML will manage flows to avoid high risk levels and maintain environmental flow needs (reduction of <10% of mean average by season) during operation. To help OW better assess how TML is protecting the Environmental Flow Needs, provide details on how and/or TML will manage flows to avoid high risk levels and maintain environmental flow needs (reduction of <10% of mean average by season) during operation.	Consider the appropriateness of water and load balance models and correct seepage migration rates and timing of peak contaminant concentrations;
OW-122	NEW	For Surface Water, Ground Water, and Aquatic Resources VCs, TML must:	Provide the cited document in Appendix D: "SRK 2024a" (page 16), which is missing from the end of the document under "References". Appendix A- Water and Load Balance Model Report.
OW-123	NEW	For Surface Water, Ground Water, and Aquatic Resources VCs, TML must:	Update the Discharge Management Plan - Calcite Precipitation document to include: • How operation and a post-closure increase in conductivity in ponds and the receiving environment affect the Saturation Indices (SI) for calcite, and predictions for precipitation; • Accounting for higher pCO2 in groundwater, which is more likely to precipitate calcite; • Further accounting for increased calcite precipitation in instances where alkalinity and magnesium in the water increase; and • A separate calcite monitoring and management plan, which considers possible impacts and interactions of the use of antiscalants for reducing calcite precipitation, considering the high background conditions of aluminum in these watersheds.
OW-124	NEW	For Surface Water, Ground Water, and Aquatic Resources VCs, TML must:	Provide additional information and figures for the Water and Load Balance Model Report that we have not been able to locate, including: • Final figures presented in "Attachment IR 356-1 as the attachment with that name at the end of App F contains no information;

Comment ID	Master ITT Comment ID (BC EAO)	OW Comment from Feb 28 or Mar 12 Letters/Report	OW Recommendations from Feb 28 or Mar 12 Letters/Report
			• Figures for each of the requested scenarios in the IR (Tributary receiving discharge above confluence with Goathorn Creek, and Goathorn Creek below confluence with tributary receiving discharge) and projected water quality from baseline through to post-closure; • Updated figures from the WLBM report (Fig 2.2-2.4 of App 4.3) that originally showed incorrect connections of the three creeks (Four Creek, Tenas Creek, Goathorn Creek); and • TML's response to the IR, labelled "Final EA Water and Load Balance results", or Attachment IR 356-1.
OW-125	NEW	For Surface Water, Ground Water, and Aquatic Resources VCs, TML must:	Use climate change predictions in the understanding of potential impacts throughout the operation and post-closure periods (e.g., changes in flow and changes in stream temperature due to changes in flow and air temperature).
OW-126	NEW	For Surface Water, Ground Water, and Aquatic Resources VCs, TML must:	Resolve outstanding technical questions regarding PAG Rock management and seepage including: • If PAG rock is to be submerged prior to the onset of ARD/ML, why would seepage tailings facilities contain the products of ARD/ML? • How much seepage is expected out of tailings facilities, both in groundwater and in surface water?

4. CLOSING

Thank you again for providing Telkwa Mining with the opportunity to respond to the Water Quality IRs from ENV and MEMLI. Telkwa Mining believes the responses provided close out the information requests that fall under Items 1 through 8. If there are any further questions or concerns, please do not hesitate to contact me.

Sincerely Yours,



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Cc: File

5. ATTACHMENTS

BC EAO AND OFFICE OF THE WET'SWUET'EN INFORMATION REQUESTS

Appendix 1: Tenas Project, Water and Load Balance Modeling Report (Updated 2025), SRK
Appendix 2: Tenas Project, Hydrometeorological Baseline and Model Development Report (Update 2025), SRK
Appendix 3: Geochemical Field Barrel Results Interpretation – Tenas Project, SRK
Appendix 4: Updated Water Quality Model Source Terms, SRK
Appendix 5: Tenas Project - Suboxic Evaluation of Non-Acid Generating Mine Rock, Okane
Appendix 6: Tenas Project Information Request Responses Related to Surface Water Valued Component, SRK
Appendix 7: Water and Wastewater Treatment Design Report and Bionest Assurance Letter, Radloff
Appendix 8: Tenas Project, Hydrogeology Technical Report, SRK
Appendix 9: Evaluation of Acute Daphnia Magna and Rainbow Trout LC50 Toxicity Supporting Tenas Project Best Available Technology Assessment Study – Parameters of Concern: Nitrite, Iron (Total) and Iron (Dissolved)
Appendix 10: Effect of Mitigation Controls on Water Quality and Quantity of the Tenas Project, SRK
Appendix 11: Tenas Project Best Achievable Technology Assessment Updated, SRK
Appendix 12: Environmental Effects Assessment - Surface Water Valued Component

Appendix 13: Tenas Project, Initial Dilution Zone Assessment, SRK
Appendix 14: Tenas Coal Mine Information Request # 498, 500-504, and 520 - Expert Advice Regarding Fish and Fish Habitat Within the Project Area, Palmer Environmental
Appendix 15: Tenas Project, Mine Material Management Based on an NPR Cut-Off of 2.0, 1.80, 1.60, and 1.20, Telkwa Mining
Appendix 16: Telkwa Coal Tenas Project Environmental Assessment Application – Responses to 2022 Supplemental Geochemistry Information Requests from the Ministry of Energy, Mines and Low Carbon Innovation, SRK
Appendix 17: Metal Leaching/Acid Rock Drainage Management Plan, SRK
Appendix 18: Tenas Project Information Request Responses Related to Geotechnical Aspects, SRK
Appendix 19: Tenas Project Dam Breach Assessment Report, SRK
Appendix 20: PAG Management Alternatives Assessment, SRK
Appendix 21: Tenas Project Potential Acid Generating Material Storage Alternatives Assessment, SRK
Appendix 22: Tenas Project Information Request Responses from Office of the Wet'suwet'en – Final, SRK

APPENDIX 1: TENAS PROJECT, WATER AND LOAD BALANCE MODELING REPORT (UPDATED 2025), SRK

FINAL

Tenas Project – Water and Load Balance Modeling Report (Updated 2025)

Tenas Project, Telkwa, BC, Canada

Telkwa Mining Limited



SRK Consulting (Canada) Inc. ▪ CAPR002055 ▪ September 2025

srk consulting

FINAL

Tenas Project – Water and Load Balance Modeling Report (Updated 2025)

Tenas Project, Telkwa, BC, Canada

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Cover Image(s):
Photo of Goathorn Creek and unnamed tributary discharge, taken in May 2025

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The opinions expressed in this document have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. While SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

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Appendices

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Useful Definitions

This list contains definitions of symbols, units, abbreviations, and terminology that may be unfamiliar to the reader.

7Q10	7-day low flow in a 1 in 10-year return period
AIR	Application Information Requirements
BC AWQG	British Columbia Approved Water Quality Guideline
BC WWQG	British Columbia Working Water Quality Guideline
CCME	Canadian Council of Ministers of Environment
POC	Parameter of concern
CPP	Coal Processing Plant
EA	Environmental Assessment
EAO	Environmental Assessment Office
ECCC	Environment Canada and Climate Change
EDP	Effluent Discharge Permit
EMP	East Management Pond
ENV	BC Ministry of Environment and Climate Change Strategy
LSA	Local Study Area
NMP	North Management Pond
NSE	Nash Sutcliffe efficiency
PAG	Potentially acid-generating
PRISM	Parameter-elevation regressions on independent slopes model
RSA	Regional Study Area
TSS	Total suspended solids
WMP	West Management Pond
WQG	Water quality guideline
WQS	Water quality station

Executive Summary

A water and load balance model has been developed in support of the BC Environmental Assessment Certificate Application (EA) and joint application submission for a BC *Mines Act* permit and BC *Environmental Management Act* discharge permit for the Tenas Project (the Project) in northwest British Columbia. The Project consists of an open pit, a series of management ponds which will contain submerged potentially acid-generating materials, a coal processing plant, water management infrastructure, ancillary facilities, and rail infrastructure. The mine will take 1.5 years to construct and will operate for 21 years. Decommissioning and reclamation will take approximately 4 years with a further 50 years being assigned to the Post-closure phase.

Inputs to the model include groundwater modeling results, climate and hydrology datasets, performance and Operations of mining elements, water management infrastructure, catchment areas, geochemical source terms and baseline water quality. Model results provide expected and worst-case water quantity and quality, during and after mining is complete. Sensitivity analyses conducted in the model are used to understand what variables the model results are most sensitive to. Where applicable, model results were calibrated using baseline information. Results are summarized in terms of water quantity and quality changes to the surrounding watercourses which may be expected to occur in Construction, Operation, Decommissioning and Reclamation, and Post-closure phases.

Modeling was completed in GoldSim software package, which uses a daily time step and reports monthly average results. Hydrologic components of the model were calibrated to regional and local streamflow datasets and encompass interactions between surface water and groundwater. Streamflow is generated on a daily timestep based on precipitation and temperature datasets, which include an orographic gradient adjustment. Both precipitation and temperature have additional adjustments included to account for climate change, which projects an increase in temperature year-round and an increase in precipitation for most months, through the year 2100.

The load balance component is based on the conservation of mass, assuming complete mixing for each prediction node and time step. Geochemical characterization results are included to estimate mass of constituents released per mass of mine rock stored in various mine waste facilities such as a backfill in the open pit. The in-stream water quality is calculated based on the mixing of Project discharge with background loading estimated from baseline monitoring of surface and groundwater quality.

Within the proposed Project area, the model simulates the flux of water and mass. Monthly withdrawals of water because of diverted catchment areas and monthly discharges into the downstream environment are estimated. A further 2.5% of water was withdrawn from Goathorn Creek to evaluate the contingency of withdrawing water for Project demands though not required by the model. Prediction nodes were selected to represent expected conditions in the downstream environment and are evaluated in relation to a baseline condition, which estimates streamflow and quality through 2100 without influence of the proposed Project.

Multiple Project alternative assessment cases were selected to understand the range of potential effects from the Project throughout the life of mine. These cases incorporate variability in hydrologic conditions, groundwater conditions and geochemical source terms. The main results reported describe the Project

Case, which incorporates Project design mitigation measures and expected inputs for geochemical source terms and average hydrology. Results for each alternative assessment case are presented in Appendix F (water quantity) and Appendix G (water quality). The Project Case model conditions are incorporated to simulate the expected, or most likely estimate based on available information. Where input assumptions are uncertain, more conservative assumptions were made. Preliminary model results were used to develop mitigation measures which were applied in subsequent model versions as appropriate.

A prior report was submitted as part of the 2022 EAC application, and while the main structure and assumptions of the model remained the same, the following changes to inputs were made:

- Review and update of water quality guidelines with respect to recent provincial publications, used for the screening of water quality modeling results and identification of potential effects.
- Review and update the Tenas Project climatic records, based on additional data from the local station since the development of the EA baseline report (SRK 2024a).
- Review of streamflow model performance against measurements collected in 2022, along with implementation of an alternative dynamic streamflow model.
- In addition to climate records and streamflows, the climate change model has been updated to match current approved scientific requirements. All three updates are summarized in the updated hydrometric report (SRK 2024a).
- Update of background source terms incorporating seasonality (summer and winter conditions) in the model based on updated baseline data.
- Update of geochemical source terms related to barrel monitoring undertaken over the past four years which was used for quality predictions (SRK 2024b).
- Update of source terms related to the non-PAG backfill in the open pit to account for methodology of constructing this backfill in thinner lifts from the bottom up and progressive reclamation through the addition of overburden and surface soil (topsoil) covers (Okane, 2024).
- Review and update to the groundwater model which led to updated calculations to estimate the load in the creeks through groundwater seepage from the Project (SRK 2024c).

Project Results

- Sufficient water is expected within the Project area to maintain the minimum 0.5 m water cover above PAG materials within 6 months of rock placement on average, and 1.5 m of water cover throughout the rest of Operations and during Post-closure.
- Process and potable water demand as well as water to mix with sewage effluent will be met throughout operation based on available water in the Open Pit sump, keeping Tenas Control Pond as a contingency.
- Project discharge ranging from 9,000 m^3/day to 24,700 m^3/day from the Tenas Control Pond will include pumped flows and overflows via the spillway into a tributary of Goathorn Creek. Additional discharge to the Bulkley River is anticipated from the Rail Infrastructure Sedimentation Pond at a

rate of up to 260 m^3/day. In closure, Project discharge will occur from the North Management Pond to the tributary of Goathorn Creek at a rate of up to 28,800 m^3/day.

- Discharging facilities (Rail Infrastructure Sedimentation Pond, Tenas Control Pond and North Management Pond) have the following parameters of concern identified in their effluent (80% of corresponding water quality guideline calculated for the receiving stream) during active discharge periods under Project Case conditions: nitrate-nitrogen, nitrite-nitrogen, sulfate, total aluminum, dissolved cadmium, dissolved cobalt, dissolved copper, total iron, total molybdenum, total nickel, total selenium, total thallium, dissolved zinc.

Receiving Environment Results

Water Quantity

Effects to surface water quantity were evaluated based on relative change over baseline conditions. A parallel pre-mining model was run in tandem with each assessment case using baseline conditions, and monthly percent change was calculated by comparing the proposed conditions with mining relative to pre-mining results. Results are summarized in relation to changes to mean annual discharge, monthly discharge, and low and high flows.

- Four Creek prediction nodes, including WQ03, WQS21, WQS20 and WQS03DS, show as high as 37% reduction and as high as 48% increase to monthly streamflow during operation. These results reflect the maximum change to catchment area and baseflow because of mining Operations. Diversion channels and mine plan optimizations help to reduce the Project footprint as much as possible. However, the open pit and the Management Ponds continue to route water that would have otherwise drained to Four Creek towards Goathorn Creek via the Tenas Control Pond discharge, resulting in a reduction of catchment area, while the C02 channel diversion results in an increase in catchment area in portions of Four Creek.
- Tenas Creek is expected to experience up to a 10% reduction in monthly streamflow during low flow periods (April and August) during operation because of open pit groundwater drawdown and catchment area reductions. The seepage from Management Ponds counters this effect by the end of operation and into Post-closure, resulting in a long-term change to mean annual discharge of less than 6%.
- Goathorn Creek flows are expected to be reduced by up to 8% during low flow months in operation. Flows downstream of the Project discharge are expected to increase by up to 6% in operation during high flow months and 11% in Post-closure due to routing of water through the Project infrastructure that would otherwise have reported to the Tenas Creek catchment. The change to mean annual discharge is less than a 3% reduction in operation and Post-closure.
- The Project may reduce monthly average flows in the Telkwa River downstream of Goathorn Creek by less than 2% in operation and an increase of 1% in Post-closure due to seepage from Management Ponds. Bulkley River monthly streamflow changes are negligible (less than 0.1% change during any phase of the Project).

Water Quality

Effects to surface water quality were evaluated based on screening against selected water quality guidelines (WQG) as well as variability within the historical monitoring record. Baseline monitoring data show the streams are naturally elevated for total aluminum, total iron, and dissolved copper and have experienced periods above the WQG values. Exceedances for modelled results are summarized by model cases and stream:

Project Case

Under expected conditions, in terms of hydrology, groundwater and source terms:

- Exceedances of the dissolved cobalt WQG may occur in Four Creek in Closure only for a few years (4 years) in Post-closure.
- Exceedances for dissolved copper WQG may occur in Goathorn Creek in winter and summer during the Operations and Post-closure phases, but results are within the natural variability of baseline monitoring data (i.e., less than the 95th percentile from baseline datasets). Because these exceedances are driven by naturally elevated concentrations of dissolved copper in the background, the concentrations do not decrease over time.
- In Telkwa River, exceedances of the total aluminum and dissolved copper WQG occur in summer months during the Operations phase in the Project Case. The results for total aluminum are less than the natural variability recorded in the baseline monitoring data (i.e. less than the 95th percentile from baseline datasets). Exceedances of the WQG of dissolved copper are experienced in summer throughout operation phase only but results are less than the 50th percentile from baseline data.

Alternative Project Case 2 (High Source terms)

Under the upper-case geochemical source term conditions, the following water quality results are noted:

- The total selenium WQG is exceeded in both summer and winter months during Post-closure by up to 1.6 times in Four Creek. The long-term winter and summer results in 2100 are below the WQG.
- The dissolved cobalt WQG is exceeded in both summer (maximum monthly only) and winter months (monthly maximum and average) up to 4.3 times the guideline in Four Creek.
- The nitrite-nitrogen WQG is exceeded in winter months by up to 1.7 times the guideline in Four Creek with some exceedances in summer months.
- The total selenium WQG is exceeded in Tenas Creek at downstream prediction nodes WQS22 and WQS04 in winter months during Post-closure by up to 1.5 times the guideline.
- The dissolved cobalt WQG is exceeded in winter months only up to 1.8 times the guideline in the downstream prediction nodes from the Project in Tenas Creek.
- Exceedances for total selenium by up to 1.5 times the WQG in Goathorn Creek, occurring only in Post-closure during the winter months. These exceedances are below the WQG by 2100.

- Exceedances for dissolved cobalt by up to 1.1 times in prediction nodes in Goathorn Creek during Operations due to higher discharge from the Project, and in WQS05 (most downstream node) in Closure up to 1.1 times the guideline due to groundwater seepage.

Alternative Project Case 5 (Low flows)

Under 7Q10 low flow conditions, the following water quality results are noted:

- The total selenium WQG is exceeded in both summer and winter months during Post-closure by up to 2.7 times in Four Creek. The long-term winter and summer results in 2100 are below the guideline.
- The nitrite-nitrogen WQG is exceeded in winter months by up to 2.9 times the guideline in Four Creek with some exceedances in summer months.

Other observations from the water quality modelling results:

- Groundwater seepage from management ponds into portions of Tenas, Goathorn, and Four Creek is expected to increase the total dissolved solids concentration and conductivity of the stream above baseline levels. In Tenas and Four creeks, the model results are within 10% of the 95th percentile from baseline monitoring. In lower reaches of Goathorn Creek, however, the model results are greater than 10% above the 95th percentile from baseline monitoring. These changes to Goathorn Creek persist into steady-state conditions.

The effects to both stream water quantity and quality were further evaluated in terms of the affected area within the spatial boundaries of the Project, including the local stream watersheds, the local study area (LSA) and the regional study area (RSA).

- In terms of water quality:
  - The modelled prediction nodes that experience long-term exceedances above water quality guidelines include the downstream portions of Four Creek only, which represents an area equal to 5.7 km^2. This affected area represents approximately 3% of the LSA and 0.4% of the RSA.
  - The modelled prediction nodes that experience valuess of other parameters (Total dissolved solids and specific conductivity) greater than 10% above the 95th percentile of the baseline monitoring records include downstream Goathorn Creek (WQSEA1, WQS06, WQS05), which represents an area equal to 6.7 km^2. This affected area represents approximately 3% of the LSA and 0.5% of the RSA.
- In terms of water quantity:
  - The modelled prediction nodes that experience a change to mean annual discharge greater than 10% reduction or 30% increase include WQS21, WQS20 and WQ03DS, which encompasses an area equal to 7.6 km^2. This affected area represents approximately 3.6% of the LSA and 0.5% of the RSA.
  - A change in seasonal flow distribution greater than 10% reduction or 30% increase in any given month under average conditions is predicted to occur at WQS03, WQS21, WQS20 and

WQS03DS. This change encompasses an area equal to 11 km^2, which represents approximately 5% of the LSA and 0.8% of the RSA.

- High flows are expected to be reduced over baseline conditions for all prediction nodes which will experience a reduction in catchment area. For the segment of Four Creek which will experience a net increase in catchment area, downstream of the diversion channel, an engineering control structure will limit the discharge during extreme events, sending excess water to the East Management Pond. Similarly, the Tenas Control Pond will have the ability to control high flood events through an additional attenuation capacity up to the 1 in 10-year flood event. As a result, the increase to high flows is expected to be minimal.
- Low flows are expected to be reduced in Operations along sections of Tenas and Four creeks because of drawdown of the groundwater table around the open pit. It is expected that extreme low flows will be similarly affected.

1 Introduction

1.1 Background

Telkwa Mining Limited (TML) are proposing to develop the Tenas Coal Deposit (the Project) in northwest British Columbia. The Project is located approximately 25 km southwest of the town of Smithers within the Telkwa River watershed and will comprise of an open pit, backfill, external material stockpiles, Management Ponds, Control Ponds, a coal processing plant, and rail infrastructure area. The Tenas Project's total mine life is 25 years including Construction, Operation, Decommissioning and Reclamation phases.

SRK Consulting (Canada) Inc. have developed a water quantity and quality model based on the proposed water management designs for the Tenas Project in support of the Environmental Assessment Certificate application (EA). The EA has been prepared in accordance with the BC Environmental Assessment Office (BC EAO) Guidelines for Preparing Environmental Assessments (BC EAO 2016) and the approved Application Information Requirements document issued in 2020.

In May 2020, the EAO issued an Application Information Requirements (AIR) document that provided the requirements of the EA (EAO, May 2020). This report supports the requirements of the EA including:

- Part A, Section 1.3, Project Design and/or Alternative Means of Carrying out the Project.
- Part B, Section 3.5, Assessment Methodology and Mitigation Measures.
- Part B, Section 4.0, Environmental Effects Assessment, Surface Water Intermediate Component.
- Part E, Management Plans and Management Strategies.

The objectives of the water quantity and quality model (Water and Load Balance Model) are defined in this report, along with the model inputs, assumptions, and results. Results of the model are used to inform the EA at the regional study area level.

This report is an updated version of the Water and Load Balance Model report submitted in August 2022 as part of the Projects EA submission. Various inputs to the WLBM were also updated since 2022 and have been integrated into this revision. The following inputs and changes were made:

- Review and updates to water quality guidelines based on provincial publications, used for screening of water quality modeling results and identification of potential effects.
- Review and update the Tenas Project climatic records, based on additional data from the local station since the development of the EA baseline report (SRK 2024a).
- Review of streamflow model performance against measurements collected in 2022, along with implementation of an alternative dynamic streamflow model.
- In addition to climate records and streamflows, the climate change model has been updated to match current approved scientific requirements. All three updates are summarized in the updated hydrometric report (SRK 2024a).

- Updated background source terms incorporating seasonality (summer and winter conditions) in the model.
- Update of source terms related to barrel monitoring undertaken over the past four years which was used for quality predictions as provided in (SRK 2024b).
- Update of source terms related to the non-PAG backfill to account for methodology of constructing this dump in lifts from the bottom up and progressive reclamation through the addition of overburden and surface soil (topsoil) covers as provided in (Okane 2024).
- Review and update to the groundwater model which led to updated calculations to estimate the load in the creeks through groundwater seepage from the Project (SRK 2024c).

Details about the updates to the inputs can be found in Section 3.

1.2 Scope of Work

This report presents the inputs, methodologies, and results of the water and load balance model ("the model"). As part of this work, the following were completed:

- Develop conceptual water balance flow diagrams.
- Compile climatic and hydrologic inputs.
- Develop water balance model and evaluate effects of the Project against baseline flow conditions.
- Modify water management infrastructure as required to achieve desired objectives.
- Develop background water quality source terms and geochemical source terms for load balance model.
- Develop load balance model and evaluate effects of the Project against baseline water quality conditions.

1.3 Model Objectives

Geochemical characterization studies have shown that a portion of waste rock from mining activities is expected to be potentially acid generating (PAG) material. To minimize oxidation of this material and the generation acid drainage and/or metal leaching, PAG rock will be stored in Management Ponds to maintain a perpetual water cover. One of the primary functions of the model is to test the ability of the Project water management infrastructure to maintain water cover.

The objectives of the model and water management plans include:

- Ensuring a minimum of 0.5 m water cover is maintained in Management Ponds within 6-months of PAG rock placement and a minimum 1.5 m throughout the rest of life of mine and Post-closure.
- Ensuring sufficient water is available to meet coal preparation plant (CPP) demand throughout Operations.
- Estimating the quality and quantity of water to be discharged to the receiving environment.

- Estimating the quality and quantity of water in the receiving environments at discharge locations and at prediction nodes in the receiving environment.
- Providing a basis for determining water management infrastructure requirements and water treatment requirements (if any).
- Providing a basis for the estimation of water management costs and water treatment costs (if any).

2 Model Overview

2.1 Regulatory Requirements and Commitments

Water takings for the Project are expected to be subject to the provincial *Water Sustainability Act* via a license for the use of surface and/or groundwater. The Project is expected to be subject to the federal *Fisheries Ac*t via the future *Coal Mining Effluent Regulations* which are currently in development (ECCC 2018), as well as the provincial *Environmental Management Act* via a Waste Discharge Authorization permit.

The *Coal Mining Effluent Regulations* are expected to specify end of pipe limits for total suspended solids (TSS), nitrate, and selenium for new and existing coal mines.

In the BC provincial jurisdiction, end of pipe limits for discharge of excess water to the environment may be specified in an Effluent Discharge Permit (EDP) issued by the BC Ministry of Environment (BC MOE) under the provincial *Environmental Management Act,* in addition to established surface water quality guidelines (WQG) for receiving environments. In advance of an EDP, the long-term average BC Approved Water Quality Guidelines or BC AWQG (ENV 2025a) and the BC Working Water Quality Guidelines or BC WWQG (ENV 2025b) for freshwater aquatic life were applied for the evaluation of results from the load balance. Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME WQG) are applied for parameters for which there is no BC AWQG or BC WWQG.

The WQG incorporated for the Project are summarized in Section 3.9.

2.2 Model Description

2.2.1 Simulation Approach

The model uses a daily time step, and reports results as monthly averages throughout the life of mine through the year 2100. The year 2100 was selected based on the current extent of available global circulation models for climate change evaluation.

Water quantity results were generated using two sets of hydrologic conditions, both of which account for climate change:

- Historical hydrologic conditions based on select years from the historical record including a composite year with monthly historical records corresponding to monthly average conditions and resulting in similar annual precipitation to the mean annual precipitation, a 1 in 100-year dry and a 1 in 10-year wet historical year. Details on this methodology are described in Section 3.1.1. Climate change adjustment factors were applied to temperature and precipitation inputs (Section 3.1.5).
- Monte Carlo simulation using a weather generating (WGEN) software with climatic data, including daily precipitation and daily temperature, for the Project area. A total of 100 model runs were completed using this approach. Climate change adjustment factors were applied to the daily generated temperature and precipitation values. At the end of 100 model runs, all results were

compiled, and probability distributions of the results were generated (i.e., 5th, 50th and 95th percentiles). Details of this methodology are described in Section 3.1.2.

Water quality predictions were completed using deterministic model runs (i.e., a single run with no probabilistic elements for climatic variables) with average hydrologic conditions to be consistent with the derivation of source terms.

2.2.2 Governing Equations

The water and load balance model operates based on conservation of mass. The water balance component tracks all inputs, outflows, and available storage at the Project. The water balance can be represented in a simplistic form as follows:

$$Water\ Storage = Water\ Input - Water\ Output \quad \text{(Eq. 2.1)}$$

Where the total water inputs include groundwater and precipitation, and water outputs include groundwater, evaporation, process water demand, discharge offsite and water loss to rock void space. Storage is available in various Project facilities.

The load balance for the Project was developed to evaluate loadings from Project components to the receiving environment. The load balance and resultant receiving water quality predictions were used as a tool to iteratively refine water management infrastructure for the Project throughout the life of mine.

The load balance assumes fully mixed conditions at each prediction node and time step. The mass balance does not account for some physical, chemical, and/or biological processes such as aerobic and anaerobic degradation, sorption and desorption, oxidation and reduction, dissolution and precipitation, and incomplete mixing within receiving environments.

Loadings and concentrations were calculated for each Project component, and loadings were generated for each corresponding receiving environment node in the water balance. Two types of loadings included in the load balance:

- Direct loadings based on defined input source terms.
- Linked loadings from reservoirs (from one reservoir to another).

Direct loadings are calculated based on the concentrations of source terms (eq. 2.2).

$$Direct\ Loading\ [mg] = Inflow\ Volume[m^3] \times Source\ Term\ Concentration\left[\frac{mg}{L}\right] \times 1000\ L/m^3 \quad \text{(eq. 2.2)}$$

Linked loadings (eq. 2.3) from reservoirs are calculated based on the calculated concentration (eq. 2.4) for the reservoir and associated inflow from the water balance.

$$Linked\ Loading\ [mg] = Inflow[m^3] \times Concentration[\frac{mg}{L}] \times 1000\ L/m^3 \quad \text{(eq. 2.3)}$$

$$Concentration = \frac{Mass\ (mg)}{Volume\ (L)} \quad \text{(eq. 2.4)}$$

2.3 Project Overview

The Project is located approximately 25 km southwest of the town of Smithers and is in the Telkwa River watershed, amongst the smaller watersheds of Tenas, Four, and Goathorn creeks (Figure 2-1). Workings will consist of an open pit, generation of both PAG and non-PAG rock as well as overburden material, Management Ponds, sedimentation ponds, a Coal Processing Plant (CPP), and rail infrastructure. The Project's total mine life is approximately 25 years including the Construction, Operation, Decommissioning and Reclamation phases. The Post-closure phase will occur after the decommissioning and reclamation phase are completed and will have an unspecified timing but will likely be approximately 50 years.

Downstream water users include fish populations in Four, Tenas and Goathorn creeks as well as Telkwa and Bulkley Rivers. The Village of Telkwa is located downstream at the confluence of the Telkwa and Bulkley Rivers, and further downstream on Bulkley River is the Town of Smithers following by Witset.

Tenas Project

Site Location

610000 615000 620000 625000 630000 635000

6070000 6065000 6060000 6055000 6050000

SMITHERS
16
CN
TELKWA
BURNT CABIN BOG ECOLOGICAL RESERVE
Tyhee Lake
Bulkley River
TELKWA COALMINE RD
LAWSON RD
Telkwa River
AVELING COALMINE RD
Helps Creek
RAIL LOADOUT
TELKWA RIVER FSR
Tenas Creek
BYPASS ROAD
Goat Horn Creek
Four Creek

Legend

- Rail Line
- Highway
- Road
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- Municipal Area
- General Private Property
- 138 kV Transmission Line
- 500 kV Transmission Line

Project Features

- Existing 25 kV Power Line
- 25 kV Power Line
- Haul Road
- Rail Loop
- Discharge Path
- Tenas Access Corridor
- Backfill Area
- Control and Plant Sedimentation Pond
- Explosive Infrastructure
- Management Pond
- Mine Infrastructure Complex
- Open Pit
- Pit Lake
- Quarry
- Rail Infrastructure
- Topsoil Stockpile
- Tenas Coal Licenses
- Telkwa Coal Limited Private Property
- Project Area
- Wildlife LSA

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. Project line features are for display only.

Sources

- Project Features: Allegiance Coal, April 21, 2021.
- Basedata: Government of British Columbia
- Basemap: World Topo Base

N

1:100,000

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Kilometres

NAD 1983 UTM Zone 9N

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1CT027.003	Production Date: Apr 29, 2021	Figure 2.1

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2.3.1 Project Infrastructure

Project infrastructure incorporated into the model is described below. Figure 2-1 presents the Project infrastructure footprint at the end of the life-of-mine.

Sedimentation Ponds

Sedimentation ponds provide residence time for sediment removal and water storage. Ten ponds will be included at the Project, including the Tenas Control Pond, the Coal Processing Plant (CPP) Sedimentation Pond, the Rail Infrastructure Sedimentation Pond, the Explosives Facility and Explosives Magazine East and West Tenas Access Corridor, Gravel Quarry 1 and 2, and Rock Quarry Sedimentation Ponds. Due to their small footprints (less than 0.01 km^2), disconnectedness from the main mining water management system, primarily TSS as the only POC, and timing, the Explosives Facility, Explosives Magazine, East and West Tenas Access Corridor, Gravel Quarry 1 and 2, and Rock Quarry Sedimentation Ponds Sedimentation Ponds were not included in the water and load balance model.

The Tenas Control Pond will be constructed downstream of all mining infrastructure and will also serve as the secondary water supply source to the CPP[1] as well as providing water supply to the Management Ponds. Excess water will be pumped from Tenas Control Pond to a tributary of Goathorn Creek, which will include a minimum discharge rate during open water months (May until October) to mix with treated sewage effluent.

The CPP Sedimentation Pond and Rail Infrastructure Sedimentation Pond are local facilities at the CPP area and rail infrastructure area, respectively. Inflows to these ponds will include drainage from associated infrastructure, and outflows will consist of evaporation and discharges to downstream creeks and rivers via pumping systems and emergency spillways.

Management Ponds

The Project will include three Management Ponds for subaqueous storage of PAG rock and processed rock: North Management Pond (NMP), East Management Pond (EMP) and West Management Pond (WMP). All Management Ponds will be lined to reduce seepage losses to the environment. Upon completion of PAG rock placement within each facility, a non-PAG rock cover will be placed across the top of PAG, followed by a layer of overburden to reduce evaporation losses.

The NMP ring-dyke dam will be constructed during pre-mining at the downstream extent of the open pit and will store PAG rock during the first years of mining. Due to its geometry, all inflows other than direct precipitation will be pumped into the NMP, including water from Tenas Control Pond, subsequent Management Ponds, and inflows from the open pit. Outflows include groundwater seepage and evaporation, overflow via gravity spillway to the Tenas Control Pond, and pumped flow to the subsequent Management Ponds.

[1] Primary water supply source to the CPP is the open pit sump.

The EMP will consist of a dam along the northern extents of the facility, upstream of the NMP. PAG rock placement in the EMP will begin once the NMP is full. A division dam will also be constructed to separate between the subsequent WMP. Inflows will include natural upstream runoff, direct precipitation, and pumped flows from Tenas Control Pond, NMP and the open pit. Outflows include groundwater seepage and evaporation, and discharge via pump or spillway to the NMP and EMP.

The WMP will consist of a dam along the northern and western extents of the facility, adjacent to the EMP dam and directly upstream of the NMP. WMP will consist of a storage area on natural ground as well as a portion of the open pit, referred to herein as the In-Pit WMP and Ex-Pit WMP. Like the EMP, inflows to the WMP will include natural upstream runoff, direct precipitation and pumped flows from the other Management Ponds and the open pit. At closure, the backfilled open pit will discharge via gravity through a rock drain directly into the WMP. Outflows include groundwater seepage and evaporation, and discharge via pump or spillway to the NMP and EMP.

Open Pit

A single open pit will be mined throughout Operations and will be backfilled with Non-PAG rock. The open pit is dewatered via pumping from a sump to the active Management Pond[2] during active mining.

Non-PAG rock is backfilled into the open pit throughout Operations. At closure, Non-PAG rock is covered with overburden and active dewatering will cease, allowing the remaining areas to flood and form the End Pit Lake. Discharge at closure will occur through the Non-PAG rock towards the WMP.

Coal Processing

Coal processing will occur on-site at the CPP. The CPP will produce coal that will be transported to the Rail Infrastructure Area for transport off-site, as well as processed rock which will be deposited in Management Ponds with PAG rock.

2.3.2 Project Stages

Four Project stages are described in Table 2-1.

[2] A Management Pond is considered active when PAG is being placed in it.

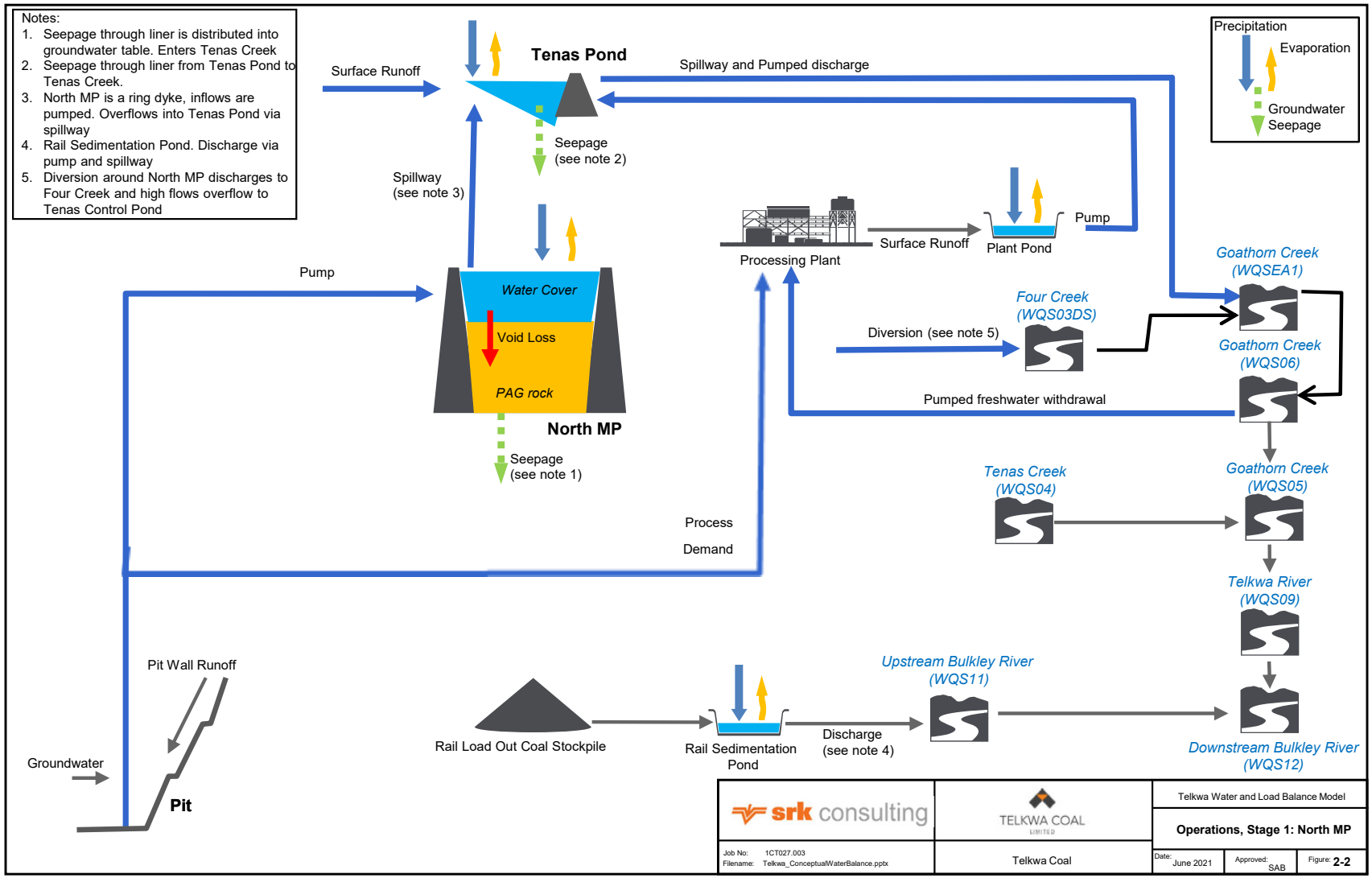
Table 2-1: Project Phases

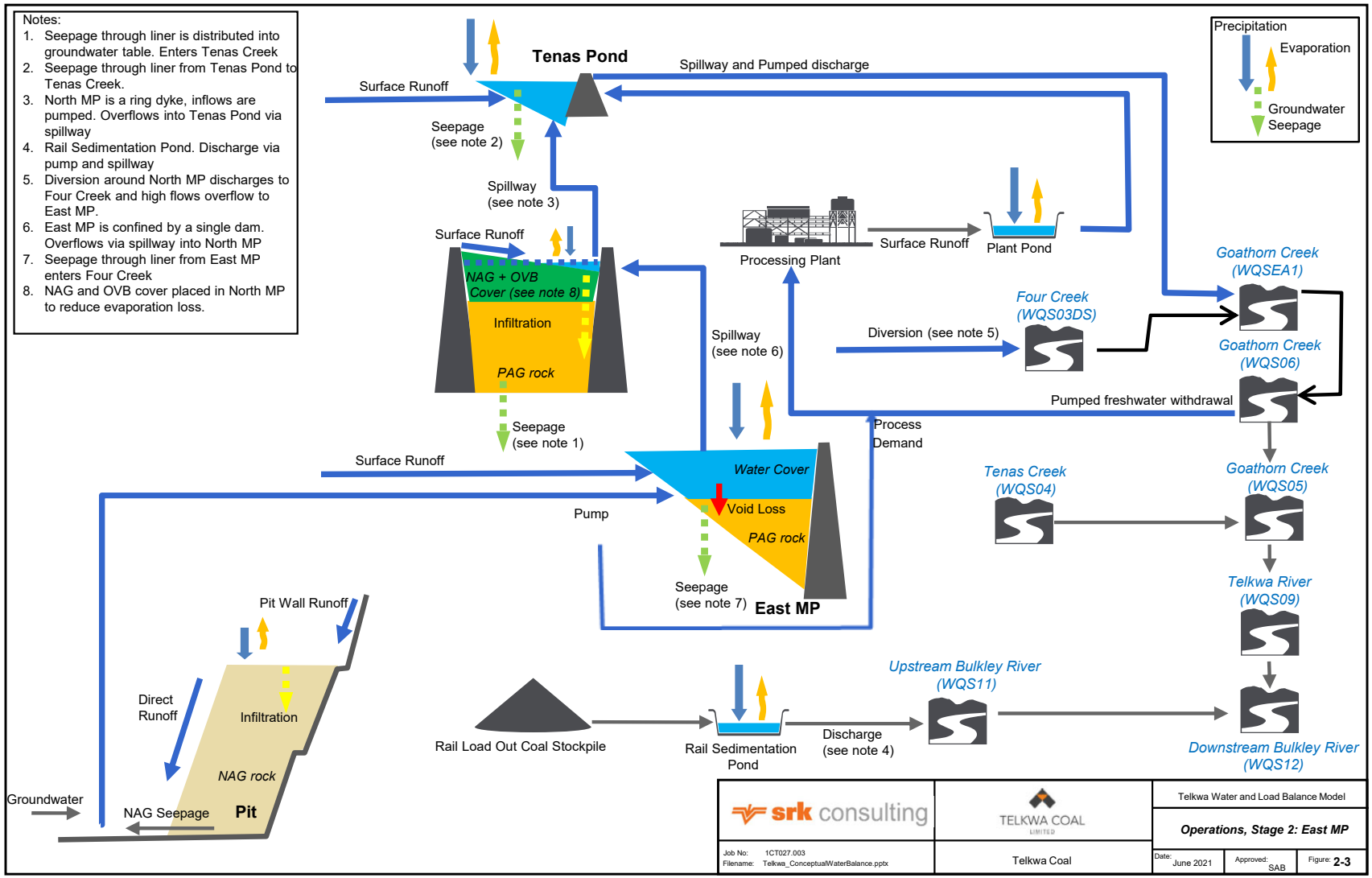
Project Stage	Project Years	Modelled Calendar Year	Length of Phase (years)	Description of Activities
Construction	-0.5 to 0	2020	1.5	Site clearing, soil salvage, open pit development, building construction, service and haul road development, Rail Infrastructure construction, bridge construction and development of onsite utilities and services. Development of mine rock, and overburden storage piles, stockpiling of reclamation material such as soil, overburden, and other materials suitable for reclamation. Development of water management systems and management ponds for storage of potentially acid generating (PAG) materials.
Operation	1 to 21	2022	21	Development of the open pit through drilling, blasting, loading, and hauling functions. Development of mine rock, and overburden storage piles, stockpiling of reclamation material such as soil, overburden, and other materials suitable for reclamation. Development of water management systems and management ponds for PAG storage. Conducting coal processing, stockpiling of raw coal prior to processing, and stockpiling of processed coal prior to shipping. Progressive reclamation will be accomplished during operation including, where available, reclamation activities such as sloping, topsoil placement and revegetation.
Decommissioning and Reclamation	22 to 25	2043	4	Decommissioning of infrastructure onsite plus reclamation activities, including sloping of storage piles, backfill materials, and placement of reclamation materials including growth media, overburden and non-PAG rock for management pond covers and revegetating surfaces that are planned to be reclaimed.
Post-closure	26 to 50	2047	53	Approximately 10 years of Active Post-Closure. This involves the filling of the open pit with water, monitoring of vegetation growth and water quality for both groundwater and surface water and wildlife. Control and sedimentation ponds may still be needed for settling of total suspended solid levels. The management ponds are left as dry land reclamation except for portions that will be left as open water. Passive closure when the control and sedimentation ponds are no longer required for settling of total suspended solid (TSS) levels and the management ponds are covered and reclaimed except for portions left as open water. Telkwa Coal Limited (TCL) will monito site

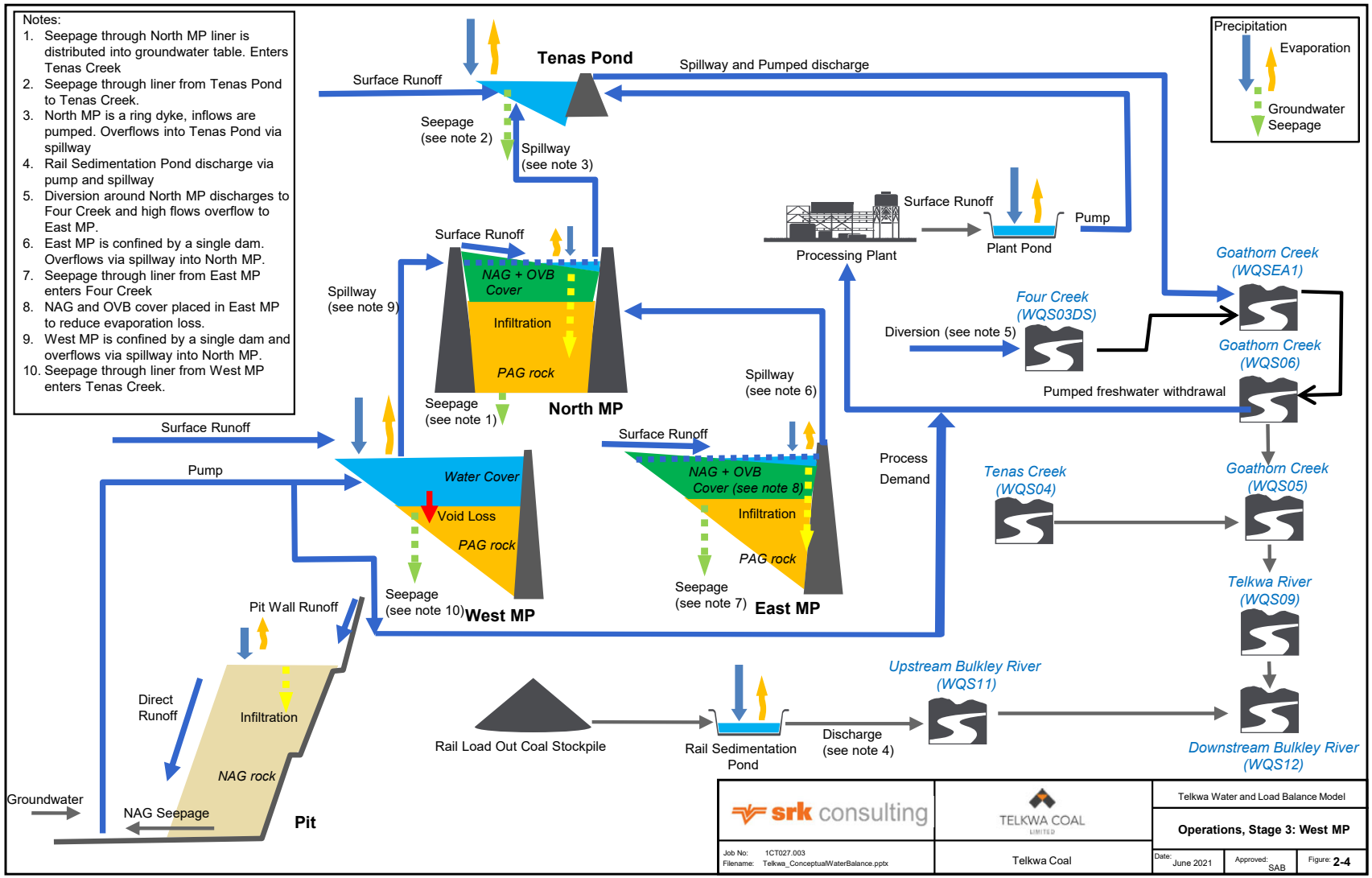
Note: Modelled Calendar year have been used historically, starting in 2020. Future modelling revisions will likely update these dates to reflect actual start date of mining.

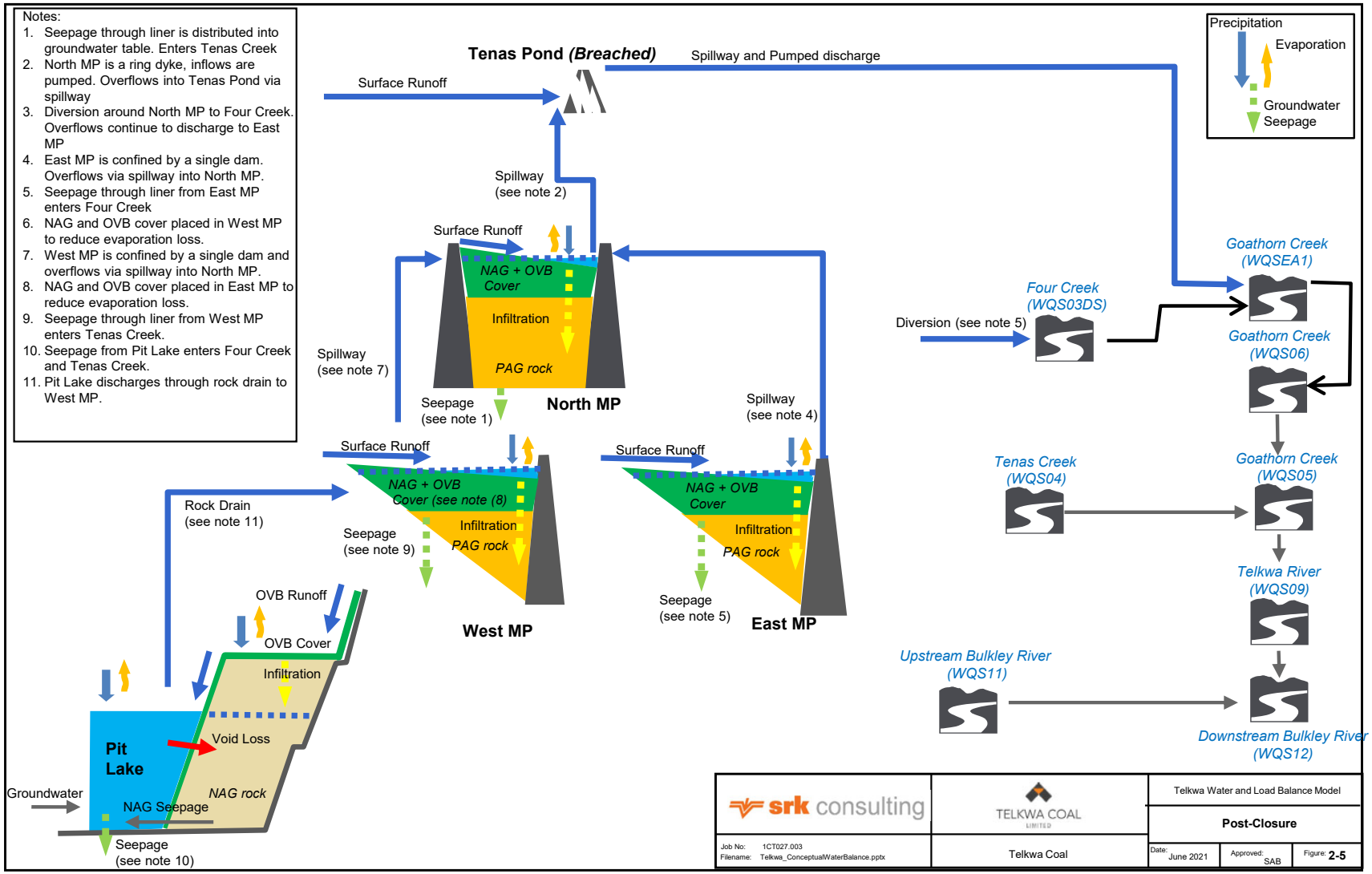
2.3.3 Flow Diagrams

The water balance conceptual flow diagrams are provided in Figure 2-2, Figure 2-3 and Figure 2-4 for Operations with the NMP, EMP and WMP, respectively, as well as in Figure 2-5 for Post-closure.


Notes:
1. Seepage through liner is distributed into groundwater table. Enters Tenas Creek
2. Seepage through liner from Tenas Pond to Tenas Creek.
3. North MP is a ring dyke, inflows are pumped. Overflows into Tenas Pond via spillway
4. Rail Sedimentation Pond. Discharge via pump and spillway
5. Diversion around North MP discharges to Four Creek and high flows overflow to Tenas Control Pond
Precipitation
Evaporation
Groundwater Seepage
Surface Runoff
Tenas Pond
Spillway and Pumped discharge
Seepage (see note 2)
Spillway (see note 3)
Pump
Water Cover
Void Loss
PAG rock
North MP
Seepage (see note 1)
Processing Plant
Surface Runoff
Plant Pond
Pump
Goathorn Creek (WQSEA1)
Four Creek (WQS03DS)
Diversion (see note 5)
Goathorn Creek (WQS06)
Pumped freshwater withdrawal
Tenas Creek (WQS04)
Goathorn Creek (WQS05)
Process Demand
Telkwa River (WQS09)
Pit Wall Runoff
Groundwater
Pit
Rail Load Out Coal Stockpile
Rail Sedimentation Pond
Discharge (see note 4)
Upstream Bulkley River (WQS11)
Downstream Bulkley River (WQS12)
srk consulting
TELKWA COAL LIMITED
Telkwa Water and Load Balance Model
Operations, Stage 1: North MP
Job No: 1CT027.003
Filename: Telkwa_ConceptualWaterBalance.pptx
Telkwa Coal
Date: June 2021
Approved: SAB
Figure: 2-2


Notes:
1. Seepage through liner is distributed into groundwater table. Enters Tenas Creek
2. Seepage through liner from Tenas Pond to Tenas Creek.
3. North MP is a ring dyke, inflows are pumped. Overflows into Tenas Pond via spillway
4. Rail Sedimentation Pond. Discharge via pump and spillway
5. Diversion around North MP discharges to Four Creek and high flows overflow to East MP.
6. East MP is confined by a single dam. Overflows via spillway into North MP
7. Seepage through liner from East MP enters Four Creek
8. NAG and OVB cover placed in North MP to reduce evaporation loss.
Precipitation
Evaporation
Groundwater Seepage
Tenas Pond
Spillway and Pumped discharge
Surface Runoff
Seepage (see note 2)
Spillway (see note 3)
Surface Runoff
NAG + OVB Cover (see note 8)
Infiltration
PAG rock
Seepage (see note 1)
Processing Plant
Surface Runoff
Plant Pond
Goathorn Creek (WQSEA1)
Four Creek (WQS03DS)
Diversion (see note 5)
Spillway (see note 6)
Goathorn Creek (WQS06)
Pumped freshwater withdrawal
Process Demand
Surface Runoff
Water Cover
Void Loss
PAG rock
Pump
Seepage (see note 7)
East MP
Tenas Creek (WQS04)
Goathorn Creek (WQS05)
Telkwa River (WQS09)
Pit Wall Runoff
Direct Runoff
Infiltration
NAG rock
Groundwater
NAG Seepage
Pit
Rail Load Out Coal Stockpile
Rail Sedimentation Pond
Discharge (see note 4)
Upstream Bulkley River (WQS11)
Downstream Bulkley River (WQS12)
srk consulting
TELKWA COAL
Telkwa Water and Load Balance Model
Operations, Stage 2: East MP
Job No: 1CT027.003
Filename: Telkwa_ConceptualWaterBalance.pptx
Telkwa Coal
Date: June 2021
Approved: SAB
Figure: 2-3


Notes:
1. Seepage through North MP liner is distributed into groundwater table. Enters Tenas Creek
2. Seepage through liner from Tenas Pond to Tenas Creek.
3. North MP is a ring dyke, inflows are pumped. Overflows into Tenas Pond via spillway
4. Rail Sedimentation Pond discharge via pump and spillway
5. Diversion around North MP discharges to Four Creek and high flows overflow to East MP.
6. East MP is confined by a single dam. Overflows via spillway into North MP.
7. Seepage through liner from East MP enters Four Creek
8. NAG and OVB cover placed in East MP to reduce evaporation loss.
9. West MP is confined by a single dam and overflows via spillway into North MP.
10. Seepage through liner from West MP enters Tenas Creek.
Precipitation
Evaporation
Groundwater Seepage
Tenas Pond
Surface Runoff
Spillway and Pumped discharge
Seepage (see note 2)
Spillway (see note 3)
Surface Runoff
NAG + OVB Cover
Infiltration
PAG rock
Spillway (see note 9)
Seepage (see note 1)
North MP
Processing Plant
Surface Runoff
Pump
Plant Pond
Goathorn Creek (WQSEA1)
Four Creek (WQS03DS)
Diversion (see note 5)
Goathorn Creek (WQS06)
Pumped freshwater withdrawal
Spillway (see note 6)
Surface Runoff
Pump
Water Cover
Void Loss
PAG rock
Seepage (see note 10)
West MP
Surface Runoff
NAG + OVB Cover (see note 8)
Infiltration
PAG rock
Seepage (see note 7)
East MP
Process Demand
Tenas Creek (WQS04)
Goathorn Creek (WQS05)
Telkwa River (WQS09)
Pit Wall Runoff
Direct Runoff
Infiltration
NAG rock
Groundwater
NAG Seepage
Pit
Rail Load Out Coal Stockpile
Rail Sedimentation Pond
Discharge (see note 4)
Upstream Bulkley River (WQS11)
Downstream Bulkley River (WQS12)
srk consulting
TELKWA COAL LIMITED
Telkwa Water and Load Balance Model
Operations, Stage 3: West MP
Job No: 1CT027.003
Filename: Telkwa_ConceptualWaterBalance.pptx
Telkwa Coal
Date: June 2021
Approved: SAB
Figure: 2-4


Notes:
1. Seepage through liner is distributed into groundwater table. Enters Tenas Creek
2. North MP is a ring dyke, inflows are pumped. Overflows into Tenas Pond via spillway
3. Diversion around North MP to Four Creek. Overflows continue to discharge to East MP
4. East MP is confined by a single dam. Overflows via spillway into North MP.
5. Seepage through liner from East MP enters Four Creek
6. NAG and OVB cover placed in West MP to reduce evaporation loss.
7. West MP is confined by a single dam and overflows via spillway into North MP.
8. NAG and OVB cover placed in East MP to reduce evaporation loss.
9. Seepage through liner from West MP enters Tenas Creek.
10. Seepage from Pit Lake enters Four Creek and Tenas Creek.
11. Pit Lake discharges through rock drain to West MP.
Precipitation
Evaporation
Groundwater Seepage
Tenas Pond (Breached)
Spillway and Pumped discharge
Surface Runoff
Spillway (see note 2)
Surface Runoff
NAG + OVB Cover
Infiltration
PAG rock
Spillway (see note 7)
Seepage (see note 1)
North MP
Spillway (see note 4)
Surface Runoff
NAG + OVB Cover (see note 8)
Infiltration
PAG rock
Seepage (see note 9)
West MP
Surface Runoff
NAG + OVB Cover
Infiltration
PAG rock
Seepage (see note 5)
East MP
Rock Drain (see note 11)
OVB Runoff
OVB Cover
Infiltration
Void Loss
Pit Lake
NAG rock
Groundwater
NAG Seepage
Seepage (see note 10)
Four Creek (WQS03DS)
Diversion (see note 5)
Goathorn Creek (WQSEA1)
Goathorn Creek (WQS06)
Tenas Creek (WQS04)
Goathorn Creek (WQS05)
Telkwa River (WQS09)
Upstream Bulkley River (WQS11)
Downstream Bulkley River (WQS12)
srk consulting
TELKWA COAL LIMITED
Telkwa Water and Load Balance Model
Post-Closure
Job No: 1CT027.003
Filename: Telkwa_ConceptualWaterBalance.pptx
Telkwa Coal
Date: June 2021
Approved: SAB
Figure: 2-5

2.4 Overview of Predictions

2.4.1 Prediction Nodes

Model prediction nodes were selected to characterize upstream and downstream conditions in relation to the Project and its discharges. Creeks and rivers which were identified as providing habitat to fish and aquatic life have multiple prediction nodes. Node locations were typically located at historic water quality monitoring sites, with several additional prediction nodes beyond the water quality campaigns on Four Creek and Tenas Creek.

Table 2-2 summarizes the prediction nodes in terms of their geographic location and the stream in which they are located. Justification for node selection is also presented, based on coordination with other EA value component disciplines and review of potential effects from the Project. Node locations are also presented on Figure 2-6 with the final footprints of the Project. Of note, the prediction node WQSEA1 was added after the first version of this report based on feedback during the EA review process.

Table 2-2: In-Stream Prediction Nodes

Prediction Node	Receiving Environment	Justification for Node Selection	Coordinates NAD 1983 UTM Zone 9N	
			Easting	Northing
WQS01	Tenas Creek, upstream of Project	Minor effects from Project anticipated from open pit groundwater table drawdown	615,171	6,050,438
WQS02	Tenas Creek, adjacent (West) to Project	Potential effects anticipated from open pit drawdown and management pond seepage, minor reduction of catchment area	617,171	6,053,841
WQS03	Four Creek, upstream of Project	Minor effects from Project anticipated from open pit groundwater table drawdown	619,235	6,049,989
WQS03DS	Four Creek, downstream of WQS20 and Project	Potential effects anticipated from open pit drawdown and management pond seepage, reduction of catchment area	620,034	6,054,076
WQS04	Tenas Creek, downstream of WQS02 and Project	Potential effects anticipated from open pit drawdown and management pond seepage, reduction of catchment area	620,499	6,057,020
WQS05	Goathorn Creek, downstream of Tenas Creek and WQS06	Potential effects anticipated, based on summation of effects to Four and Tenas creeks and Project discharge into Goathorn Creek	620,615	6,058,133
WQS06_US	Goathorn Creek, upstream of Four Creek	Minor effects from Project anticipated from open pit groundwater table drawdown	620,587	6,053,711
WQS06	Goathorn Creek, upstream of Tenas Creek, downstream of Four Creek	Potential effects anticipated from Project discharge and effects to Four Creek	621,095	6,057,390
WQSEA1	Goathorn Creek, upstream of Tenas Creek, downstream of Four Creek, located 100m downstream of the confluence with the unnamed tributary, receiving discharge from	Potential effects anticipated from Project discharge and effects to Four Creek	620,184	6,055,180

Prediction Node	Receiving Environment	Justification for Node Selection	Coordinates NAD 1983 UTM Zone 9N	
			Easting	Northing
	the Project, closer to discharge than WQS06			
WQS09	Telkwa River, downstream of Goathorn Creek	Potential effect from Project anticipated from catchment area reduction and summation of effects from Goathorn, Tenas and Four creeks	621,394	6,058,998
WQS11	Bulkley River, upstream of Telkwa River, downstream of Rail Infrastructure	Minor effects from Project anticipated from Rail Infrastructure runoff	629,601	6,059,221
WQS12	Bulkley River, downstream of Telkwa River	Minor effects anticipated, based on summation of effects in Telkwa River and all upstream creeks, as well as upstream Bulkley River	625,021	6,063,831
WQS13	Goathorn Creek, upstream of Project	Minor effects from Project anticipated from open pit groundwater table drawdown	621,664	6,051,778
WQS20	Four Creek, adjacent (East) of Project	Potential effects anticipated from open pit drawdown and management pond seepage, reduction of catchment area	619,344	6,052,005
WQS21	Four Creek, upstream of WQS20 and Project	Potential effects anticipated from open pit drawdown and management pond seepage, reduction of catchment area	619,269	6,051,446
WQS22	Tenas Creek, downstream of WQS02 and Project	Potential effects anticipated from open pit drawdown and management pond seepage, minor reduction of catchment area	619,313	6,056,222

Tenas Project

Receiving Environment Prediction Nodes Map

615000 620000 625000 630000 635000

6065000 6060000 6055000 6050000

WQS12
CN
16
Bulkley River
WQS11
WQS09
WQS05
WQS06
Helps Creek
WQS04
WQS22
Telkwa River
WQSEA1
WQS03DS
WQS06US
WQS02
Tenas Creek
WQS20
WQS21
WQS13
WQS01
WQS03
Four Creek
Goathorn Creek

Legend

- Surface Water Monitoring Station
- Highway
- Rail Line
- Wetland
- Watercourse
- Waterbody

Mine Features

- Bypass Road
- Proposed Pit Haul Road
- Backfill
- Core Footprint
- Pit Lake
- Plant and Maintenance Area
- Pond
- Rock Cover

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Features: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Base

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0 1 2 3 4 5

Kilometers

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

1CT027.003	Production Date: Jul 30, 2025	Figure 2-6

srk consulting

ALLEGIANCE COAL LIMITED

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2.4.2 Modelled Assessment Cases

Multiple assessment cases were developed to understand the range of potential effects from the Project throughout the life of mine. Cases incorporate variability in hydrologic conditions, groundwater conditions and geochemical source terms:

- **Background concentrations**: Concentration (in mg/L of water) of each water quality parameter applied to streamflow or groundwater generated from natural catchments. All assessment cases consider the median (50th percentile) water quality data. The upper percentile (95th) is used for screening purposes of model results.
- **Geochemical source terms**: Concentration (in mg/L of water from a given source) or loading rate (in mg per kg of mine rock placed over time) source terms were developed from review of geochemical datasets. Results are presented for the base case source term, which is most likely to occur, and a high source term for a reasonable worst case.
- **Hydrology:** Streamflow and Project discharge are driven by precipitation and temperature inputs and calibrated runoff parameters. Hydrologic scenarios are further described in Section 3.1. and include:
  - Repeated average year precipitation and temperature,
  - Consecutive wet or dry year precipitation,
  - Stochastically generated daily precipitation, and
  - A low flow condition using the 7-day low flow in a 1 in 10-year return period (7Q10).
- **Groundwater seepage**: Groundwater modeling results were incorporated into the model (Section 0). Two cases are presented, including the expected groundwater conditions and sensitivity case seepage (high hydraulic conductivity) rates.

A Pre-Mining Case was simulated in parallel to each assessment case to evaluate the effects of the Project for surface water quantity with respect to a similar baseline. The hydrologic scenario applied to each assessment case was mirrored in the Pre-Mining Case for the same years, enabling comparisons with identical assumptions without mining influences. The assessment considers effects in relation to surface water quantity based on the percent change over Pre-Mining Case (i.e., without effects of mining) conditions.

Table 2-3 presents a summary of assessment cases applied in the model. Relevant results include water quantity and water quality in the receiving environment (Stream) as well as within Project infrastructure (Project).

Table 2-3: Summary of Modelled Assessment Cases

Assessment Case	Background Concentrations	Geochemical Source Terms	Hydrology	Groundwater Seepage	Relevant Results	Purpose
Project Case	Median from Baseline	Typical	Average Annual Precipitation	Expected Groundwater Conditions	Stream and Project Water Quantity, Water Quality	Applied and evaluated for all prediction nodes, forming the basis of the effects assessment of the Project
Alternative Case 1	Median from Baseline	Typical	Average Annual Precipitation	Increased hydraulic conductivity Groundwater Conditions	Stream and Project Water Quantity, Water Quality	Considers higher seepage rates from Project infrastructure and higher drawdown from open pit and the effects on Four Creek and Tenas Creek baseflow rates and winter (low flow) water quality
Alternative Case 2	Median from Baseline	High	Average Annual Precipitation	Expected Groundwater Conditions	Stream and Project Water Quality	Considers higher loading rates from Project to downstream environment and the associated in-stream water quality. Used for Initial Dilution Zone model scenarios in Goathorn Creek (SRK 2025b)
Alternative Case 3	n.a.	n.a.	Consecutive 100-year Dry Events	Expected Groundwater Conditions	Project Water Quantity	Minimize water available for water covers
Alternative Case 4	Median from Baseline	Typical	Consecutive 10-year Wet Events	Expected Groundwater Conditions	Stream and Project Water Quantity, Water Quality	Maximize Project discharge rates and the effects to receiving environment (Goathorn Creek) in terms of flow rates and water quality

Assessment Case	Background Concentrations	Geochemical Source Terms	Hydrology	Groundwater Seepage	Relevant Results	Purpose
Alternative Case 5	Median from Baseline	Typical	7Q10 Low Flow with Average Annual Precipitation[1]	Expected Groundwater Conditions	Stream Water Quantity, Water Quality	Project influence on low flow conditions. Water quality predictions used in Initial Dilution Zone model (SRK 2025c)
Alternative Case 6	n.a.	n.a.	Stochastic Precipitation	Expected Groundwater Conditions	Project Water Quantity	Effect on water covers and Project discharge rates
Alternative Case 7	Median from Baseline	Typical	10% increased Annual precipitation	Expected Groundwater Conditions	Stream and Project Water Quantity, Water Quality	Effect on Project discharge rates and water quality in receiving environment
Pre-Mining Case	n.a.	n.a.	Variable to coincide with selected assessment case	Pre-Mining	Stream Water Quantity	Baseline conditions without Project interaction (i.e., no-mining condition)

n.a. = not applicable

2.4.3 Spatial Boundaries of Assessment

Two spatial boundaries were considered in the EA for surface water:

- the Local Study Area (LSA).
- the Regional Study Area (RSA).

The LSA is defined where direct discharges occur to watercourses within the vicinity of the mine (e.g., Tenas Creek, Four Creek, and Goathorn Creek), to the edge of the mixing zone in the Telkwa River, and downstream of the Rail Infrastructure Area in the Bulkley River. The total area of the LSA is 208.3 km^2.

The RSA, which encompasses the LSA, extends to monitoring location WQS12 in the Bulkley River, approximately 2km downstream of the confluence with the Telkwa River, and includes the Telkwa River catchment area to be consistent with other valued component boundaries. The RSA continues upstream of the confluence of the Telkwa River to the Bulkley River at Quick Water Survey of Canada station (08EE004), which captures conditions upstream of the Rail infrastructure Area. The total area of the RSA is 1430 km^2.

Spatial boundaries are presented in Figure 2-7, where the LSA is a purple dashed line, and the RSA is a green dashed line.

DRAFT
For Discussion Purposes Only

BABINE MOUNTAINS PARK

SMITHERS

CN

16

JEAN BAPTISTE 28

BURNT CABIN BOG ECOLOGICAL RESERVE

Tyhee Lake

TELKWA

AVELING COALMINE RD

TELKWA COALMINE RD

Teras Creek

BYPASS ROAD

LAWSON RD

Bulkley River

TELKWA RIVER FSR

Telkwa River

Goathorn Creek

BURNIE-SHEA PARK

570000 580000 590000 600000 610000 620000 630000 640000

6080000 6070000 6060000 6050000 6040000 6030000

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Tenas Project

Surface Water Local Study Area (LSA) and Regional Study Area (RSA)

Legend

- RSA Boundary
- LSA Boundary
- City/Town
- Rail Line
- Highway
- Tenas Access Corridor
- Road
- Proposed Water Pipeline
- Watercourse
- Wetland
- Waterbody
- Park or Protected Area
- First Nation Reserve
- Municipal Area
- Telkwa Coal Private Land
- Private Land
- Project Area

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Area: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Base

N

1:250,000

0 2 4 6 8 10
Kilometres

NAD 1983 UTM Zone 9N

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1CT027.003	Production Date: Dec 11, 2020	Figure 2-7

ALLEGIANCE COAL LIMITED

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2.4.4 Predicted Parameters

The following types of model results are presented for water quality and water quantity to support the EA Application.

Water Quantity Results

Internal Project Results:

- Ability of the Project to maintain the minimum water cover requirements for all Management Ponds throughout life of mine.
- Ability of the Project to meet process water demands at the CPP.
- Project discharge rates to Goathorn Creek tributary.

Receiving Environment Results:

- Relative change to streamflow under a no-mining condition (Pre-Mining Case). Monthly percent change over Pre-Mining conditions were calculated at each node and summarized per Project stage.

Water Quality Results

Parameters included in the model are summarized in Table 2-4. Other parameters estimated outside of the model include temperature, pH, conductivity, total suspended solids, total dissolved solids, PAHs, and turbidity. Estimates for these parameters were developed based on relationships to modelled parameters, or qualitatively.

Internal Project Results:

- Monthly average and maximum concentrations within Management Ponds as well as all discharging facilities, including the Tenas Control Pond and the Rail Infrastructure Sedimentation Pond. Note that due to their small footprints (less than 0.01 km^2), disconnectedness from the main mining water management system, primarily TSS as the only POC, and timing, the Explosives Facility, Explosives Magazine, East and West Tenas Access Corridor, Gravel Quarry 1 and 2, and Rock Quarry Sedimentation Ponds Sedimentation Ponds were not included in the Goldsim water and load balance model but will discharge runoff to the downstream environment. Changes to water quality downstream of these ponds is expected to be minimal based on use of best management practices. Total suspended solids will be controlled with sedimentation pond designs.
- Results are screened against the WQG as outlined in Section 2.1, as well as against baseline conditions.

Receiving Environment Results:

- Monthly average water quality results at each prediction node, screened against the WQG.
- For each period and each Project stage, both the average and maximum monthly results are presented for winter and summer conditions:
  - Winter extends from November through April (frozen conditions)

– Summer extends from May through October (open-water season).

Table 2-4: Water Quality Parameters Modelled in the Load Balance

Parameters Included in Predictions				
Aluminum, dissolved	Cadmium, dissolved	Iron, total	Nickel, dissolved	Sodium, total
Aluminum, total	Cadmium, total	Lead, dissolved	Nickel, total	Strontium, dissolved
Ammonia-Nitrogen, total	Calcium, dissolved	Lead, total	Nitrate-Nitrogen	Sulfate
Antimony, dissolved	Calcium, total	Lithium, dissolved	Nitrite-Nitrogen	Thallium, dissolved
Antimony, total	Chloride	Lithium, total	Phosphorus, total	Thallium, total
Arsenic, dissolved	Chromium, dissolved	Magnesium, dissolved	Potassium, dissolved	Tin, dissolved
Arsenic, total	Chromium, total	Magnesium, total	Potassium, total	Tin, total
Barium, dissolved	Cobalt, dissolved	Manganese, dissolved	Selenium, dissolved	Uranium, dissolved
Barium, total	Cobalt, total	Manganese, total	Selenium, total	Uranium, total
Beryllium, dissolved	Copper, dissolved	Mercury, dissolved	Silica, dissolved	Vanadium, dissolved
Beryllium, total	Copper, total	Mercury, total	Silver, dissolved	Vanadium, total
Boron, dissolved	Fluoride	Molybdenum, dissolved	Silver, total	Zinc, dissolved
Boron, total	Iron, dissolved	Molybdenum, total	Sodium, dissolved	Zinc, total

2.4.5 In-Stream Characteristics

Changes from the Project on streamflow are characterized in accordance with guidance documents for the EA Application. Surface water has been identified as a valued component, of which water quantity and water quality are each sub-components. The characterization of effects (magnitude, frequency, duration, context, reversibility, and extent) is discussed in the EA Application.

Surface water quantity results are evaluated in terms of:

- Change to mean annual discharge, based on percent change between mean annual discharge in Project Case conditions and Pre-Mining conditions.
- Change to seasonal flow distribution, based on percent change between monthly average discharge in Project Case conditions and Pre-Mining conditions.
- Change to low flows, based on percent change between the 7Q10 in Alternative Assessment Case 5 and Pre-Mining conditions.

Surface water quality results are evaluated in relation to WQG, in context with the natural variability from baseline monitoring data.

3 Model Inputs and Assumptions

3.1 Climate and Hydrology

SRK prepared a hydrometeorological characterization report for the Project to support water management designs and water balance modeling (SRK 2024a). Outputs from the analyses relevant to the water balance include:

- Average lake evaporation rates.
- Long-term temperature and precipitation records developed from Smithers Airport and other regional datasets and corrected for the Project location and prediction node catchments.
- Rainfall-runoff models calibrated for each stream.

Inputs to the water balance are summarized in the following sections.

3.1.1 Historical Climate Conditions

The Project-specific precipitation record includes 77 years of data, from 1943 to 2022. Annual precipitation values were compared with the annual frequency analysis results presented in the hydrometeorological characterization report (SRK 2024a), and select years were identified to simulate dry and wet conditions. Average conditions were represented by a composite year made from average monthly precipitation from the synthetic record. Table 3-1 presents the historical precipitation datasets incorporated into the model for select hydrologic conditions, including the 100-year dry and 10-year wet.

Table 3-1: Historical Precipitation Data Incorporated for specific Hydrologic Conditions in the Model

Hydrologic Condition	Return Period (years)[1]	Frequency Analysis Results for Annual Precipitation (mm/a) [2]	Corresponding Historical Year with Similar Annual Precipitation	Historical Annual Precipitation (mm/a)
Wet	10	798	1957	799
Mean	n.a.	676	Composite	666
Dry	100	454	1970	467

Source:https://srk.sharepoint.com/sites/NACAPR002055/Internal/200_Review%20New%20Climate%20and%20Streamflow%20Data/Met_Data/TenasStation_Review%20of%20Average%20Year_202403_njs.xlsx?web=1

Notes:

1. Frequency analysis described in SRK 2024a.
2. Return periods were selected based on available historical information.

The precipitation inputs used to simulate mean hydrologic conditions were updated. Instead of selecting a year from the historical record which matched the mean annual precipitation, a synthetic year was generated, with monthly precipitation sums that matched the monthly average precipitation distribution, as well as the mean annual precipitation. This provided a better approximation of monthly

average conditions and is run as the base condition climate to simulate the historical mean hydrologic conditions.

Sensitivity analyses (Section 2.4.2) were prepared to assess three consecutive wet or dry years applied at critical periods throughout the life of mine:

- Three consecutive dry years were applied at the most critical period for water demand, during operation of all three Management Ponds. The Project discharge during this period is minimized, which influences downgradient streamflow.
- Three consecutive wet years were applied at the most critical period of the mine life, at the end of Operations when the Project footprint is maximized and the Management Ponds approach their maximum capacity. This period produced the highest annual discharge rates and therefore increases stream water quantity and impacts stream water quality.

Under all historical precipitation conditions, the historical temperature record coinciding with precipitation inputs was used.

3.1.2 WGEN and Stochastic Hydrology

The weather-generating (WGEN) model stochastically generates daily precipitation and minimum and maximum air temperature based on monthly statistics. WGEN generates precipitation independently of other variables and air temperature is dependent on the occurrence of rain. The long-term timeseries for air temperature and total precipitation developed for the Project were used as inputs to generate statistical parameters for the WGEN model.

Precipitation is first determined by the probability of consecutive precipitation days, then the precipitation amount is generated according to a gamma distribution. The monthly probabilities of a wet day occurring after a wet day, *P(W/W)*, or dry day, *P(W/D)*, are given in Table 3-2. A wet day is defined as having more than 0.25 mm of precipitation. Table 3-3 shows the fitted gamma distribution parameters (α and β). The WGEN methodology is described in (Richardson and Wright, 1984).

Table 3-2: Probabilities of Wet or Dry Day Occurrence

Month	P(W/W)	P(W/D)
January	0.670	0.375
February	0.608	0.272
March	0.476	0.262
April	0.538	0.235
May	0.544	0.291
June	0.620	0.346
July	0.617	0.277
August	0.617	0.273
September	0.613	0.341
October	0.694	0.422

Month	P(W/W)	P(W/D)
November	0.652	0.435
December	0.624	0.390

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/ Water Balance Modelling/Mode/Updated EA Case/TelkwaEAModel_v41.gsm

Table 3-3: Precipitation Gamma Distribution Parameters

Month	α	β
January	0.826	4.50
February	0.768	4.09
March	0.837	3.20
April	0.822	3.90
May	0.748	5.55
June	0.747	6.60
July	0.807	5.44
August	0.749	5.68
September	0.808	5.92
October	0.717	6.53
November	0.777	5.63
December	0.765	4.68

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/ Water Balance Modelling/Mode/Updated EA Case/TelkwaEAModel_v41.gsm

Air temperature is generated based on the occurrence of precipitation, and the seasonal change in the means and coefficients of variation for minimum and maximum air temperature fitted with a sinusoidal curve:

$$u_i = \bar{u} + C\cos\left(\frac{2\pi}{365}(i - 200)\right), i = 1, \ldots, 365$$

Where u_i is the air temperature or coefficient of variation value on day *I,* $\bar{u}$ is the mean of u_i, *C* is the seasonal amplitude, and *i* is the amplitude position in days. Richardson and Wright (1984) recommends a *i* of 200 days. The maximum daily air temperature is highly dependent on the occurrence of precipitation; however, the minimum daily air temperature is not, and statistics were generated using both wet and dry days. These parameters are presented in Table 3-4, where temperature is presented in units of Kelvin.

Table 3-4: WGEN Air /temperature Parameters

Parameter	Value
Mean of maximum air temperature (dry) (K)	281
Mean of maximum air temperature (wet) (K)	279.8
Amplitude of maximum air temperature (wet or dry) (K)	13.6
Mean coefficient of variation of maximum air temperature (wet or dry)	0.0184
Amplitude of coefficient of variation of maximum air temperature (wet or dry)	-0.00529

Parameter	Value
Mean of minimum air temperature (wet or dry) (K)	269.9
Amplitude of minimum air temperature (wet or dry) (K)	9.763
Mean coefficient of variation of minimum air temperature (wet or dry)	0.0188
Amplitude of coefficient of variation of minimum air temperature (wet or dry)	-0.0.0112

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/ Water Balance Modelling/Mode/Updated EA Case/TelkwaEAModel_v41.gsm

3.1.3 Prediction Node Climate Adjustments

Based on the range of terrain and elevation bands within the watersheds of each prediction node, an adjustment to climate parameters was required to develop streamflow estimates in each stream. Detailed methodology for the climate adjustments is presented in Appendix A.

The long-term Project temperature and precipitation records were adjusted using the Parameter-elevation Relationships on Independent Slopes Model (PRISM) to estimate climate parameters for each of the local hydrometric stations within each stream. An average monthly precipitation for each hydrometric station watershed was derived from the gridded PRISM monthly precipitation model. These monthly precipitation values were compared against the monthly precipitation estimates for the Project, and a ratio was calculated for each month and each station (Table 3-5).

Table 3-5: Monthly Precipitation Correction Factors applied to Project Precipitation based on PRISM

Month	Tenas Hydro	Four-Hydro	Goathorn Hydro	Telkwa Hydro	Bulkley Hydro
Jan	1.84	1.30	1.88	2.06	1.74
Feb	1.68	1.19	1.71	1.89	1.81
Mar	2.00	1.42	2.03	2.29	2.07
Apr	1.81	1.39	1.87	2.05	1.83
May	1.28	1.04	1.26	1.31	1.14
Jun	1.18	1.15	1.23	1.19	1.09
Jul	1.11	1.13	1.16	1.10	1.03
Aug	1.28	1.03	1.28	1.31	1.17
Sep	1.52	1.09	1.53	1.60	1.33
Oct	1.53	1.09	1.56	1.79	1.70
Nov	1.92	1.37	1.94	2.20	1.95
Dec	1.92	1.36	1.96	2.22	1.93

Appendix A

A similar process was employed for temperature. A monthly average temperature for each hydrometric station watershed was derived from the gridded PRISM monthly temperature model. These monthly temperature values were compared against the monthly temperature estimates for the Project, and a correction addend was calculated for each month and each station (Table 3-6).

Table 3-6: Monthly Average Temperature Correction Addends (in degrees Celsius) applied to Project Average Temperature based on PRISM

Month	Tenas Hydro	Four-Hydro	Goathorn Hydro	Telkwa Hydro	Bulkley Hydro
Jan	-0.45	-0.24	-0.52	-0.45	-0.27
Feb	-0.88	-0.37	-0.98	-1.03	-0.73
Mar	-1.27	-0.43	-1.54	-1.66	-0.93
Apr	-1.64	-0.68	-1.96	-2.13	-1.19
May	-1.74	-0.78	-2.03	-2.29	-1.26
Jun	-1.81	-0.74	-2.06	-2.46	-1.38
Jul	-1.77	-0.80	-2.00	-2.33	-1.24
Aug	-1.48	-0.51	-1.71	-2.00	-0.92
Sep	-1.28	-0.43	-1.51	-1.73	-0.70
Oct	-1.17	-0.55	-1.46	-1.50	-0.58
Nov	-0.93	-0.30	-1.08	-1.16	-0.43
Dec	-0.32	-0.04	-0.36	-0.37	-0.15

Appendix A

The daily temperature and precipitation time series adjusted for each streamflow station were used to calibrate rainfall-runoff model inputs (Section 3.1.7) as well as in the water balance model.

3.1.4 Evaporation

Lake surface evaporation for the Project was developed using the Morton CRWE shallow lake evaporation (SRK 2024a). Based on the Project temperature record, as well as modelled solar radiation, relative humidity and wind speeds from the Smithers Airport station, the estimated mean annual evaporation for the Project is 598 mm. Table 3-7 presents the monthly average lake evaporation rates applied in the model.

Table 3-7: Historical Project Monthly Open Water Evaporation Rates (mm)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Monthly Evaporation (mm/mo)	0	0	0	64	101	111	120	101	52	0	0	0	598
Daily Evaporation (mm/d)	0		0	2.1	3.3	3.7	3.8	3.3	1.7	0	0	0	n.a

Source: SRK 2024a

The evaporation rates were assigned an adjustment factor calculated for each pond, depending on the dominant wind direction (S-W), and the longest width based on the dominant direction for each pond, according to the following table 3-8:

Table 3-8: Adjustment factor for evaporation rate for each pond of the Project

	NMP	EMP	WMP	Pit Sump	Plant Pond	Rail Load Out Pond
Jan	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Feb	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Apr	4.5%	3.7%	3.1%	12.9%	15.2%	25.6%
May	3.2%	2.7%	2.2%	9.3%	11.0%	18.5%
Jun	2.4%	2.0%	1.7%	7.0%	8.2%	13.8%
July	2.1%	1.7%	1.4%	6.0%	7.1%	11.9%
Aug	2.6%	2.1%	1.8%	7.5%	8.9%	14.9%
Sep	3.6%	2.9%	2.5%	10.2%	12.1%	20.3%
Oct	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Nov	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dec	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source:.https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Inputs/morton_pond_evap_correction_coef_20240821.xlsx?web=1

Changes to evaporation rates for Management Ponds when they become covered are described in Section 3.4.4.

3.1.5 Climate Change

Climate change was evaluated for the Project in terms of rates of change using monthly adjustment factors for three published projection periods. Dates to effect climate change in the model were selected as the center of each published projection period. All scenarios, hydrologic conditions and water management cases include climate change. Selection of climate change scenario for the purpose of the Project evaluation and model are reported in SRK2024a as well as methodologies for developing rates of change are presented.

Daily precipitation rates were multiplied by monthly adjustment factors presented in Table 3-9, where a value of 100% represents the use of historical data, a value less than 100% represents a decrease in monthly precipitation, and a value greater than 100% represents an increase in monthly precipitation. Results indicate a net increase in precipitation for most months with an annual adjustment factor

increasing over time, except for the last decade of this dataset. These values were interpolated to have changes for each decade in the WLBM based on values reported in SRK 2024a.

Table 3-9: Daily Precipitation Adjustment Factors for Climate Change

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1/1/2020	106%	110%	114%	94%	96%	96%	101%	99%	100%	111%	93%	118%	**103%**
1/1/2030	118%	112%	122%	101%	104%	99%	96%	103%	108%	113%	99%	123%	**108%**
1/1/2040	115%	112%	120%	104%	111%	100%	102%	105%	109%	122%	102%	124%	**110%**
1/1/2050	123%	113%	124%	112%	115%	103%	105%	104%	116%	124%	106%	121%	**114%**
1/1/2060	123%	117%	128%	117%	123%	100%	108%	104%	120%	126%	110%	132%	**117%**
1/1/2070	121%	119%	130%	119%	119%	103%	106%	101%	120%	135%	113%	136%	**118%**
1/1/2080	126%	113%	130%	122%	124%	111%	106%	103%	120%	133%	117%	140%	**121%**
1/1/2090	133%	125%	135%	131%	130%	110%	111%	105%	130%	145%	123%	135%	**126%**
1/1/2100	138%	98%	111%	116%	130%	107%	89%	100%	100%	132%	118%	133%	**114%**

Source: SRK 2024a

Note: Red text reflects a decrease over baseline conditions. A decrease for the decade starting in 2020 indicate that it's decreasing compared to historical baseline average.

Daily temperature changes were included as a net increase or decrease to historical values, as presented in Table 3-10. A value of 0 represents no change from historical temperature data, where a value greater than 0 represents a net increase in daily temperature in degrees Celsius (°C). The annual trend is a net increase in temperature for all months of the year.

Table 3-10: Daily Mean Temperature Increase for Climate Change (°C)

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1/1/2020	-1.62	1.29	0.24	0.93	0.94	1.19	1.10	0.98	0.97	0.97	0.70	0.86	**0.71**
1/1/2030	-0.97	1.78	0.73	1.19	1.25	1.48	1.49	1.46	1.25	1.35	1.03	1.48	**1.13**
1/1/2040	-0.28	2.32	1.09	1.59	1.88	1.79	1.94	1.90	1.80	1.77	1.42	1.77	**1.58**
1/1/2050	0.65	2.52	1.21	1.89	2.14	2.21	2.12	2.17	2.02	2.03	2.08	2.72	**1.98**
1/1/2060	0.68	3.41	1.81	2.32	2.62	2.59	2.60	2.69	2.50	2.55	2.44	2.71	**2.41**
1/1/2070	1.05	3.35	2.13	2.52	3.11	2.76	2.74	3.05	2.69	2.80	2.78	3.37	**2.70**
1/1/2080	1.63	3.74	2.45	2.92	3.29	3.17	3.31	3.52	3.16	3.13	3.11	4.13	**3.13**
1/1/2090	2.07	4.47	2.53	2.99	3.49	3.33	3.53	3.74	3.38	3.42	3.60	4.40	**3.41**
1/1/2100	3.35	4.76	3.17	3.56	4.16	3.53	4.30	4.17	3.70	3.75	4.56	5.32	**4.03**

Source: SRK 2024a

Daily evaporation rates were multiplied by monthly adjustment factors presented in Table 3-11, where a value of 100% represents the use of historical data, a value less than 100% represents a decrease in monthly evaporation, and a value greater than 100% represents an increase in monthly evaporation. The annual trend is a net increase in evaporation for all months of the year.

Table 3-11: Daily Evaporation Adjustment Factors for Climate Change

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1/1/2020	99%	101%	100%	98%	100%	103%	105%	102%	102%	98%	104%	101%	**101%**
1/1/2030	99%	101%	100%	98%	99%	104%	106%	104%	103%	98%	104%	101%	**102%**
1/1/2040	100%	103%	100%	99%	101%	104%	107%	106%	103%	98%	104%	102%	**102%**
1/1/2050	100%	103%	101%	99%	101%	106%	108%	107%	104%	99%	105%	102%	**103%**
1/1/2060	101%	103%	101%	99%	102%	107%	109%	108%	106%	100%	105%	102%	**104%**
1/1/2070	101%	103%	101%	100%	101%	107%	109%	109%	107%	100%	105%	103%	**104%**
1/1/2080	101%	104%	102%	101%	104%	108%	113%	111%	108%	101%	106%	103%	**105%**
1/1/2090	102%	104%	101%	100%	104%	109%	115%	112%	110%	102%	106%	104%	**106%**
1/1/2100	102%	104%	100%	98%	102%	109%	115%	114%	113%	101%	106%	103%	**106%**

Source: SRK 2024a

Climate inputs are drivers of the streamflow modeling in the water balance model, as described in Section 3.1.7. Effects of climate change on streamflow is therefore carried forward through the adjustments to temperature and precipitation.

3.1.6 Snowmelt

The SNOW-17 snow accumulation and ablation model developed by the National Weather Service River Forecast System (NWSRFS) was implemented in GoldSim to model snowmelt for the Project. The main processes included in this model are dividing precipitation into rain or snow, accumulation of snowpack, energy exchange, heat deficit in the snowpack, ground melt and snowmelt as a snow water equivalent (Anderson 2006). Model inputs include temperature and precipitation, based on the selected climate scenario, and input parameters to model a column of snow. Details on model inputs and calibration using a regional snow gauging station are described in SRK 2024a.

The routine in Goldsim produces an excess water term daily, which is the sum of rainfall and snowmelt.

3.1.7 Project Runoff Model

Runoff is frequently presented as the depth of water distributed evenly throughout the watershed area. Since the Project is located within the Goathorn Creek, Tenas Creek, Four Creek, Telkwa River and Bulkley River watersheds, rainfall-runoff models were calibrated for each stream based on the excess water produced from the snowmelt model described in Section 3.1.6.

Constant variables including the lag time, minimum baseflow and recession coefficient, along with monthly runoff coefficients, were adjusted to fit the modelled daily flow to the observed daily flow at each stream. A Nash Sutcliffe Efficiency (NSE) function was included in GoldSim, comparing the modelled vs. observed flow results. Model calibration results are described in SRK 2024a and summarized in Table 3-12.

Impacted catchments, including open pit wall areas and Management Ponds or other ponded areas, incorporated a different set of monthly runoff coefficients. Basin lag and recession were not incorporated

for these types of catchments, allowing all runoff to report to the downstream node in a single timestep. Open pit walls were assumed to consist primarily of exposed mine rock, resulting in fewer losses to infiltration than natural runoff. In this case, a monthly runoff coefficient of 0.8 or 1.0 was used, based on the corresponding values for natural catchments. Pond surfaces were assumed to have runoff coefficients equal to 1.0 year-round. Model inputs for open pit wall and pond areas are also presented in Table 3-12.

Table 3-12: Rainfall-Runoff Model Inputs

Location		Goathorn	Telkwa	Tenas	Bulkley	Four	Project	Open pit Wall	Waterbody
Minimum Unit Baseflow [L/s/km^2]		1.4	4.1	0.43	3.5	0.3	0.69	n.a	n.a
Lag Time [days]		1	1	1	1	1	1	n.a	n.a
Recession		0.9	0.92	0.91	0.96	0.77	0.86	n.a	n.a
Runoff Coefficient	January	1	1	1	1	1	1	1	1
	February	1	1	1	1	1	1	1	1
	March	0.45	1	1	1	1	0.82	1	1
	April	0.91	1	1	0.67	0.34	0.75	0.8	1
	May	0.26	0.78	0.31	0.54	0.10	0.22	0.8	1
	June	0.21	0.28	0.11	0.34	0.10	0.14	0.8	1
	July	0.76	0.92	0.12	0.53	0.04	0.31	0.8	1
	August	0.28	0.54	0.20	0.26	0.02	0.17	0.8	1
	September	0.14	0.28	0.10	0.35	0.04	0.09	0.8	1
	October	0.37	0.49	0.15	0.39	0.02	0.18	0.8	1
	November	0.14	098	0.88	0.90	0.50	0.51	0.8	1
	December	1	1	1	1	0.4	0.80	1	1

Source: SRK 2024a

Note: runoff coefficients and the baseflow value for the Project are the average for Tenas, Four and Goathorn Creeks

Runoff from overburden stockpiles was assumed to mimic natural runoff conditions, based on the expectation that dumps will be vegetated once completed, and were assigned the same parameters as natural catchments. Runoff for Non-PAG rock are discussed in Section 3.67.

3.1.8 Low Flow Model

Low flow conditions are an important indicator of stream stability in terms of its capacity to provide habitat for fish and aquatic life, as well as other users. The water and load balance model incorporates a baseflow rate calibrated on historical records (Section 3.1.7), which represents typical monthly average low flow conditions. The baseflows were selected based on review of the extended historical records at each hydrometric station, converted to unit baseflows ($m^3/s/km^2$) and applied to each modelled prediction node (SRK 2024a, summarized in Table 3-12). However, the model is unable to simulate more extreme low flow conditions, such as the 7-day low flow for specific return periods.

Low flow conditions were evaluated in two ways:

- Change to low flow conditions were developed external to the water and load balance model based on a ratio of modelled baseflow and the statistical 7-day low flow for a 1 in 10-year return period event (7Q10). Baseline 7Q10 conditions were calculated for each stream based on the extended long-term flow records. A ratio of modelled baseflow over statistical 7Q10 was calculated for each stream or river, based on the unit 7Q10 and the unit baseflow inputs. This ratio was applied to the modelled low flow conditions, which are the same under average precipitation and the 100-year dry conditions based on the constant baseflow input, to calculate the corresponding 7Q10 under post-mining conditions. Percent change relative to Pre-Mining 7Q10 was calculated for each stream node.
- Change to water quality under low flow conditions were evaluated in the Initial Dilution Zone model (SRK 2025c) and are not presented in this report.

3.2 Mine Plan

A mine plan summarizing tonnages and/or volumes of overburden, PAG, and non-PAG rock and PAG processed rock was provided by Telkwa Mining Limited as input to the water and load balance. Cumulative annual volumes of open pit capacity, Non-PAG backfill, PAG material and processed rock are presented in Table 3-13.

Table 3-13: Mine Plan Annual Volumes

Year	Mine Year	Cumulative Non-PAG Backfill Volume (Mm^3)	Cumulative PAG Volume (Mm3)	Cumulative Processed Rock Volume (Mm3)
2021	-1	-	-	-
2022	1	1.16	0.33	0.04
2023	2	2.61	1.54	0.23
2024	3	3.72	3.09	0.41
2025	4	7.55	4.80	0.58
2026	5	11.95	6.57	0.76
2027	6	15.73	8.55	0.94
2028	7	19.30	10.32	1.12
2029	8	21.64	12.08	1.30
2030	9	23.79	13.21	1.51
2031	10	26.17	14.93	1.70
2032	11	29.87	16.37	1.88
2033	12	33.14	18.23	2.06
2034	13	35.83	20.06	2.24
2035	14	38.17	21.21	2.41
2036	15	40.32	22.53	2.56
2037	16	42.22	24.12	2.73
2038	17	44.54	25.28	2.90
2039	18	46.79	26.52	3.07
2040	19	48.57	28.23	3.26
2041	20	50.02	29.43	3.47
2042	21	51.00	30.91	3.65
2043	22	51.00	31.83	3.77

Source: /NACAPR002055/Internal/Water Balance Modelling/Inputs/MasterInputs_TelkwaEA_Rev09_sab_ccm.xlsm

3.3 Catchment Areas

The expansion of mining footprints and resulting reduction in natural catchments contributing to each facility is captured in the varying catchment area timeline. A total of 13 catchment regions were delineated and sub-delineated based on varying land types.

Appendix B includes catchment area figures for each phase of the Project, as well as summary tables with model input areas for each catchment and sub-catchment. Tables are also provided for the changing catchment areas of downstream prediction nodes, while figures for the pre-mining and post-mining prediction node areas are presented in Appendix A.

3.4 Management Ponds

Each Management Pond was modelled with two reservoir elements in GoldSim: one representing the free water volume and one representing the water in the void space of deposited PAG rock and processed rock. Inflows including precipitation and runoff or pumped water from other facilities are linked to the free water reservoir. Outflows from the free water reservoir include evaporation, pumped water to other facilities, and water lost (infiltration) to the void space of placed rock. The only outflow from the rock voids reservoir is seepage into the ground, which is replaced by infiltration from the free water reservoir. This approach enables the separation of water quality in the rock voids from water quality in the free water body, which accounts for the difference in retention time of each facility. Retention time in the rock voids reservoir is the quotient of the void volume and the groundwater seepage rate. The retention time in the void space of the placed waste rock is much longer than the flushing time of the free water reservoir.

Free water reservoirs are used to track the water cover depth above PAG and processed rock to ensure the minimum water cover of 1.0 m is achieved during placement of PAG and 1.5 m after management pond is completed. Water more than target water cover depths is pumped or discharged via spillway from the pond to manage the water level (SRK 2021d). Controls to manage water cover depths are to:

- Activate pump at a rate of 9,000 m^3/day from Tenas Control Pond to any given Management Pond when that ponds' water cover depth is less than 0.50 m.
- Activate pump at a rate of 9,000 m^3/day from any given Management Pond to the Tenas Control Pond when water cover depth exceeds 0.70 m.

Pumping rates were determined based on a monthly water balance for the Tenas Control Pond, presented in the Water Management Design Technical Report (SRK 2021a).

3.4.1 Management Pond Volumetrics

Management Pond capacity and water cover thicknesses are calculated in the model based on stage-storage relationships developed from the final dam and open pit configuration of each facility (Appendix C).

Table 3-14 presents the design levels and volumes for each Management Pond, including the dam crest, spillway invert and cumulative volume, as well as the cumulative PAG rock, processed rock, Non-PAG rock and overburden volumes deposited in each pond. Volumes include total volume occupied by material, including void space. The void volumes were assumed to be 30% of the total volume for placed Non-PAG (and overburden) and PAG rock, and 15% for processed rock. These void volumes are conservative and are expected to be smaller due to natural compaction that will occur during placement in shallow lifts.

Table 3-14: Summary of Management Pond Levels and Capacities

Parameter	NMP	EMP	WMP	Notes
Total Saturated PAG Rock Volume [m^3]	2,386,000	11,561,000	27,432,000	Total volume with water in voids,
Total Saturated Processed Rock Volume [m^3]	3004,000	858,000	2,614,000	Total volume with water in voids,
Top of PAG Rock Elevation [masl]	825.2	847.3	846.9	Based on stage-storage curves (Appendix C)
Non-PAG Rock Cover average approximate Thickness [m]	1.5	1.5	1.5	Selected by TCL and SRK
Non-PAG Rock Cover Volume [m^3]	425,000	1,5750,000	1,422,000	Based on stage-storage curves (Appendix C)
Top of Non-PAG Rock Elevation [masl]	826.7	848.8	848.4	
Closure Spillway Invert [masl]	828.0	850.0	850.0	Selected by Telkwa Mining and SRK
Overburden Cover average approximate Thickness [m]	1.3	1.2	1.6	Calculated based on spillway invert and top of Non-PAG rock
Overburden Cover Volume [m^3]	848,000	1,356,000	1,548,000	Based on stage-storage curves (Appendix C)
Dam Crest Elevation [masl]	830.0	852.0	852.0	Selected by TCL and SRK

Source: /NACAPR002055/Internal/Water Balance Modelling/Inputs/MasterInputs_TelkwaEA_Rev09_sab_ccm.xlsm

3.4.2 PAG Rock Deposition

The PAG rock deposition schedule by volume for each Management Pond is presented in Figure 3-1.

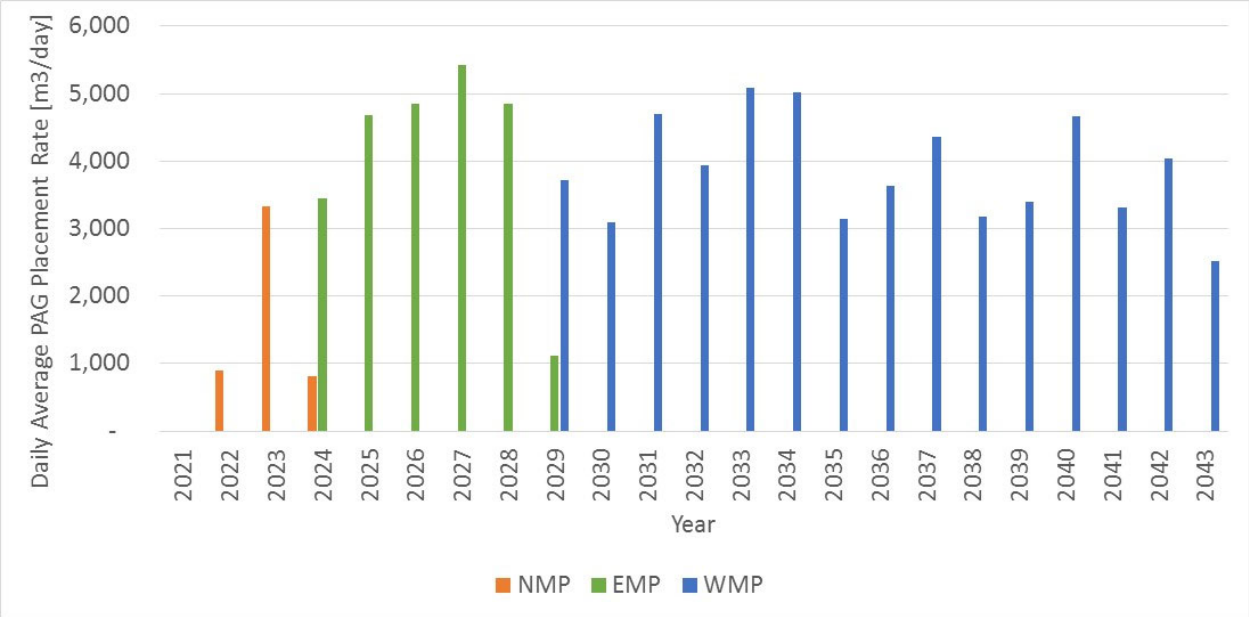


Figure 3-1: Annual Average PAG Placement Rates, m^3/day

Source: /NACAPR002055/Internal/Water Balance Modelling/Inputs/MasterInputs_TelkwaEA_Rev09_sab_ccm.xlsm

3.4.3 Processed Rock Deposition

Processed rock from the CPP is deposited in the active Management Ponds, comingled with PAG rock deposition. The deposition rate of processed coal is 500 m^3/day on average.

3.4.4 Management Pond Covers

Upon completion of PAG rock and processed rock deposition in each Management Pond, a cover system will be constructed to provide the following:

1. Reduce evaporative losses by decreasing the water vapor gradient between the water and atmosphere.
2. Isolate PAG rock from potential human and environmental influence and exposure (i.e. from oxidation from oxygen ingress).
3. Help return the landscape to pre-mining conditions.

The cover design is discussed in Appendix C of the Water Management Technical Design Report (SRK 2021a).

Evaporation rates from the Management Ponds once covered were reviewed as part of the scoping-level cover design. Covers will be vegetated with plant species that meet closure objectives. Based on existing vegetation in the area, a forest of black spruce and aspen will be planted across the Management Pond covers as part of progressive closure of each facility. Actual evapotranspiration rates from similar forests

range from 252 mm/year to 450 mm/year (SRK 2021a, Appendix C). Based on this range, it was assumed that the cover would reduce annual evaporation rates from the Management Ponds to 400 mm/year, or effectively reducing evaporation by 25% over an open-water body. A sensitivity analysis was performed on this assumption, which considered the ability of Management Ponds to maintain minimum water covers without the benefit of the cover (i.e., evaporation rates are equal to open-water conditions). Results are discussed in Section 4.1.1.

3.4.5 Management Pond Dams and Buttresses

Seepage and runoff from Management Pond dams and buttresses will be captured in peripheral ditches and conveyed to the Tenas Control Pond.

The dams and long-term buttresses constructed for each Management Pond will be constructed with Non-PAG rock and overburden. The volume of Non-PAG rock and overburden will be approximately equal throughout the life of mine. Modeling assumes that the water chemistry of buttress and dam runoff and seepage will be the average of the Non-PAG rock and overburden source terms.

Once construction of each dam and buttress are complete, a compacted overburden layer will be placed over each facility to reduce the infiltration rate into the structures from 40% to 10% of precipitation (Section 3.7). This will be followed by layer of growth media and/or soil for final vegetation planting for the decommissioning and reclamation and Post-closure phases. Runoff from the cover will have overburden source term and seepage will have the average of the Non-PAG rock and overburden source terms. Runoff and seepage rates are described with the waste rock hydrology conceptual model (Section 3.7).

3.5 Water Supply

Tenas Control Pond supplies water for the Project. Water is distributed to three locations:

- the Management Ponds to maintain water covers over PAG rock.
- mixing with the treated effluent from the sewage treatment plant discharge during May through October.
- the CPP if not enough is available from the Open Pit sump.

3.5.1 CPP Process Requirements

The CPP water demand is approximately 15,000 m^3/month based on the processing rate of 1.05 million tonnes per annum. A maximum water demand of 130 litres per tonne, and an allowance of 3,625 m^3/month for wash bays and dust suppression (all rates provided by TML) were also implemented. Water is supplied by the sump located downstream of the Open Pit, collecting seepage from the backfill, then from the Tenas Control Pond as a contingency if the Pit sump is unable to provide enough for process water throughout Operations. The water balance completed for the EA shows that the Pit sump can always provide water for process and therefore Tenas Control Pond is not required as a water supply source. A contingency water supply source from Goathorn Creek was also simulated at a rate equal to

2.5% percent of the pre-mining flow rate. This source is configured to be utilized as needed based on low water volumes in the Project area, however the modelled removal of water from Goathorn Creek at node WQS06 occurs throughout the entire Project Operations period for the purpose of the EA. This condition is discussed in model results (Section 4.1.2). The water balance completed showed that this contingency is not required.

3.5.2 Management Pond

Management Ponds are required to maintain a minimum water cover above stored PAG rock and processed rock to reduce the risk of oxidation (Section 3.4) and subsequent acid rock drainage. Water supply requirements for the Management Ponds vary throughout the life of mine and are expected to increase with increasing PAG rock and processed rock volumes. The Management Ponds collect flows from active open pit mining and natural runoff from undisturbed catchment areas. Any deficits are made up by pumping from the Tenas Control Pond, supplied by a pumping system with a capacity of 9,000 m^3/day.

3.5.3 Sewage Effluent

The sewage treatment plant will discharge 5,000 m^3 of treated effluent per year into the tributary of Goathorn Creek (Radloff 2021) during the open-water season (May through September). A dilution rate of 10:1 is required, which will be supplied by a minimum discharge rate from the Tenas Control Pond of 8,300 m^3/month during the discharge period (50,000 m^3/year).

3.5.4 Tenas Control Pond Operations

The Tenas Control Pond design is presented in SRK (2021d), which includes a maximum operating level, an emergency spillway, a minimum operating level, and a contingency storage volume to attenuate storm events. Target volumes are used in the model to trigger actions including discharge to environment or pumps to Management Ponds. The following triggers have been included:

- The design volume of the Tenas Control Pond to its spillway is 1,060,300 m^3. The design stipulates that a minimum of 210,300 m^3 of storage be maintained as contingency for storm events (SRK 2021d). The model does not simulate storm events and uses an upper bound equal to the target maximum operating volume of 850,000 m^3, thereby ensuring that the contingency storage is maintained. Pond overflows in the model represent depletion of contingency storage and the model was optimized to ensure overflows do not occur under average hydrologic conditions.
- Discharge to Goathorn Creek tributary at a rate of 15,000 m^3/d or less is enabled when the Tenas Control Pond volume exceeds 500,000 m^3, which only occurs during open water season months (May to October). This volume was selected as part of pond optimization to avoid depletion of contingency storage during average conditions. Discharge during winter months is prevented through active discharge throughout open water season to avoid reduced dilution capacity in Goathorn Creek at that time.

- Pumping to Management Ponds for water cover supply is disabled when the pond volume is reduced below 50,000 m^3/month. This target volume ensures that a minimum volume is available for sediment control and potentially to provide process water supply.

The Tenas Control Pond stage-storage curve is presented in Appendix C.

3.6 Collection Channel Efficiency

A diversion channel south of the EMP (channel C02) will divert runoff to Four Creek. Ditch bypass contributes to water availability to maintain the Management Pond water cover. A sensitivity analyses was completed on the dich efficiency for this system to ensure water cover could be maintained without relying on ditch bypass (20% of flows).

3.7 Waste Rock Hydrology

The hydrologic model for waste rock storage facilities differs from natural catchment hydrology, due to the lack of overburden and vegetation and the ability of dumps to temporarily store water in their void space (assumed to be 30%). During active material placement, all rock piles, including Non-PAG rock backfill, dams, and buttresses, are modelled as water reservoirs, accumulating inflow until the internal moisture content reaches a specified level. At the specified saturation level, water is assumed to discharge as seepage from the toe of the facilities, where it is captured by collection channels and diverted to downstream management and/or control ponds.

Figure 3-2 presents the conceptual model and Table 3-15 summarizes the model inputs and assumptions.

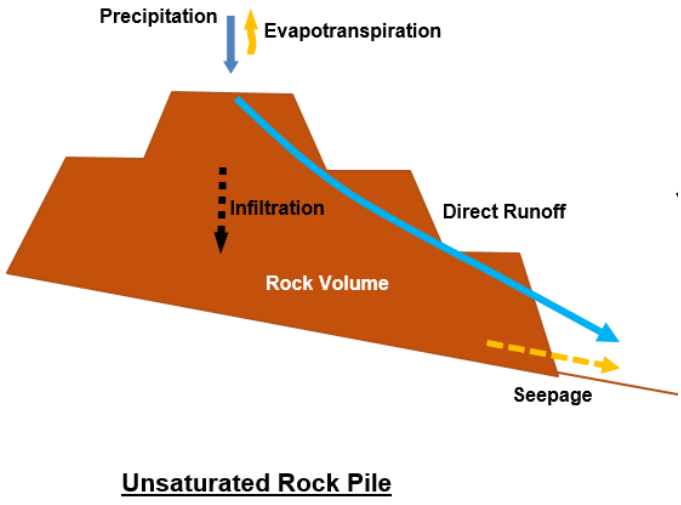


Figure 3-2: Conceptual Waste Pile Model for Unsaturated Rock

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\ConceptualModel\Planning\TelkwaWB_Planning_01292021.pptx

Open Pit Backfilled Material during Operations and closure

The seepage produced by the backfill (Non-PAG and overburden) during Operations and closure were modeled separately to the SRK Goldsim water balance model. The seepage was estimated in parallel to the development of a source term for the Non-PAG backfill, as described in Okane 2024, and these seepage rates were used as an input to the SRK Goldsim water balance model. Okane used a different framework to SRK to estimate seepage from the backfill with the use of a Wetting-up and Draindown model, but the resulting seepage are of the same order of magnitude as the SRK water balance model and therefore acceptable as inputs for the Goldsim model. Okane's model differs in that the backfill is separated into different mine rock layers, and considers hydraulic conductivity for each layer, as new rock is being placed (Okane 2024).

All Non-PAG rock will be covered with overburden at the end of Operations, reducing infiltration and increasing direct runoff rates, and approximately 70% of total rock volume placed in the open pit will be Non-PAG with the remainder is overburden which is also non-PAG.

Once the mine rock backfill is saturated, seepage is conveyed to the West Management Pond.

Other Unsaturated Rock Piles

Other unsaturated rock piles include the rock dams and buttresses of Management and Control Ponds. The model assumes fixed percentages of precipitation falling on unsaturated rock pile areas will become runoff, evaporate, or infiltrate. Water that infiltrates will be stored in the rock pile until the pile reaches the target moisture content of 7.0% by mass, after which any additional water will discharge as seepage at the toe of the pile.

The mine plan currently states that dams and buttresses will be 30% Non-PAG rock and 70% overburden material by volume. Seepage water chemistry is modeled based on a combined source term developed by SRK assuming the mixed material proportion detailed above (SRK 2024b). This assumes that overburden will be distributed throughout the rock pile, ensuring that water is in contact with both materials equally limiting the chance of preferential flow pathways in the Non-PAG rock which could result in Non-PAG rock dominated seepage water chemistry. Seepage will be lagged with a recession value, like natural runoff rates. A recession value of 0.995 was selected for seepage to simulate a relatively smooth outflow.

Table 3-15: Assumptions for Saturated and Unsaturated Rock Piles

Parameter	Unsaturated Rock	Saturated Rock	Justification
% of Precipitation that Infiltrates	40%	10%, based on Okane water balance modelling	Okane 2024 for Saturated Rock
% of Precipitation as Direct Runoff	10%	Varies per month based on natural runoff rates	
% of Precipitation that Evaporates on surface	50%	50%, based on Okane water balance modelling	Based on monthly water balance

Parameter	Unsaturated Rock	Saturated Rock	Justification
Target Moisture Content which enables Seepage	7%[1]	~30%, based on Okane models (Okane 2024)	Based on SRK experience with operational waste rock dumps (unsaturated)
Runoff Recession Value	0.995	Unknown, part of Okane's internal modelling	Selected to create an even outflow with minimal response to peak rainfall events

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\ConceptualModel\Planning\TelkwaWB_Planning_01292021.pptx

Note: [1] 7% by mass of placed rock

3.8 Groundwater

A regional groundwater model was developed for the EA. The model estimated groundwater fluxes, discharge, and recharge from the Project (SRK 2024c). Model results assume that management and control ponds are lined, including the in-pit portions of the WMP which are in contact with overburden. All non-overburden contact areas in the WMP in-pit area are not lined. Two modelled scenarios were considered:

- Expected groundwater scenario corresponds to the best fit model inputs, calibrated against head observations and average annual baseflows in each stream. This condition produced a normalized root mean square error (NRMSE) of 3.2% for hydraulic heads and 3.6% for baseflows (SRK 2024c).
- A sensitivity groundwater scenario corresponds to an outlier condition where the hydraulic conductivities are maximized, while the calibration target is held near the minimum generally accepted in British Columbia (10% NRMSE [Normalized Root Mean Square Error]). This condition emphasizes the potential groundwater flows into the open pit, underneath the waste and water management facilities, and into the creeks (SRK 2024c).

Four snapshot periods were evaluated in the groundwater model:

- End of Year 1: The North Management Pond and Tenas Control Pond are filled with water and PAG rock. No other Management Ponds are active. Connections to the open pit are dictated by the facility footprint and depth currently and active dewatering is occurring.
- End of Year 7: The East Management Pond is filled with water and PAG rock, joining the North Management Pond and the Tenas Control Pond. The open pit extents have increased, and active dewatering continues.
- End of Mining: The West Management Pond is filled with water and PAG rock, joining the North and East Management Ponds and the Tenas Control Pond. The open pit is filled to the maximum level but the open pit is still being actively dewatered.
- Post-Closure: All Management Ponds remain in-place, however the Tenas Control Pond has been breached and no longer stores water. Dewatering from the open pit has ended and the end pit lake and saturated waste rock have formed.

Groundwater connections are incorporated into the water and load balance model based on three components: direct connections to Project infrastructure, changes to stream baseflow, and load transport to streams.

3.8.1 Groundwater Flow Rates through Project Infrastructure

Instantaneous connections occur between the groundwater system and each mining facility, including the open pit, Management Ponds, and the Tenas Control Pond. Groundwater inflows and groundwater seepage loss connected to each facility occur on a daily timestep throughout the model period and are presented in Table 3-16 for the expected case groundwater model scenario and in Table 3-17 for the high case groundwater model scenario.

Table 3-16: Expected Case Groundwater Connections to Mining Facilities throughout Life of Mine [m^3/day]

Phase	WMP	NMP	EMP	Tenas Control Pond	Open Pit	Open pit with Saturated Backfill
Inflows						
EoY1	0.0	0.0	0.0	0.0	317	n.a
EoY7	0.0	0.0	0.0	0.0	888	n.a
End of Mining	139	0.0	0.0	0.0	550	n.a
Post-Closure	137	0.0	0.0	0.0	n.a.	171
Outflows						
EoY1	0.0	198	0.0	140.0	0.0	n.a
EoY7	0.0	198	458	140.0	0.0	n.a
End of Mining	836	198	458	140.0	0.0	n.a
Post-Closure	819	198	458	0.0	n.a.	7.1

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Groundwater\Telkwa_Summary_2020_GW_model_results_Draft_20201203_gf_sab_rev03.xlsx

Notes:

Connections are not applicable (n.a.) for end pit lake at closure since it is replaced by the end pit lake and saturated backfill components. The reverse is true for the End Pit Lake and saturated backfill during Operations.

Table 3-17: Sensitivity Case Groundwater Connections to Mining Facilities throughout Life of Mine [m^3/day]

Phase	WMP	NMP	EMP	Tenas Control Pond	Open Pit	Open Pit with Saturated Backfill
Inflows						
EoY1	0.0	0.0	0.0	0.0	408	n.a
EoY7	0.0	0.0	0.0	0.0	1144	n.a

Phase	WMP	NMP	EMP	Tenas Control Pond	Open Pit	Open Pit with Saturated Backfill
End of Mining	95	0.0	0.0	0.0	671	n.a
Post-Closure	86	0.0	0.0	0.0	n.a.	110
Outflows						
EoY1	0.0	210	0.0	290.0	0.0	n.a
EoY7	0.0	210	535	290.0	0.0	n.a
End of Mining	2073	210	535	290.0	0.0	n.a
Post-Closure	1919	210	535	0.0	n.a.	189

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Groundwater\Telkwa_Summary_2020_GW_model_results_Draft_20201203_gf_sab_rev03.xlsx

3.8.2 Changes to Stream Baseflow

The change in water levels within the Management Ponds, Control Ponds, and the open pit affect the groundwater discharge rates to each downstream creek and river. The calibrated rainfall-runoff model included a constant unit baseflow for each major creek, which is applied to each associated prediction node. The baseflows were simplified in the groundwater model calibration (SRK 2024c). To understand the change to baseflows because of the mine, the groundwater model predicted baseline baseflow and baseflow during mining at each prediction node for each scenario. The rate baseflow changed between baseline conditions and mining conditions were directly applied to the baseflow component for each prediction node in the water balance model.

The baseflow dominates the total streamflow during winter months but represents a minor portion of the total streamflow during the open-water season, even during the late summer flows. Baseflow rates in the receiving environment increase or decrease, depending on location in relation to the open pit and the Management Ponds. These changes are linearly interpolated between each snapshot for each prediction node. Table 3-18 presents the rate of change to prediction node baseflows under base case groundwater modeling conditions, and Table 3-19 presents the results for sensitivity groundwater case conditions.

Four Creek baseflow contribution

A recent study (SLR 2025) specifically analyzed data collected for the groundwater system and streamflow regime of Four Creek and developed a water balance model to examine whether Four Creek exhibits perched conditions. Perched conditions would imply that baseflow found in the Creek are disconnected for part or all of the reach of the Creek. Their conclusions suggest that perched conditions are likely "*due to the presence of fine till in the shallow overburden which acts as a low permeability layer inhibiting water from percolating down to the main deep groundwater table.*[SLR 2025]. This implies that changes to the groundwater table due to mining (i.e. drawdown from open pit and raised levels in Management Ponds) would not impact the baseflows in upstream Four Creek.

Other reasons that support their results are as follow:

- *"Vertical hydraulic gradients consistently show negative values, indicating that Four Creek is a losing stream, where water from the creek seeps outwards into the shallow subsurface.*
- *Conductivity measurements along Four Creek show minimal variation except for a few locations. These conductivity measurements suggest contributions to streamflow along Four Creek come from direct precipitation and recently fallen precipitation that arrives at the creek as interflow along the creek's length.*
- *Discharge measurements collected along the length of the channel network do not indicate the presence of consistent groundwater contributions to baseflow."* [SLR 2025]

While these results indicate perched conditions that would disconnect prediction nodes WQS03, WQS20, and WQS21, this report and the WLBM uses the results from the hydrogeological model (SRK 2024c) as these are considered more conservative in terms of changes to Four Creek.

Table 3-18: Rate of Change to Baseflow for Prediction Nodes throughout Life of Mine under Base Case Groundwater Conditions (SRK 2024c)

Node	Stream	End of Year1	End of Year7	End of Mining	Post-Closure
WQS01	Tenas Creek	-0.1%	-0.2%	-0.4%	-0.3%
WQS02	Tenas Creek	-1.1%	-3.9%	1.7%	1.9%
WQS03	Four Creek	-0.7%	-20.5%	-29.8%	-22.7%
WQS03DS	Four Creek	-4.2%	-5.0%	-0.3%	4.0%
WQS04	Tenas Creek	-0.9%	-5.6%	3.3%	3.0%
WQS05	Goathorn Creek	-0.5%	-1.9%	0.8%	1.1%
WQSEA1	Goathorn Creek	-0.3%	-0.5%	-0.1%	0.3%
WQS06	Goathorn Creek[1]	0.0%	0.0%	0.0%	0.0%
WQS06US	Goathorn Creek	0.0%	-0.2%	-0.2%	0.0%
WQS09	Telkwa River	-0.4%	-1.6%	0.7%	1.0%
WQS11	Bulkley River	0.0%	0.0%	0.0%	0.0%
WQS12	Bulkley River	-0.01%	-0.02%	0.01%	0.01%
WQS13	Goathorn Creek	0.0%	-0.2%	-0.3%	0.0%
WQS20	Four Creek	-2.6%	-21.3%	-32.8%	-22.3%
WQS21	Four Creek	-1.5%	-22.0%	-34.4%	-25.0%
WQS22	Tenas Creek	-1.0%	-5.9%	3.4%	3.1%

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Groundwater\Telkwa_Summary_2020_GW_model_results_Draft_20201203_gf_sab_rev03.xlsx

Note: [1] WQSEA1 was not modelled in the previous version of the model (from August 2022) and was added after the groundwater model results were made available. Due to the close proximity between WQSEA1 and WQS06, the changes to baseflows are now applied to WQSEA1 instead of WQS06.

Table 3-19: Rate of Change to Baseflow for Prediction Nodes throughout Life of Mine under High Case Groundwater Conditions (SRK 2024c)

Node	Stream	End of Year1	End of Year7	End of Mining	Post-Closure
WQS01	Tenas Creek	-0.1%	-0.5%	-0.5%	-0.3%
WQS02	Tenas Creek	-1.6%	-6.6%	10.9%	11.5%
WQS03	Four Creek	0.0%	0.0%	0.0%	0.0%
WQS03DS	Four Creek	-16.8%	-13.4%	92.2%	121.3%
WQS04	Tenas Creek	0.0%	-10.6%	32.0%	30.7%
WQS05	Goathorn Creek	-0.2%	-2.1%	7.1%	7.1%
WQSEA1	Goathorn Creek	-0.3%	-0.3%	1.9%	2.2%
WQS06	Goathorn Creek	0.0%	0.0%	0.0%	0.0%
WQS06US	Goathorn Creek	0.0%	-0.2%	-0.2%	-0.3%
WQS09	Telkwa River	-0.2%	-1.5%	5.2%	5.3%
WQS11	Bulkley River	0.0%	0.0%	0.0%	-0.2%
WQS12	Bulkley River	0.0%	-0.02%	0.08%	0.08%
WQS13	Goathorn Creek	0.0%	-0.1%	-0.3%	-0.6%
WQS20	Four Creek	-22.9%	-100.0%	-100.0%	-100.0%
WQS21	Four Creek	-22.9%	-100.0%	-100.0%	-100.0%
WQS22	Tenas Creek	-0.2%	-12.4%	36.4%	35.1%

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Groundwater\Telkwa_Summary_2020_GW_model_results_Draft_20201203_gf_sab_rev03.xlsx

Under the sensitivity case groundwater model predictions, there is no baseflow to Four Creek at WQS20 and WQS21 (i.e., 100% reduction in Table 3-19). Rate of change to combined streamflow, including runoff contributions, is discussed with the model results.

3.8.3 Contaminant Plume from Project Infrastructure

Water outflows from the Management Ponds, Tenas Control Pond and the open pit into the groundwater system take place instantaneously. However, there is a natural lag between the timing of seepage at the source and seepage being observed within the various stream prediction nodes. Particle tracing within the groundwater model revealed that a portion of seepage reaches the adjacent reach of Tenas Creek before end of mining, but that most of the seepage will not be observed until well past closure.

The model assumes the following:

- Seepage contributions into Tenas Creek prediction nodes WQS02 and WQS22 begin at end of Year 7 and increase linearly to their end of mining.
- Seepage from each Management Pond is delayed 25 years from infiltrating into the facility to reaching prediction nodes. This timing is conservatively early based on the particle tracing results.
- Tenas Control Pond is decommissioned in closure; however, the seepage plume is assumed to continue contributing to the streams for 25 years beyond its decommissioning. Modeling assumes the pond is decommissioned 5 years after the start of closure, and seepage is assumed to continue to discharge to the creeks for an additional 25 years.

The contaminant load reaching each prediction node is calculated based on the percentage of particles leaving each Management Pond, open pit or Control Pond that reach each node under steady-state conditions, considering the dilution of the mine seepage into the total groundwatershed for each stream calculated by the groundwater model. Results for expected case conditions are presented in Table 3-20 and sensitivity case groundwater seepage conditions in Table 3-21.

Table 3-20: Percentage of Groundwater Seepage from each Mining Facility Reporting to Downstream Prediction Nodes under Expected Case Groundwater Conditions (SRK 2024c)

Facility	Node	Phase			
		End of Year1	End of Year7	End of Mining	Post-Closure
North Management Pond	WQS04	0%	0%	7%	67%
	WQS05	0%	0%	5%	67%
	WQS09	0%	0%	8%	0%
	WQS22	0%	0%	7%	67%
East Management Pond	WQS03DS	0%	0%	0%	56%
	WQS04	0%	0%	0%	7%
	WQS05	0%	0%	0%	98%
	WQSEA1	0%	0%	0%	91%
West Management Pond	WQS02	0%	0%	5%	38%
	WQS04	0%	0%	7%	83%
	WQS05	0%	0%	7%	89%
	WQSEA1	0%	0%	0%	6%
	WQS09	0%	0%	7%	0%
	WQS22	0%	0%	7%	76%
Tenas Control Pond (1)	WQS04	0%	0%	0%	37%
	WQS05	0%	0%	0%	38%
	WQS03DS	0%	0%	0%	0%
Saturated Open pit Backfill	WQS02	0%	0%	0%	17%
	WQS04	0%	0%	0%	67%
	WQS05	0%	0%	0%	83%
	WQSEA1	0%	0%	0%	17%
	WQS22	0%	0%	0%	50%

Notes:

1. Seepage from the Tenas Control Pond is reduced to zero from 1/1/2074 onwards to reflect the decommissioning of the facility.

Table 3-21: Percentage of Groundwater Seepage from each Mining Facility Reporting to Downstream Prediction Nodes under High Case Groundwater Conditions (SRK 2024c)

Facility	Node	Phase			
		End of Year1	End of Year7	End of Mining	Post-Closure
North Management Pond	WQS04	0%	0%	15%	32%
	WQS05	0%	0%	15%	32%
	WQS09	0%	0%	15%	0%
	WQS22	0%	0%	15%	32%
East Management Pond	WQS03DS	0%	0%	0%	34%
	WQS04	0%	0%	0%	10%
	WQS05	0%	0%	0%	98%
	WQSEA1	0%	0%	0%	87%
West Management Pond	WQS02	0%	0%	25%	48%
	WQS04	0%	0%	51%	81%
	WQS05	0%	0%	51%	87%
	WQSEA1	0%	0%	0%	5%
	WQS09	0%	0%	51%	0%
	WQS22	0%	0%	51%	77%
Tenas Control Pond (1)	WQS04	0%	0%	0%	28%
	WQS05	0%	0%	0%	38%
	WQS03DS	0%	0%	0%	0%
Saturated Open pit Backfill	WQS02	0%	0%	0%	8%
	WQS03DS	0%	0%	0%	8%
	WQS04	0%	0%	0%	58%
	WQS05	0%	0%	0%	100%
	WQSEA1	0%	0%	0%	42%
	WQS22	0%	0%	0%	25%

Notes:

1. Seepage from the Tenas Control Pond is reduced to zero from 1/1/2074 onwards to reflect the decommissioning of the facility.
2. End Pit Lake discharge to groundwater only occurs under Sensitivity Case groundwater modeling predictions and is therefore excluded from Table 3-20 (base case).

3.9 Water Quality Objectives

The following sections present the proposed in-stream guidelines and end of pipe limits.

3.9.1 In-Stream Guidelines

The long-term average BC Approved Water Quality Guidelines or BC AWQG (ENV 2025a) and the BC Working Water Quality Guidelines or BC WWQG (ENV 2025b) for freshwater aquatic are applied in the evaluation of results from the load balance for most cases, exceptions are laid out below. When both a dissolved and a total guideline was found for a parameter (e.g. nickel), only the dissolved value was kept. Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME WQG) are applied for parameters for which there is no BC AWQG or BC WWQG. WQG values for various parameters depend on the water quality in the receiving environment itself. WQG values are established for different potential receiving environments, based on average background concentrations (i.e., pre-mining conditions). When guidelines depend on hardness, the median hardness from baseline datasets within each creek was selected. Post-mining stream hardness will be higher than baseline and are presented with water quality results in Section 0.

In the case of selenium, the CCME WQG is 0.001 mg/L, which was developed as an alert concentration for early detection of selenium concerns. The BC Ministry of Environment proposed a guideline value of 0.002 mg/L by comparing ambient selenium surface water concentrations in British Columbia (ENV 2014), Alberta and across Canada. With the review of existing toxicological data, the CCME advise that the BC WQG for selenium can be applied across Canada based on jurisdiction's needs and policy goals (ECCC 2021). For this reason, the BC WQG for total selenium was selected as the in-stream target threshold concentration for the Project.

The BC WQG for total mercury is dependent on the in-stream concentration of methyl mercury (MeHg) and can range from 0.02 µg/ for streams where MeHg represents 0.5% or less of total mercury, 0.01 µg/L for streams where MeHg represents 1.0% of total mercury, and 0.00125 µg/L for streams where MeHg represents more than 8.0% of total mercury. Concentrations of MeHg were not measured as part of the baseline monitoring program. The detection limit for total mercury in baseline datasets is 0.0025 µg/L, which is greater than the lowest BC WQG of 0.00125 µg/L for higher proportions of MeHg. The geochemical characterization found mercury concentrations in the humidity cell data were always below the detection limit of 0.01 µg/L. For these reasons, mercury is not expected to be a parameter of concern for the Tenas Project, and the mid-range BC WQG (0.01 ug/L) was used to assess model results.

In the case of total molybdenum, the BC wildlife (ruminant) long-term Chronic WQG was chosen as it was the most stringent (WQG=0.034mg/L) and was applicable for the Project.

There was no BC WQG (Approved or Working), and no CCME guideline for Total Strontium. Therefore, the ECCC FEQG (environment guideline for Aquatic Life was applied as a default (WQG= 2.5mg/L).

Proposed long-term average WQG for the protection of freshwater aquatic life and human health at the Project are summarized in Table 3-22.

Table 3-22: Proposed Long-term Average Water Quality Guidelines for Freshwater Aquatic Life in receiving Environments

Receiving Environment		Tenas Creek					Four Creek					Goathorn Creek					Telkwa River					Bulkley River				
Parameter	**Units**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**
Ammonia, total	mg-N/L	1.3		1.27	**1.3**	Used BC AWQG	0.992		1.27	**0.992**	Used BC AWQG	1.56		1.27	**1.56**	Used BC AWQG	1.66		1.27	**1.66**	Used BC AWQG	1.6		1.27	**1.6**	Used BC AWQG
Chloride	mg/L	150		120	**150**	Used BC Acute AWQG	150		120	**150**	Used BC AWQG	150		120	**150**	Used BC AWQG	150		120	**150**	Used BC AWQG	150		120	**150**	Used BC AWQG
Fluoride	mg/L	1.22		0.12	**1.22**	Used BC AWQG	1.37		0.12	**1.37**	Used BC AWQG	1.19		0.12	**1.19**	Used BC AWQG	0.99		0.12	**0.99**	Used BC AWQG	0.84		0.12	**0.84**	Used BC AWQG
Nitrate	mg-N/L	3		13	**3**	Used BC AWQG	3		13	**3**	Used BC AWQG	3		13	**3**	Used BC AWQG	3		13	**3**	Used BC AWQG	3		13	**3**	Used BC AWQG
Nitrite	mg-N/L	0.02			**0.02**	Used BC AWQG	0.02			**0.02**	Used BC AWQG	0.02			**0.02**	Used BC AWQG	0.02			**0.02**	Used BC AWQG	0.02			**0.02**	Used BC AWQG
Sulphate	mg/L	218			**218**	Used BC AWQG	309			**309**	Used BC AWQG	218			**218**	Used BC AWQG	218			**218**	Used BC AWQG	128			**128**	Used BC AWQG
Aluminum, total	mg/L	0.35		0.1	**0.35**	Used BC AWQG	0.69		0.1	**0.69**	Used BC AWQG	0.27		0.1	**0.27**	Used BC AWQG	0.19		0.1	**0.19**	Used BC AWQG	0.18		0.1	**0.18**	Used BC AWQG
Antimony, total	mg/L	0.074			**0.074**	Used BC AWQG	0.074			**0.074**	Used BC AWQG	0.074			**0.074**	Used BC AWQG	0.074			**0.074**	Used BC AWQG	0.074			**0.074**	Used BC AWQG
Arsenic, total	mg/L	0.005		0.005	**0.005**	Used BC AWQG	0.005		0.005	**0.005**	Used BC AWQG	0.005			**0.005**	Used BC AWQG	0.005		0.005	**0.005**	Used BC AWQG	0.005		0.005	**0.005**	Used BC AWQG
Barium, total	mg/L	1			**1**	No AWQG, Used WWQG	1			**1**	No AWQG, Used WWQG	1			**1**	No AWQG, Used WWQG	1			**1**	No AWQG, Used WWQG	1			**1**	No AWQG, Used WWQG
Beryllium, total	mg/L	0.00013			**0.00013**	No AWQG, Used WWQG	0.00013			**0.00013**	No AWQG, Used WWQG	0.00013			**0.00013**	No AWQG, Used WWQG	0.00013			**0.00013**	No AWQG, Used WWQG	0.00013			**0.00013**	No AWQG, Used WWQG
Boron, total	mg/L	1.2		1.5	**1.2**	Used BC AWQG	1.2		1.5	**1.2**	Used BC AWQG	1.2		1.5	**1.2**	Used BC AWQG	1.2		1.5	**1.2**	Used BC AWQG	1.2		1.5	**1.2**	Used BC AWQG

Receiving Environment		Tenas Creek					Four Creek					Goathorn Creek					Telkwa River					Bulkley River				
Parameter	**Units**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**
Cadmium, dissolved	mg/L	0.00017			**0.00017**	Used BC AWQG	0.00023			**0.00023**	Used BC AWQG	0.00016			**0.00016**	Used BC AWQG	0.00011			**0.00011**	Used BC AWQG	0.000085			**0.00009**	Used BC AWQG
Chromium (Cr(VI)), total	mg/L		0.0025	0.001	**0.0025**	No AWQG, Used WWQG		0.0025	0.001	**0.0025**	No AWQG, Used WWQG		0.0025	0.001	**0.0025**	No AWQG, Used WWQG		0.0025	0.001	**0.0025**	No AWQG, Used WWQG		0.0025	0.001	**0.0025**	No AWQG, Used WWQG
Cobalt, dissolved	mg/L	0.00045			**0.00045**	Used BC AWQG	0.00056			**0.00056**	Used BC AWQG	0.00045			**0.00045**	Used BC AWQG	0.00039			**0.00039**	Used BC AWQG	0.00039			**0.00039**	Used BC AWQG
Copper, dissolved	mg/L	0.0026			**0.0026**	Used BC AWQG	0.0047			**0.0047**	Used BC AWQG	0.0013			**0.0013**	Used BC AWQG	0.0008			**0.0008**	Used BC AWQG	0.0011			**0.0011**	Used BC AWQG
Iron, total	mg/L	1		0.3	**1**	Used BC Acute WQG	1		0.3	**1**	Used BC Acute WQG	1		0.3	**1**	Used BC Acute WQG	1		0.3	**1**	Used BC Acute WQG	1		0.3	**1**	Used BC Acute WQG
Iron, dissolved	mg/L	0.35			**0.35**	Used BC Acute WQG	0.35			**0.35**	Used BC Acute WQG	0.35			**0.35**	Used BC Acute WQG	0.35			**0.35**	Used BC Acute WQG	0.35			**0.35**	Used BC Acute WQG
Lead, dissolved	mg/L	0.0031		0.002	**0.0031**	Used BC AWQG	0.0061		0.004	**0.0061**	Used BC AWQG	0.0026		0.002	**0.0026**	Used BC AWQG	0.0022		0.001	0.0022	Used BC AWQG	0.0022		0.001	**0.0022**	Used BC AWQG
Manganese, total	mg/L	0.94			**0.94**	Used BC AWQG	1.09			**1.09**	Used BC AWQG	0.91			**0.91**	Used BC AWQG	0.79			**0.79**	Used BC AWQG	0.73			**0.73**	Used BC AWQG
Mercury, total	mg/L	0.00002		0.000026	**0.00002**	Used BC AWQG	0.00002		0.000026	**0.00002**	Used BC AWQG	0.00002		0.000026	**0.00002**	Used BC AWQG	0.00002		0.000026	**0.00002**	Used BC AWQG	0.00002		0.000026	**0.00002**	Used BC AWQG
Molybdenum, total	mg/L	7.6		0.073	**0.034**	Used BC ruminant wildlife guideline	7.6		0.073	**0.034**	Used BC ruminant wildlife guideline	7.6		0.073	**0.034**	Used BC ruminant wildlife guideline	7.6		0.073	**0.034**	Used BC ruminant wildlife guideline	7.6		0.073	**0.034**	Used BC ruminant wildlife guideline
Nickel, dissolved	mg/L	0.003			**0.003**	Used BC AWQG	0.005			**0.005**	Used BC AWQG	0.002			**0.002**	Used BC AWQG	0.001			**0.001**	Used BC AWQG	0.001			**0.001**	Used BC AWQG
Selenium, total	mg/L	0.002		0.001	**0.002**	Used BC AWQG	0.002		0.001	**0.002**	Used BC AWQG	0.002		0.001	**0.002**	Used BC AWQG	0.002		0.001	**0.002**	Used BC AWQG	0.002		0.001	**0.002**	Used BC AWQG

Receiving Environment		Tenas Creek					Four Creek					Goathorn Creek					Telkwa River					Bulkley River				
Parameter	**Units**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**	**BC AWQG**	**BC WWQG**	**CCME WQG**	**Selected for FEAC 2025**	**Rationale**
Silver, total	mg/L	0.00005		0.00025	**0.00005**	Used BC AWQG	0.0015		0.00025	**0.0015**	Used BC AWQG	0.00005		0.00025	**0.00005**	Used BC AWQG	0.00005		0.00025	**0.00005**	Used BC AWQG	0.00005		0.00025	**0.00005**	Used BC AWQG
Strontium, dissolved	mg/L				**2.5**	No BC AWQG or WWQG, Used ECCC FEQG for Aquatic Life				**2.5**	No BC AWQG or WWQG, Used ECCC FEQG for Aquatic Life				**2.5**	No BC AWQG or WWQG, Used ECCC FEQG for Aquatic Life				**2.5**	No BC AWQG or WWQG, Used ECCC FEQG for Aquatic Life				**2.5**	No BC AWQG or WWQG, Used ECCC FEQG for Aquatic Life
Thallium, total	mg/L		0.00003	0.0008	**0.00003**	No AWQG, Used WWQG		0.00003	0.0008	**0.00003**	No AWQG, Used WWQG		0.00003	0.0008	**0.00003**	No AWQG, Used WWQG		0.00003	0.0008	**0.00003**	No AWQG, Used WWQG		0.00003	0.0008	**0.00003**	No AWQG, Used WWQG
Uranium, total	mg/L		0.0085	0.015	**0.0085**	No AWQG, Used WWQG		0.0085	0.015	**0.0085**	No AWQG, Used WWQG		0.0085	0.015	**0.0085**	No AWQG, Used WWQG		0.0085	0.015	**0.0085**	No AWQG, Used WWQG		0.0085	0.015	**0.0085**	No AWQG, Used WWQG
Zinc, dissolved	mg/L	0.0071		0.014	**0.0071**	Used BC AWQG	0.0139		0.028	**0.0139**	Used BC AWQG	0.0074		0.015	**0.0074**	Used BC AWQG	0.0042		0.008	**0.0042**	Used BC AWQG	0.0039		0.008	**0.0039**	Used BC AWQG

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20240516_UEA_to%20BAT%20Team/New%20Results%20to%20BAT%20Team/BAT_Calcs_05042024/Telkwa_BAT_assessment_BCWQGused_15072025.xlsx?web=1

Notes:

* Guidelines determined by baseline receiving water quality.
** Short-term maximum BC AWQG are provided for fluoride and total and dissolved iron.
*** All chromium in baseline monitoring data is assumed to be Cr(VI)
**** The guideline for total mercury is dependent on the methyl mercury concentrations of the receiving environment, which is not measured in the baseline data. The mid-range guideline was selected, which assumes a concentration of MeHg that is 1.% of total mercury. since the lowest limit is below the detection limit of the baseline monitoring data.

3.10 Source Term Summary

The load balance considers multiple scenarios of source term combinations, based on alternative rock management strategies and ranges in geochemical source terms.

Two PAG rock exposure scenarios were considered, including a 6-month exposure period (typical exposure), and a 12-month exposure period (high case exposure). The longer exposure period simulates a scenario where the PAG rock may oxidize for a longer period, and therefore generate more soluble load that will be flushed from surfaces when placed in the management ponds.

For baseline surface water and groundwater concentrations 50th (P50) and 95th percentile (P95) source terms were developed. Specifically, seasonal surface water concentrations were applied in the model following the open water season (May to October) and the frozen winter season (November to April).

Base case and high case source terms were developed for non-PAG rock runoff, pit wall rock runoff and coal stockpile runoff. The base case uses geochemical inputs that are representative of the average bulk properties of the mine rock. The high case source term is calculated assuming the drainage from each source is in equilibrium with gypsum (i.e., sulfate concentrations are increased to gypsum saturation) and scaling up elemental concentrations assuming the base case element sulfate ratios are preserved. Additional detail on the source term derivation methods is provided in Appendix E, as well as in Okane's report specifically for the backfill Non-PAG seepage (Okane 2024).

Table 3-23 shows a summary of geochemical source terms developed for the Project where each source term represents an estimate of water quality (mg/L), or parameter loadings (kg/t of rock) contributed by a Project component. The following sections provide more detailed explanations of the source terms included in the load balance.

Table 3-23: Summary of Load Balance Source Terms

Source Term	Units	Applies to
Background Groundwater Concentration	mg/L	Groundwater inflows to open pit and Management Ponds
Background Surface Water Concentrations	mg/L	Applied to undisturbed catchments. Includes separate terms for Telkwa River, Bulkley River, Four Creek, Tenas Creek and Goathorn Creek based on two different seasons: open water season (May to October) and a winter season (November to April).
Backfill Non-PAG seepage	mg/L	Applied to the backfill in the Pit in Operations in Closure, from Okane's 2024 report. Was blended with overburden, and considered progressive cover
Non-PAG Runoff/Seepage Concentration	mg/L	Non-PAG waste rock storage piles, also applied to infrastructure pad surface areas, rail infrastructure area and CPP area. Was blended with overburden for the dams and buttresses
Coal stockpile runoff	mg/L	Applied to temporary coal stockpiles in the Rail Infrastructure area
Open pit wall runoff	mg/L	Applied to exposed open pit wall area
Processed Rock Runoff Concentration	mg/L	Applied to surface runoff volume from coal stockpiles in the Rail Infrastructure area

PAG Rock Flush Rate	kg/t	PAG waste rock backfill to Management Ponds
NAG Rock Flush Rate	kg/t	Non-PAG waste rock backfill to the Management Ponds
Coal Reject Flush Rate	Kg/t	Coal reject to the Management Ponds
Blasting Residue	mg/a	Non-PAG, PAG and coal waste rock volumes
Sewage Treatment Plant Effluent	mg/L	Applied to effluent water from sewage treatment plant into Tenas Pond

Source: Generated in report.

3.10.1 Background Water Quality

Background water quality has been monitored since at least the early 1980s. Baseline water quality monitoring specific to the Project was initiated in 2017 by ERM and has continued since. There is a considerable amount of existing surface water and groundwater quality baseline information available.

Available water quality data were reviewed in support of the EA, and statistics were developed for both surface water and groundwater. Detailed baseline water quality characterization is presented in ERM 2021, including reference to the certified laboratories that conducted sample analysis and quality assurance completed with result compilation, and were updated in 2024 with new available data up to May 2024.

Groundwater Quality

50th and 95th percentile background groundwater chemistry for wells in the Project area was used for groundwater inflows to the open pit. Total or dissolved concentrations for each parameter were applied depending on whether the WQG for the parameter applies to total or dissolved fractions. For some parameters of particular interest for the Project (namely, aluminum, chromium, copper, and iron), both total and dissolved concentrations were applied regardless of whether the WQG for the parameter applies to total or dissolved fractions.

Background groundwater chemistry is summarized in Appendix D. In processing the background and receiving water quality data, values presented as less than the method detection limit were assumed equal to the method detection limit to be conservative.

Groundwater in the overburden and bedrock wells exceed CCME WQG for fluoride on average. Groundwater exceedances of WQG for total metals are likely an artefact of high TSS concentrations and were corrected accordingly to match observed dissolved concentrations. Both overburden wells and bedrock wells exceed the BC WQG for dissolved cadmium on average.

Surface Water Quality

50th and 95th percentile background surface water quality in Tenas Creek, Four Creek, and Goathorn Creek was applied for the Tenas area, as well as excess water from overburden and topsoil stockpiles. Background surface water quality is summarized in Appendix D. The data used to produce the 50th and 95th background surface quality for the Receiving Environment used in the water and load balance model

comes from the water quality baseline study done between 2017 and 2019 (ERM 2019) and updated with water quality data up to 2024.

50th and 95th percentile background surface water quality in each of Four Creek, Goathorn Creek, Tenas Creek, Telkwa River, and Bulkley River was applied as receiving water quality for associated prediction nodes. Receiving environment water quality is summarized in Appendix D.

In processing the baseline water quality data, values presented as less than the method detection limit were assumed to be equal to the method detection limit to be conservative.

Based on grab samples, all surface water streams have occasionally exceeded the BC AWQG for total aluminum and exceedances typically occur during the spring freshet.

Based on grab samples, most surface water streams have exceeded the BC AWQG for dissolved copper, namely Goathorn Creek, Telkwa, and Bulkley River.

Based on grab samples, surface water Telkwa River, and Bulkley River have exceeded the short-term BC AWQG for total iron.

3.10.2 Non-PAG backfill Seepage Source Terms

Supporting information on the geochemical and reactive transport modelling for the Non-PAG backfill source terms can be found in Okane (2024). Concentrations accompanied by seepage rates (as described in section 3.7) were detailed for two cases, a base case representative of typical conditions and a high case for higher loadings due to higher oxidation in the backfill:

The monthly seepage flow rates and corresponding monthly concentrations can be found in Appendix E and in Okane 2024.

3.10.3 Open Pit Wall, Coal Stockpile, and Non-PAG runoff Source Terms

Estimated source term ranges for non-PAG runoff for dams and buttresses of Management Ponds and Tenas Control Ponds, coal stockpile runoff, and open pit wall runoff are summarized in Appendix E. Base case and high case source terms were developed. As described in Section 3.10, the base case uses geochemical inputs that are representative of the average bulk properties of the mine rock and the high case source term is calculated assuming the drainage from each source is in equilibrium with gypsum. Element concentrations are scaled-up in the high case assuming the base case element sulfate ratios.

Open pit wall source terms were generated for three periods throughout the life of mine based on the exposed pit wall area at the end of deposition of PAG rock in each management pond. The model conservatively incorporates a constant source term for pit wall runoff based on the maximum source term concentration for each element across the three periods. Runoff from pit wall areas is expected to be neutral throughout Operations. Modeling assumes that 95% of open pit walls will be covered by end of closure, including all areas that have the potential to become acid-generating.

Source terms for non-PAG rock, coal stockpiles and open pit walls are dissolved element concentrations. Particulate element concentrations were calculated for ponds discharging to the environment based on

an assumed TSS concentration of 35 mg/L and proportions of TSS comprised by various elements based on whole rock analysis for non-PAG and PAG rock. Total element concentrations were calculated by adding dissolved and particulate concentrations (Appendix E).

Particulates were assumed to be filtered in groundwater pathways. All groundwater loadings to downstream prediction nodes were assumed to be dissolved concentrations only.

3.10.4 PAG Rock, Coal Rejects (Processed Rock), and Non-PAG Flushing Terms

Supporting information on the derivation of flushing source terms are presented in Appendix E.

Loading from PAG rock, coal rejects and non-PAG rock used in the management pond covers is assumed to be flushed from the rock when it is placed in the management ponds into the ponded water within an average of one year of placement. Annual PAG rock and unit coal reject and non-PAG rock flushing rates were prepared for the following two scenarios:

- Typical Exposure Scenario: assuming PAG rock is stored on surface for six months.
- High Exposure Scenario: assumes PAG rock is stored on surface for 12 months.

3.10.5 Nitrogen Species derived from Blasting

Nitrogen loading from blasting with ammonium nitrate and fuel oil (ANFO) explosives was accounted for using estimates of explosive usage and the annual tonnages of waste rock. Explosive characteristics were developed based on Fergusson and Leask 1988 and SRK experience (Table 3-24). Typical ammonium nitrate and nitrogen contents, and nitrogen distribution were applied to estimate concentrations of ammonia, nitrate, and nitrite, based on volumes of waste rock reported in the mine plan. Nitrogen losses were decreased from typical values as the mine plan integrates the use of blasthole liners, which would significantly reduce the nitrogen losses in the system (conservatively by a factor of 4). Delayed release and natural attenuation of nitrogen species have not been accounted for within the water and load balance at this time to be conservative, and it is assumed that all nitrogen species are flushed from waste rock on an annual basis.

Table 3-24: Explosive demand and characteristics

Parameter	Units	Value
Powder Factor	g/m^3 waste rock	500
Explosive Loss	%	1.25[1]
Explosives Mix		
% Bulk ANFO	%	75
% Bulk Emulsion	%	25
Quantities in Ammonium Nitrate		
% Nitrogen	% of ANFO	35
Nitrogen Composition		
% Nitrate	%	87
% Nitrite	%	2
% Ammonia	%	11

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Model\EA_Modeling\TelkwaEAModel_v24.gsm

Note: [1] This value is assuming the use of blasting liners, based on a mix of ANFO (25%) and emulsion (75%)

Nitrate, nitrite, and ammonia loading were added to each Management Pond or Tenas Control Pond based on the mass of PAG or Non-PAG rock upstream of each facility.

The ANFO model assumptions accounts for operational controls and mitigation measures during blasting to reduce the potential release of blast residuals such as the use of blasting liners. A high case of 5% explosive loss is also used along with the high case source term to look at potential higher nitrogen residue released.

3.10.6 Sewage Treatment Plant

A sewage treatment plant will operate onsite and will discharge treated effluent to Goathorn Creek tributary at a rate of 5,000 m^3/year from May through September. The effluent water quality for parameters in the model are presented in Table 3-25 (Radloff 2021).

Table 3-25: Sewage Treatment Plant Effluent Water Quality

Parameter	Units	Value
Nitrate (as N)	mg-N/L	36.9
Nitrite (as N)	mg-N/L	0.1
Total Ammonia (as N)	mg-N/L	1.9

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Model\EA_Modeling\TelkwaEAModel_v24.gsm

3.11 Model Quality Assurance and Quality Control

SRK's quality assurance and quality control (QA/QC) procedures include:

- Verification that all model elements were correctly linked.
- Cross-checking of flows and source terms to ensure model elements not duplicated or missed.
- Cross-checking of model elements and mine phases to ensure the timing of events is accurate as per the EA mine plan.
- Confirmation that the inputs and assumptions were correct and consistent with other EA models.
- Verification of model functions and expressions to ensure are working as intended.
- Professional judgement and experience to evaluate if results reflect the understanding of the conceptual model.

3.12 Uncertainty, Complexity, and Conservatism

Project Case Results and Mitigation Measures

The Project Case model conditions, including the source terms and average hydrologic conditions are incorporated to simulate the expected (typical), or best estimate, based on available information. An appropriate level of conservativism was used for model assumptions as described in the sections above. Mitigation measures were incorporated into the water management plan to address impacts to water quantity or quality.

The alternative assessment cases are intended to represent the reasonable worst case, or the upper bound of expected changes to water quality and quantity. Mitigation measures have not necessarily been incorporated to address potential water quality or quantity considerations identified in the Alternative Assessment cases. Contingency planning and/or adaptive management may be more appropriate if concentrations exceed the Project Case estimates. These contingencies were modelled separately in the mitigation report (SRK 2025b) and assessed in the framework of a Best Available Technology Assessment report (SRK 2025a).

4 Model Results

Model results are presented in the following sections for all assessment cases described in Section 2.4.2.

Results are grouped into sub-sections on water quantity and water quality.

4.1 Project Water Quantity Results

4.1.1 Water Cover

Water balance results are used to determine whether the minimum water cover thickness of 0.5 m during PAG placement can be maintained in all Managements Ponds within 6-months of PAG rock placement and 1.5 m for the rest of the life of mine and closure. The depth of the water cover 30 days after rock placement is also predicted.

Water cover results for each relevant assessment case area summarized in the following sections.

Project Case

Monthly average water cover results for the Project Case are presented in Figure 4-1, including the PAG rock elevation (red), the water surface elevation (black), the monthly average water cover depth (green) and the 30-day lagged water cover depth (blue). A temporary (4-month) reduction in NMP water cover occurred in the winter of 2024 due to the small footprint of the Project at that time. Water in EMP and WMP is stored there prior to adding PAG, but is quickly drawn back to between 0.5 m and 1.0 m for operational purposes during PAG placement. Water is occasionally pumped from Tenas Control Pond to NMP, EMP and WMP while PAG is being placed to maintain water cover, but these pumping events are infrequent. Since the duration of low water cover in NMP is less than 6 months (duration of exposure in source terms), and the water cover is not depleted, results show that the minimum water cover can be maintained in operation and closure. The 30-day lagged water cover is always above 1.0 m under average conditions outside of PAG placement. The system is sufficiently robust for average conditions.

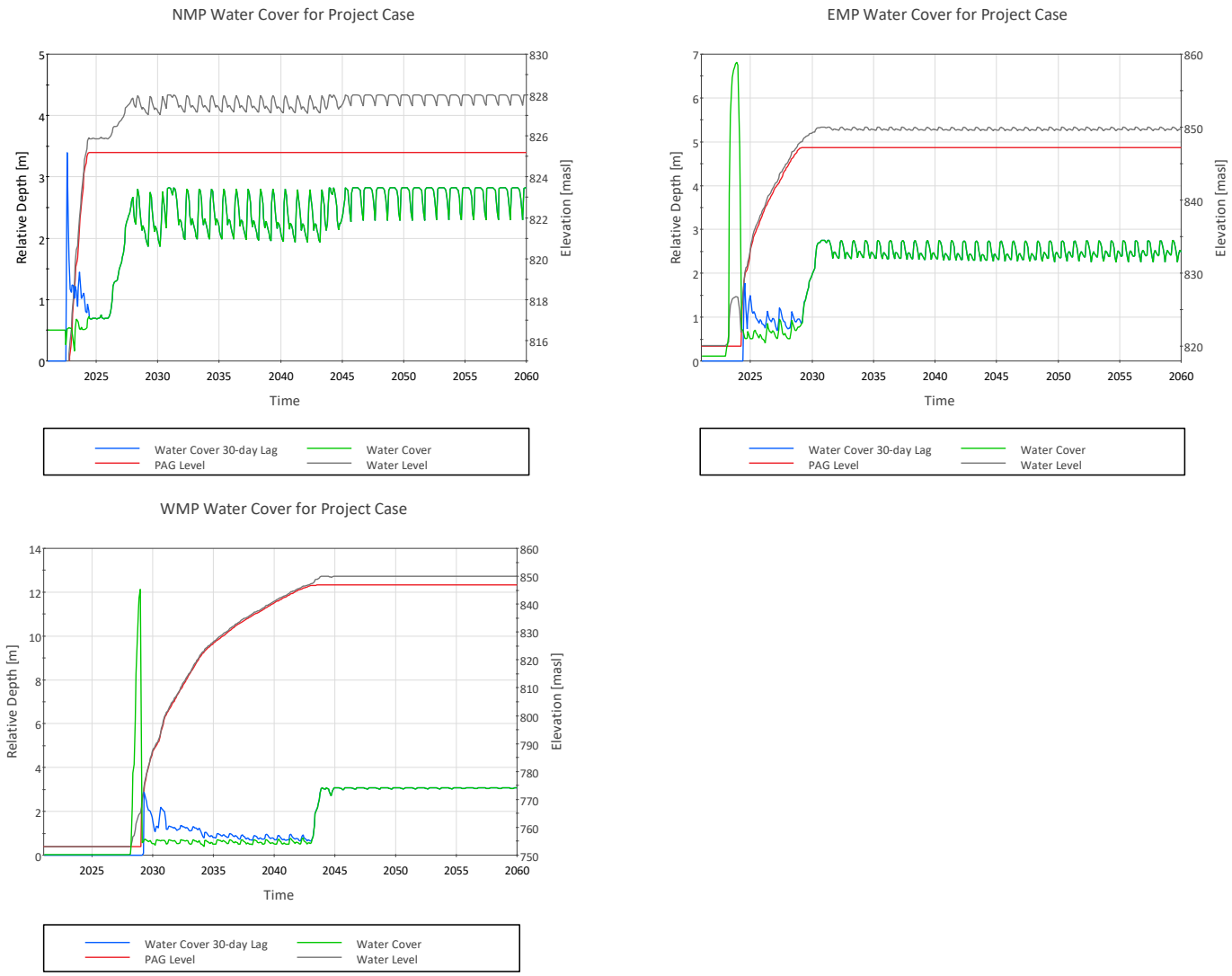


Figure 4-1: Monthly Average Water Cover in Management Ponds for Project Case

Source: CAPR002055 Telkwa Project general EA Support\Internal\Water Balance Modelling\Model\202309_Updated EA Case\2025_submitted_modelresults\TelkwaEAModel_v40_UEA_new hydro_updatedSTs_newGW_BCresults.gsm

Alternative Case 1

Water cover thickness results for Alternative Case 1, with groundwater seepage rates that represent maximized hydraulic conductivity in the groundwater model, are presented in Figure 4-2 for each Management Pond. Like Project Case results, a short-term low water cover period is observed in the NMP during 2024, while the minimum 1.0 m thickness is maintained in all other years throughout operation and closure outside of PAG placement. The 30-day lagged water cover is always above 0.5 m during PAG placement and 1.5 m after completion of the management pond.

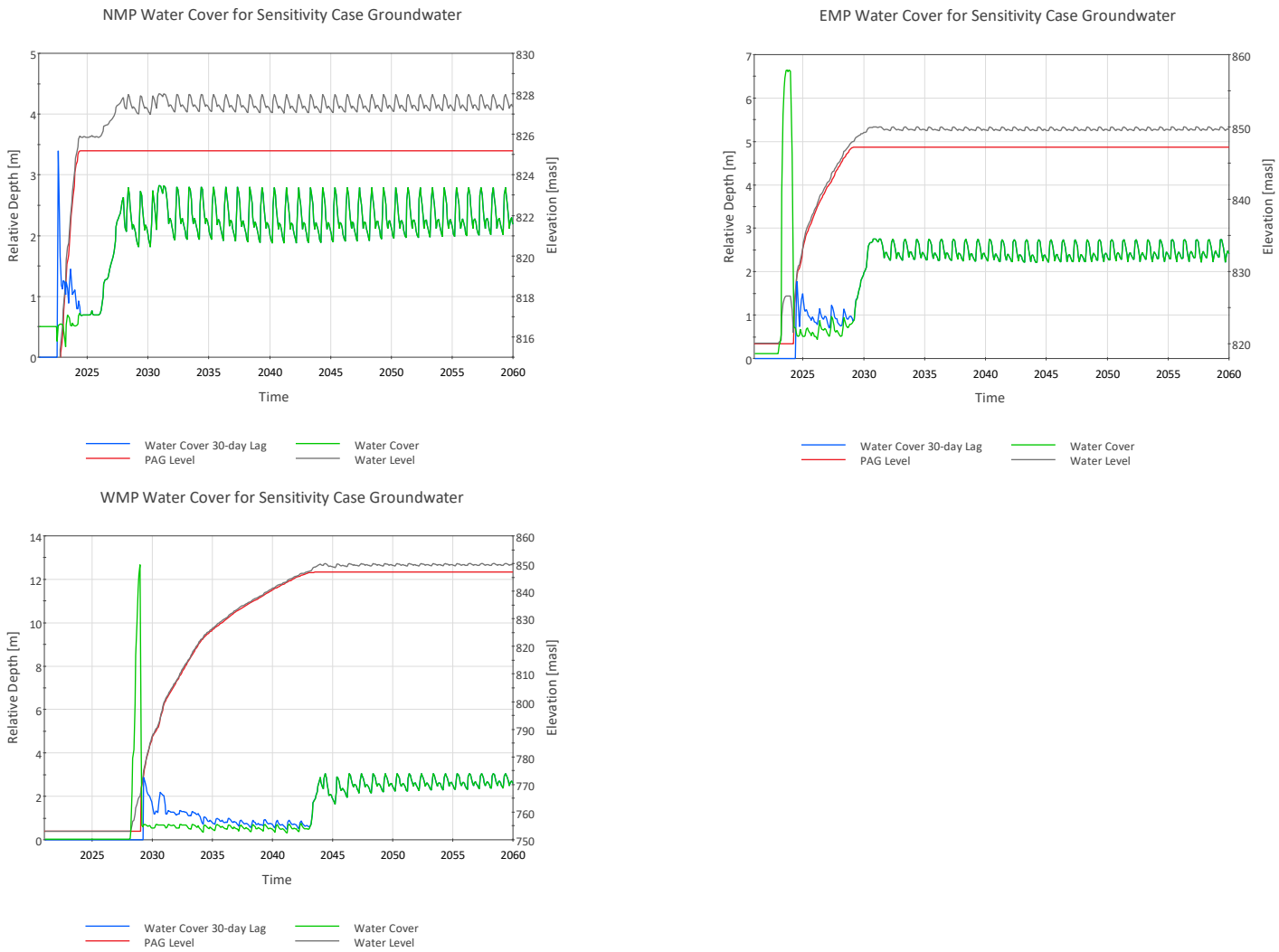


Figure 4-2: Monthly Average Water Cover in Management Ponds for Alternative Case 1 for Groundwater Seepage Loss with increased hydraulic conductivity

Source: : CAPR002055 Telkwa Project general EA Support\Internal\Water Balance Modelling\Model\202309_Updated EA Case\2025_submitted_modelresults\TelkwaEAModel_v40_UEA_newhydro_updatedSTs_newGW_Alt1results.gsm

Alternative Case 3

Alternative Case 3 applies three consecutive 100-year dry precipitation conditions to the Project area. An early Operations period was evaluated (Figure 4-3) as well as a late Operations period (Figure 4-4), for years 2022 through 2024 and 2041 through 2044, respectively. Results show the 10-year operating period around each scenario.

The early Operations period is more critical than the late Operations period. The water cover in the NMP is less than 0.5 m for multiple months in early 2024. In this scenario, the Tenas Control Pond is discharging to Goathorn Creek in May 2024 during freshet. As an operational decision water could be stored to provide additional water cover. In the event of an extreme period of dry years, contingency pumping of 2.5% from Goathorn Creek may also be enabled to provide water supply which has been provided in the model. During these prolonged dry periods, the 30-day lagged cover remains greater than 0.5 m. At no time would PAG rock be directly exposed. For this reason, and accounting for alternative pumping sources or storage of water during freshet, the water management system is sufficiently robust to meet management objectives under the extreme dry scenario considered.

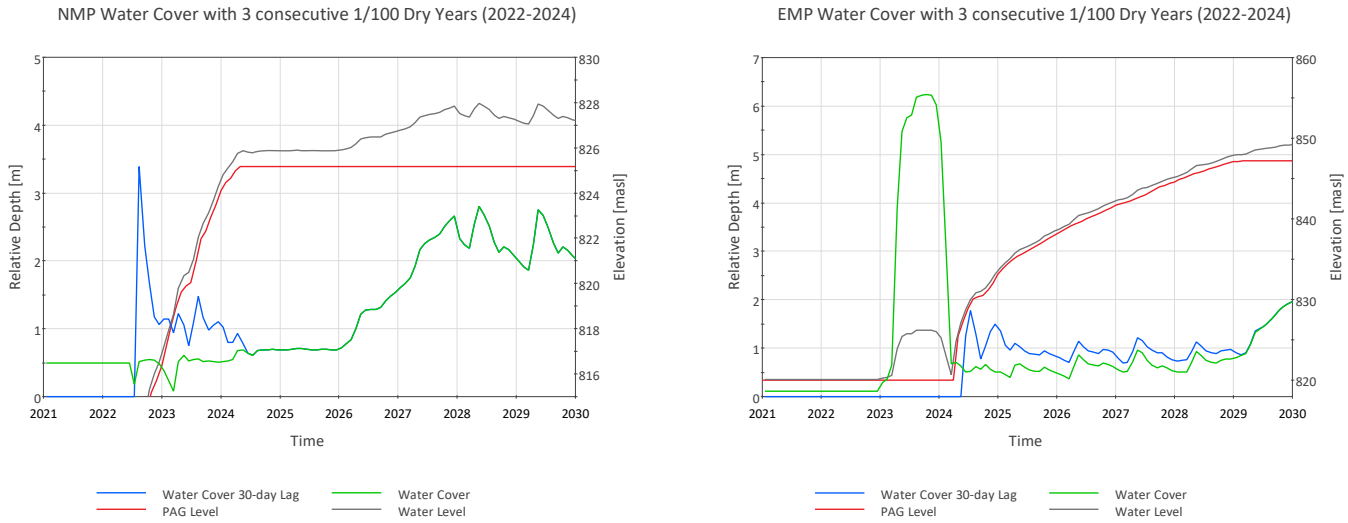


Figure 4-3: Monthly Average Water Cover in Management Ponds for Alternative Case 3 with Three Consecutive 100-year Dry Years in Early Operations (2022-2024)

Source: : CAPR002055 Telkwa Project general EA Support\Internal\Water Balance Modelling\Model\202309_Updated EA Case\2025_submitted_modelresults\TelkwaEAModel_v40_UEA_newhydro_updatedSTs_newGW_Alt3aresults.gsm

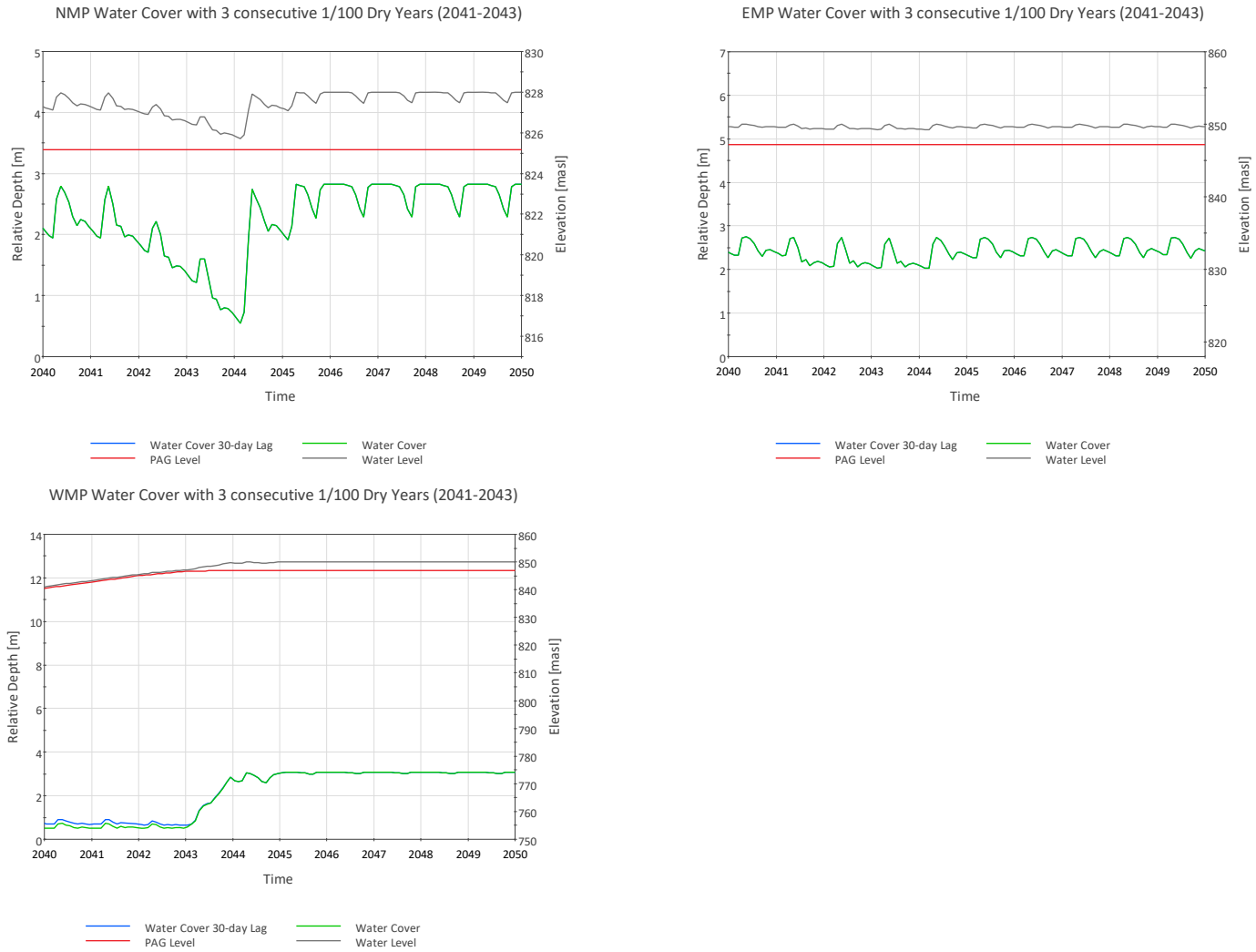


Figure 4-4: Monthly Average Water Cover in Management Ponds for Alternative Case 3 with Three Consecutive 100-year Dry Years in Late Operations (2041-2043)

Source: : CAPR002055 Telkwa Project general EA Support\Internal\Water Balance Modelling\Model\202309_Updated EA Case\2025_submitted_modelresults\TelkwaEAModel_v40_UEA_new hydro_updatedSTs_newGW_Alt3bresults.gsm

Alternative Case 6

Stochastic modeling of climatic variables (temperature and precipitation) over the life of mine was also used to test the robustness of the water management system. On each timestep (daily), the WGEN climate model selects a precipitation, daily maximum and daily minimum temperature value based on historical statistics. A total of 100 realizations of the full mine life were simulated. The statistical distribution of modelled simulations from the Monte Carlo simulation are presented in Figure 4-5, including the 1%, 50% and 99% percentile of results. Note that the plots were cropped to 2050 for ease of presentation, however the full closure period was simulated to 2100. Water cover fluctuations beyond 2050 are like those observed from 2045 to 2050, without being depleted below the 1.0 m minimum thickness.

Results indicate that temporary reductions in water cover below the 1.0 m target are plausible in the Management Ponds, however these periods are less than 6 months in duration and the water cover is never fully depleted (to 0 m thickness). Like Alternative Assessment 3, alternative water supply sources may be incorporated as mitigation measures throughout the operational period if extreme dry conditions persist. Water covers are maintained at the 99% result level in closure.

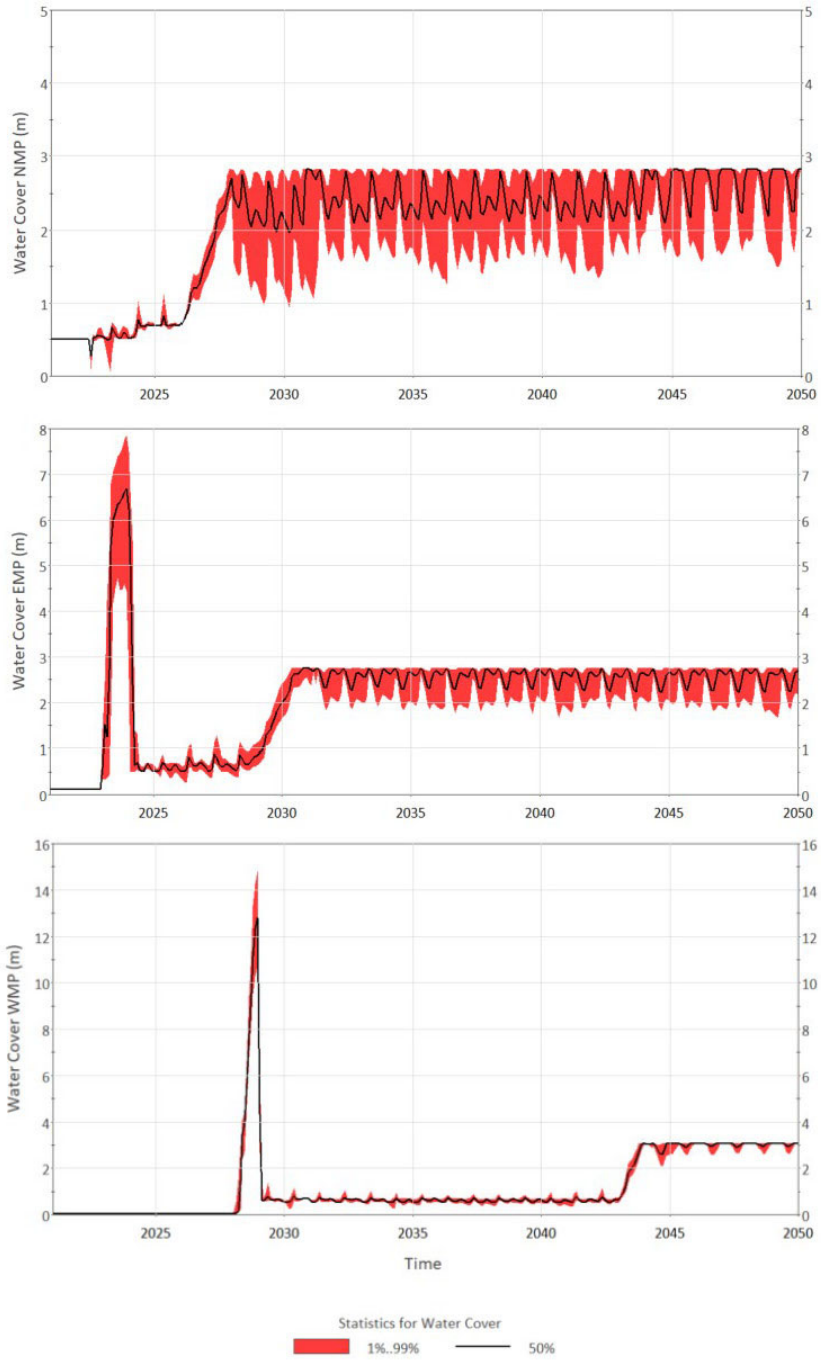


Figure 4-5: Monthly Average Water Cover in Management Ponds for Alternative Case 6 with Stochastic Climate, including the 1%, 50% and 99% Results

Source: : CAPR002055 Telkwa Project general EA Support\Internal\Water Balance Modelling\Model\202309_Updated EA Case\2025_submitted_modelresults\TelkwaEAModel_v40_UEA_new hydro_updatedSTs_newGW_Alt6results.gsm

Additional Sensitivity Analyses

Other sensitivity analyses included:

- An upper-case evaporation analysis was modelled where Management Pond water covers were left without soil and rock covers. This increased evaporation rates to the full open-water values, instead of 25% reduction (as described in Section 3.4.4). Results show that the water cover requirements are still achieved in all three management ponds under average hydrologic conditions.
- The capture efficiency of the diversion channel upstream of the East Management Pond was assumed to be 80%, which results in 20% of upstream runoff contributing to the pond's water cover in perpetuity. A case was modelled assuming 100% diversion efficiency, which reduces the inflows to the water cover. In this case and under average hydrologic conditions, the minimum water covers are maintained.

4.1.2 Process Water Supply

The Open Pit Sump is the primary source of process water for the CPP at a rate of approximately 500 m^3/day. Under Project Case conditions, process water supply is met year-round throughout the operation period. Tenas Control Pond is a back-up source for process water supply but is never needed under average conditions.

Alternative Assessment Case 6 was used to test process water supply under variable annual climatic conditions. Results presented in Figure 4-6 show that water supply can be met even under extreme dry conditions. No water needs to be drawn from Tenas Control Pond under variable annual climate conditions. The 2.5% contingency of water withdrawal from Goathorn Creek was also not required.

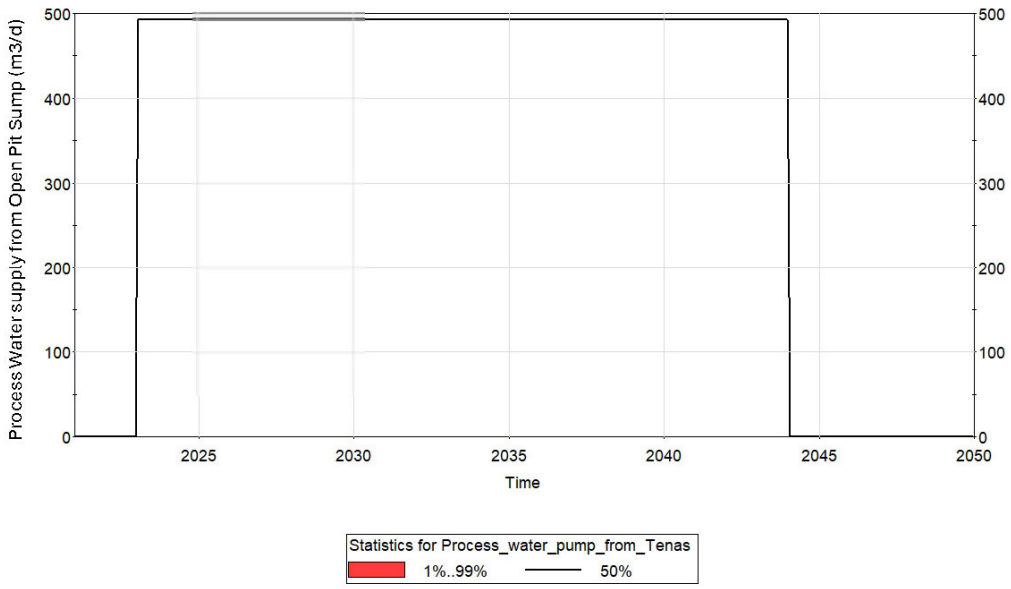


Figure 4-6: Monthly Average Process Water Supply in Alternative Assessment Case 6 with Stochastic Climate, including the 1%, 50% and 99% Results

Source: : CAPR002055 Telkwa Project general EA Support\Internal\Water Balance Modelling\Model\202309_Updated EA Case\2025_submitted_modelresults\TelkwaEAModel_v40_UEA_new hydro_updatedSTs_newGW_Alt6results.gsm

4.1.3 Project Discharge

Tenas Control Pond, the Rail Infrastructure Sedimentation Pond, and the North Management Pond. discharge surface water to the receiving environment (Table 4-1).

Table 4-1: Summary of Discharging Facilities Throughout Life of Mine

Project Facility	Means of Discharge	Receiving Environment	Active Project Stage
Tenas Control Pond	Pump or spillway	Tributary of Goathorn Creek	Construction, Operation, Closure and Reclamation
Rail Infrastructure Sedimentation Pond	Pump of spillway	Tributary of Bulkley River	Construction, Operation
North Management Pond	Spillway	Tributary of Goathorn Creek	Post-Closure

Source: Prepared in text.

The monthly average discharge rates and annual total discharge volumes for the Project Case, Alternative Assessment Cases 4 and 7 are presented in Table 4-2. For Alternative Assessment Case 4, the consecutive wet periods were applied to years where the discharge would be maximized for each facility. In the case of the Tenas Control Pond, maximum discharge occurs in early Operations when the Project water storage capacity is minimized. For the North Management Pond, maximum discharge occurs near the end of the Post-closure model period, when climate change effects to precipitation are maximized and available storage is minimized.

Table 4-2: Project Facility Discharge Rates

Assessment Case	Project Facility		
	Tenas Control Pond	Rail Infrastructure Sedimentation Pond	North Management Pond
Project Stage	Operation and Closure Reclamation	Operation and Construction	Post-Closure
Maximum Monthly Discharge Rates [m³/day]			
Project Case	22,000	240	26,300
Alt Case 4: 3 Wet Years (1) (2)	24,700	240	25,700
Alt Case 7: 10% increased precipitation	24,300	260	28,800
Maximum Annual Discharge Volume [m³]			
Project Case	1,741,000	21,200	1,494,000
Alt Case 4: 3 Wet Years (1)	2,181,000	24,800	1,849,000
Alt Case 7: 10% increased precipitation	2,054,000	23,600	1,775,000
Average Annual Discharge Volume [m³]			
Project Case	1,139,400	19,600	1,342,400

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Project_discharge_EASubmitted_20250717.xlsx?web=1

Notes:

1. Three consecutive wet years (approximately the 1 in 10-year wet return period) applied to most critical period, depending on the structure. For Tenas Control Pond and Rail Infrastructure Pond, critical period is 2028-2030 when EMP starts overflowing into NMP, which in turns fills Tenas Control Pond and higher discharge rate, while the critical period is 2068-2070 for North Management Pond which only discharges to environment in Post-closure.
2. The maximum monthly discharge rate is higher for an average year vs 1/10 wet year due to the timing of the precipitation in both representative years chosen. This is because precipitation during the freshet months is higher in the average year but are higher later in the year for the 1./10 wet year throughout the open-water season. However, the maximum annual discharge is higher for the 1/10 wet year vs the average year.

The Tenas Control Pond pumping rate to the tributary for Goathorn Creek was 15,000 m³/day between May and October. The maximum discharge in the Project Case exceeds the pumping rate, which means the spillway is used during Operations. The overflow occurs during spring freshet (May) when the EMP is also overflowing.

The NMP only discharges to the tributary of Goathorn Creek in Post-closure after the Tenas Control Pond has been decommissioned. It discharges over the closure spillway. Highest flows occur in April (i.e. spring freshet).

Changes to Goathorn Creek and Bulkley River from the Project discharges are discussed in Section 4.3.

4.2 Project Water Quality Results

Modelled water quality in the sedimentation ponds and Management Ponds are a function of the following loading sources:

- PAG, Non-PAG, and processed rock loading rates based on volume of rock placed in the Management Ponds per year.
- Water pumped from the open pit, which includes open pit wall runoff and non-PAG rock backfill seepage.
- Natural runoff.
- Seepage from Non-PAG rock and overburden in Management Pond dams and buttresses.

Results were screened against water quality guidelines in the receiving environment. Results were also compared to receiving water baseline water quality statistics. The Management Ponds void water results are compared to baseline statistics and the stream water quality guidelines for which most seepage from a specific management pond is received. Specifically, North Management Pond is compared to Goathorn Creek, East Management Pond is compared to Four Creek, and West Management Pond is compared to Tenas Creek. The Tenas Control Pond is compared to Goathorn Creek water quality guidelines and baseline statistics as surface water from site are directly discharged to Goathorn Creek, as well as results for water contained in the water cover of the Management Ponds. The Rail Infrastructure Sedimentation Pond is compared to the Bulkley River water quality statistics and guidelines.

Monthly average and maximum concentrations are presented for winter and summer periods. Winter is the 6-month period from November to April (frozen conditions). Summer is from May to October (open-water season). Ponds decommissioned during closure and reclamation are only evaluated during Operations. Ponds that operate through Post-closure are evaluated during Operations and closure. Results are presented in Appendix G for Project Case conditions and for alternative assessment cases.

The following parameters were identified as Parameters of Concern (POCs) in the framework of the Best Achievable Technology (BAT) Assessment report (SRK 2025a) as these had maximum monthly values in the effluent end of pipe (surface water discharge or groundwater seepage) equal to or higher than 80% of the water quality guideline calculated for the receiving stream, for the Final EAC Project Case (2024), also called Project Case:

- Nitrate-nitrogen
- Nitrite-nitrogen
- Sulfate
- Aluminum total
- Cadmium dissolved
- Cobalt dissolved
- Copper dissolved
- Iron total
- Molybdenum total
- Nickel total
- Selenium total

- Thallium total[3]
- Zinc dissolved

4.2.1 Management Ponds

The Management Ponds do not discharge directly to the environment during Operations. The Management Ponds discharge excess water via pumps and spillways to the Tenas Control Pond (discussed in Section 4.2.2).

Figure 4-7 and Figure 4-8 present the modelled concentrations of total selenium and nitrate, respectively, in each Management Pond over time for the Project Case, including the water quality in the water cover (solid lines) and the water quality in the rock voids (dashed lines). Results for other parameters are presented in Appendix G (Tables G1-G9), and are compared to water quality guideline for each stream, as outline in Section 4.2.

As discussed in Section 3.4, the water cover and water in rock voids within each Management Pond were modelled as two separate reservoirs. The water cover quality fluctuates seasonally (Figure 4-7). Concentrations increase as PAG rock is added but decrease because of dilution during freshet (May). The water quality in the voids is more constant throughout the year. Peak concentrations in each Management Pond occur near the end of each ponds' operation, prior to the placement of Non-PAG and overburden rock covers. A secondary spike occurs in the NMP from the WMP near the end of Operations. After PAG rock and processed rock placement is complete, the water cover quality in WMP is mainly due to the load received from the Pit backfill, which continues to produce load for the remainder of the modelling period (Okane 2024). Dilution of the void water concentrations (Figure 4-7) occurs more slowly, based on the lower flushing rate controlled by seepage to groundwater. The water quality in the voids is used for seepage water quality to downstream prediction nodes. The travel times from the pond to downgradient receivers is approximately 25-years (see Section 3.8.3).At the end of Operations when Tenas Control Pond has been decommissioned, the NMP will discharge to a tributary to Goathorn Creek.

Other POCs are described in Appendix G (Tables G1-G9).

[3] Thallium total was identified after the BAT report was produced as this is a newly updated BC AWQG (March 2025)

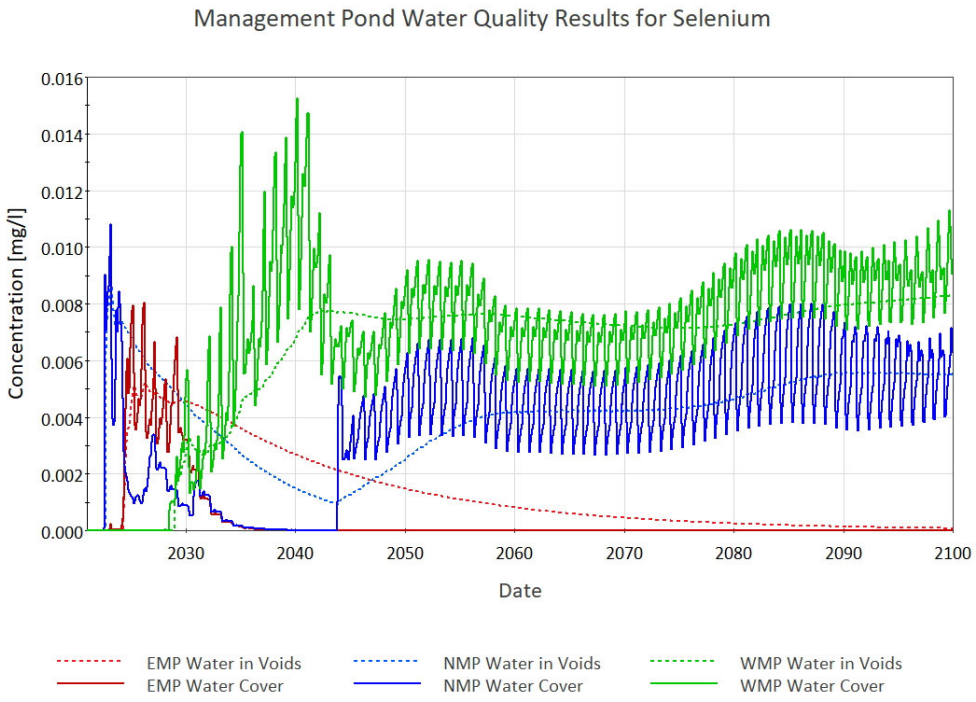


Figure 4-7: Management Pond Total Selenium Results for Project Case

Source: https://srk.sharepoint.com/:f:/s/NACAPR002055/Etr0F_6Ta99CoZITrRJypV0BGK97wtulX609l8LLiQTzXA?e=qNt9UM

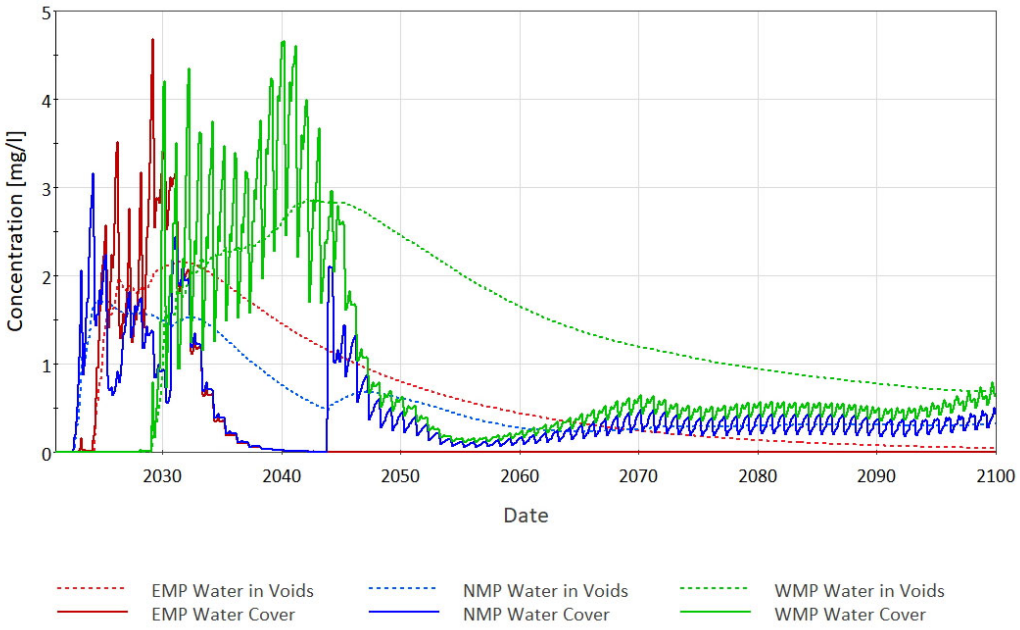


Figure 4-8: Management Pond Nitrate-Nitrogen Results for Project Case

Source: https://srk.sharepoint.com/:f:/s/NACAPR002055/Etr0F_6Ta99CoZITrRJypV0BGK97wtulX609l8LLiQTzXA?e=qNt9UM

4.2.2 Tenas Control Pond

The Tenas Control Pond will discharge to a tributary of Goathorn Creek during Operations until it is decommissioned. Since the Tenas Control Pond is assumed to be fully mixed, the water quality of any seepage is expected to be equal to the pond water quality, and therefore separate seepage water quality is not presented. Water quality results for the Tenas Control Pond are presented in Appendix G. Figure 4-9 and Figure 4-10 present Tenas Control Pond total selenium and nitrate-nitrogen concentrations, respectively. The water volume is also shown in both figures. Results extend through 2050, which includes the pond dewatering period. Tenas Control Pond will be dewatered in 2048 and is decommissioned by 2050.

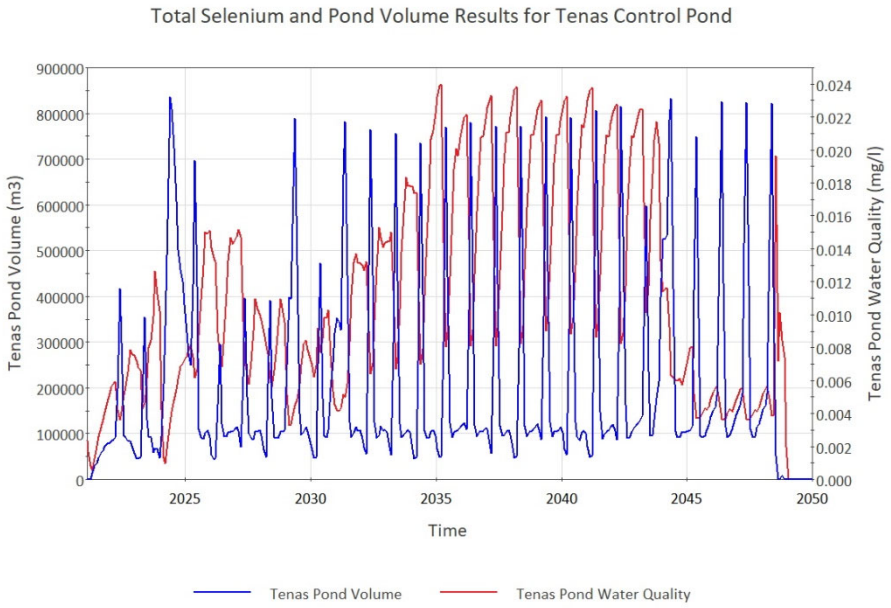


Figure 4-9: Tenas Control Pond Volume and Total Selenium Concentration in Tenas Control Pond

Source: https://srk.sharepoint.com/:f:/s/NACAPR002055/Etr0F_6Ta99CoZITrRJypV0BGK97wtulX609l8LLiQTzXA?e=qNt9UM

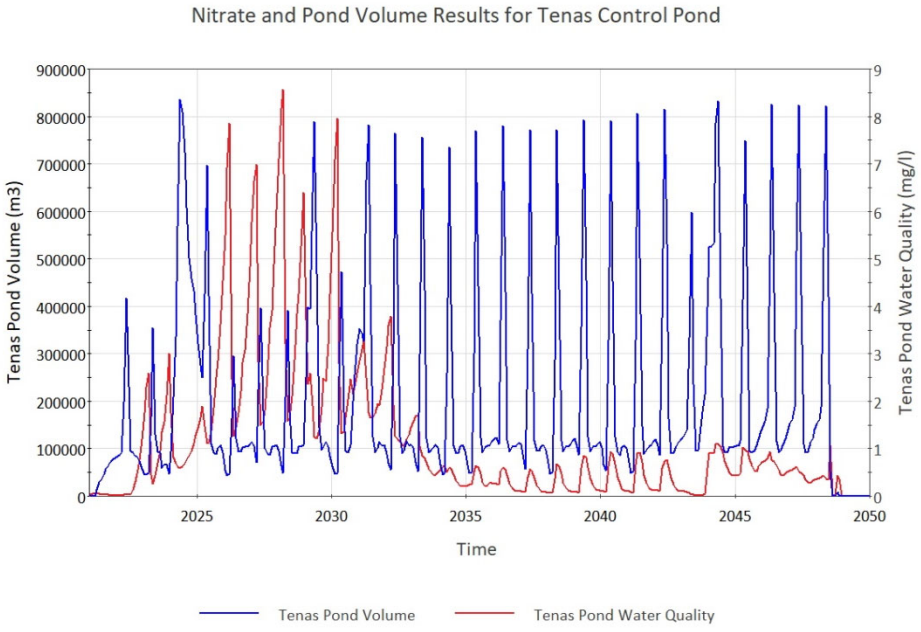


Figure 4-10: Tenas Control Pond Volume and Nitrate-Nitrogen Concentration in Tenas Control Pond

Source: https://srk.sharepoint.com/:f:/s/NACAPR002055/Etr0F_6Ta99CoZITrRJypV0BGK97wtulX609l8LLiQTzXA?e=qNt9UM

Selenium concentrations increase over time in the Tenas Control Pond as the volume of PAG and Non-PAG rock in the Project's footprint expand to maximum extent. Seasonal fluctuations occur.

Concentrations are lowest in freshet (May) each year. The Tenas Control Pond volume is highest during freshet (Figure 4-9). While the selenium concentrations are higher than the water quality guideline for Goathorn Creek, (0.002mg/L), no selenium exceedances are found in the receiving environment (see Section 4.4). Peak concentrations for selenium is 0.023 mg/L towards the end of Operations.

Nitrate-nitrogen concentrations are highest in the first 15 years of Operations after the construction of the Management Pond dams and buttresses. The peak concentration is approximately 8 mg/L, which occurs over winter months when the pond doesn't discharge. The concentration in Tenas Control Pond is above the water quality guideline for nitrate (WQG = 3 mg/L), but never exceeds when discharged in the receiving environment.

Other POCs are described in Appendix G.

4.2.3 Rail Infrastructure Sedimentation Pond

Modelled water quality in the Rail Infrastructure Sedimentation Pond is a function of processed coal rock source terms, with dilution from runoff and direct precipitation. The pond is decommissioned in closure. Pond concentrations increase in the summer months from evaporation. Average water quality in the pond in summer and winter during Operations are summarized and compared against WQG calculated for Bulkley River in Appendix G. Changes to the Bulkley River are discussed in Section 4.4. No exceedances of WQG are expected because of Rail Infrastructure Sedimentation Pond discharges. Figure 4-11 presents the modelled total selenium concentrations at the Rail Infrastructure Sedimentation Pond. Applying the processed coal rock source terms to the full pad area is conservative because coal isn't stockpiled for long before being loaded on a train. It is not likely to oxidize.

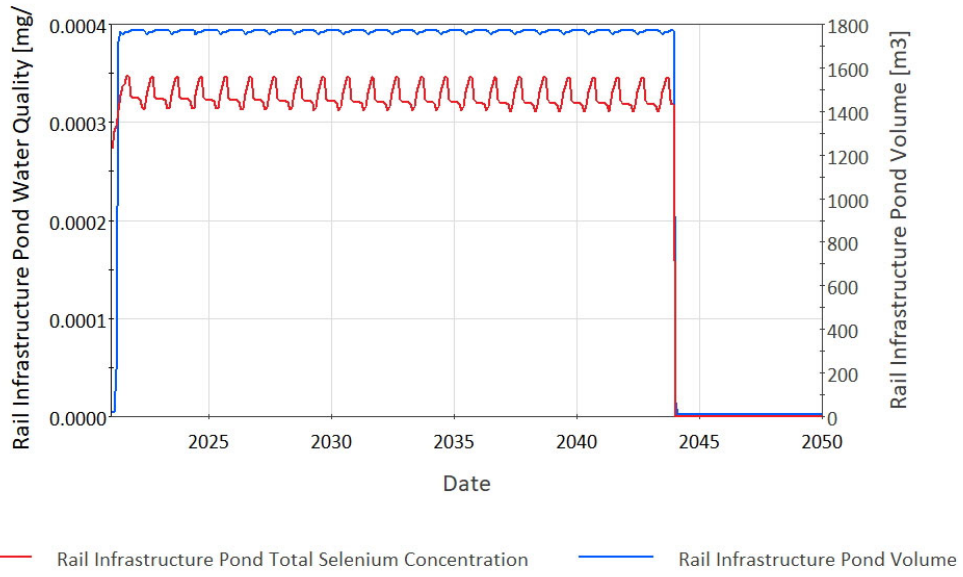


Figure 4-11: Total Selenium Concentration in Rail Infrastructure Sedimentation Pond for Project Case

Source: https://srk.sharepoint.com/:f:/s/NACAPR002055/Etr0F_6Ta99CoZITrRJypV0BGK97wtulX609l8LLiQTzXA?e=qNt9UM

4.2.4 Alternative Assessment Cases

The only alternative assessment case which affects the pond water quality is Case 2, using high geochemical source terms. Table 4-3 compares the maximum monthly water quality in each operating facility for the Project Case and Alternative Assessment Case 2 model conditions. Results for other parameters in Case 2 are presented in Appendix G (Figures G-1 to G-5 and Tables G1-G9), including time series plots of results, similar to those presented in Section 4.2.1, 4.2.2 and 4.2.3.

Table 4-3: Project Water Selenium Results for Project Case and Alternative Assessment Case 2 with High Source Terms

Facility	Maximum Monthly Total Selenium Concentration [mg/L]	
	Project Case	Alt Case 2: High Source Terms
WMP	0.015	0.048
EMP	0.008	0.026
NMP	0.011	0.034
Tenas Control Pond	0.024	0.049
Rail Infrastructure Sedimentation Pond	0.00035	0.008

Source: compiled in the text.

While Selenium concentrations are higher than the water quality guideline (WQG total selenium = 0.002 mg/L) in the effluents, no exceedances are found in the streams in the Project Case (see section 4.4). Discussion for the Alternative cases affecting stream water quality can be found in Section 4.4.2.

Table 4-4: Project Water Nitrate-Nitrogen Results for Project Case and Alternative Assessment Case 2 with High Source Terms during Operations

Facility	Maximum Monthly Nitrate-Nitrogen Concentration [mg/L]	
	Project Case	Alt Case 2: High Source Terms
WMP	4.7	17
EMP	4.7	19
NMP	3.2	13
Tenas Control Pond	8.6	34
Rail Infrastructure Sedimentation Pond	/	/

Source: compiled in the text.

While nitrate concentrations are higher than the water quality guidelines (WQG nitrate = 3mg/L) in the effluent, no exceedances are found in the streams (see section 4.4).Monthly maximum concentrations for other POCs are summarized in tables for the facilities in Appendix G. While these POCs are exceeding their respective water quality guidelines in the effluent, the only exceedances found in the streams for the Project Case is dissolved copper in Goathorn Creek, which is naturally high in the background concentrations and would be similar without the Project's impact. Other results for the Alternative Cases affecting the water quality in the stream can be found in Section 4.4.2.

4.3 Change to Streamflow

The relative change between streamflow for each assessment case and the Pre-Mining Case were calculated using the monthly average water balance model result time series.

Results are discussed in relation to change to mean annual discharge (MAD), seasonal flow distribution, and high and low flows.

4.3.1 Project Case Results for Mean Annual Discharge

The change to mean annual discharge was evaluated using the following thresholds:

- 10% decrease from mean annual discharge.
- 30% increase from mean annual discharge.

The water quantity thresholds were selected based on the BC Environmental Flow Needs environmental risk management framework, which uses a 10% reduction or withdrawal from streamflow as an indicator of stream sensitivity for fish habitat (BC ENV, 2016).

Table 4-5 presents the maximum increase, average change and maximum decrease in MAD based on the Project Case relative to Pre-Mining Case for each Project Stage. Yellow highlighted cells identify prediction nodes and Project stages where an increase in streamflow exceeds 30% and orange highlighted cells identify prediction nodes where streamflow is reduced by more than 10%. Results indicate whether a net increase or net decrease is not expected for a node or Project stage as not applicable (n.a.).

Table 4-5: Percent Change in Mean Annual Discharge for Project Case Relative to Pre-Mining Case, including Maximum Increase, Maximum Decrease and Average Change, over each Project Stage

		% Change in Mean Annual Discharge relative to Base Case Conditions								
		Construction			Operation			Post-Closure		
Stream	Node	Maximum Increase	Average Change	Maximum Decrease	Maximum Increase	Average Change	Maximum Decrease	Maximum Increase	Average Change	Maximum Decrease
Tenas Creek	WQS01	n.a	0.0%	0.0%	n.a	0.0%	0.0%	n.a	0.0%	0.0%
	WQS02	n.a	0.0%	0.0%	n.a	-1.5%	-1.6%	n.a	-1.4%	-1.4%
	WQS22	n.a	0.0%	0.0%	n.a	-6.3%	-6.9%	n.a	-5.9%	-6.1%
	WQS04	n.a	0.0%	0.0%	n.a	-7.3%	-7.9%	n.a	-6.1%	-6.3%
Four Creek	WQS03	n.a	0.0%	0.0%	n.a	-1.0%	-1.5%	n.a	-0.9%	-1.1%
	WQS21	n.a	-0.1%	-0.1%	48.3%	37.2%	-0.1%	34.2%	33.8%	n.a
	WQS20	n.a	-0.1%	-0.1%	46.8%	35.3%	-0.1%	32.3%	31.9%	n.a
	WQS03_DS	n.a	-0.1%	-0.1%	2.8%	-15.1%	-24.2%	n.a	-19.2%	-19.3%
Goathorn Creek	WQS13	n.a	0.0%	0.0%	n.a	0.0%	0.0%	n.a	0.0%	0.0%
	WQS06_US	n.a	0.0%	0.0%	n.a	0.0%	0.0%	0.0%	0.0%	0.0%
	WQSEA1	n.a	0.0%	0.0%	2.7%	1.6%	n.a	1.6%	1.2%	n.a
	WQS06	n.a	0.0%	0.0%	2.7%	1.5%	n.a	1.6%	1.2%	n.a
	WQS05	n.a	0.0%	0.0%	0.8%	-1.5%	-2.2%	n.a	-1.5%	-2.0%
Telkwa River	WQS09	n.a	0.0%	0.0%	0.1%	-0.2%	-0.4%	0.1%	0.0%	-0.1%
Bulkley River	WQS11	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WQS12	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	n.a	0.0%	0.0%

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_ChangetoMAD_20250722_CCM.xlsx?web=1

Note: n.a. (not applicable) values represent prediction nodes which do not experience a net increase or net decrease over Pre-Mining conditions

The maximum percent decrease to MAD is greater than 10% at downstream Four Creek node, WQS03DS, and increases by more than 30% in the Four Creek prediction nodes WQS20 and WQS21 during the operation and Post-closure Project stages. Figure F-1 in Appendix F presents a time series of the annual change to mean annual discharge throughout the modelled period at Four Creek prediction nodes.

All other streams are not expected to have greater than 10% reduction to MAD.

4.3.2 Project Case Results for Seasonal Flow Distribution

Changes to seasonal flow distribution are evaluated for each node and Project stage. Results discussed below focus on Four Creek prediction nodes, where MAD could decrease by at least 10% or increase by more than 30%.

Table 4-6 presents the monthly variability of the change in streamflow at Four Creek for the Project Case relative to the Pre-Mining Case, while the results through the life of mine are plotted in Figure F-2 in Appendix F. Results highlight the monthly maximum, average and minimum percent change in monthly streamflow throughout each Project stage.

Table 4-6: Four Creek Project Case Streamflow Monthly Change over Pre-Mining Case

Scenario		Four Creek Monthly % Change Relative to Pre-Mining Case											
		WQS03			WQS21			WQS20			WQS03DS		
Period	Month	Maximum Increase	Average	Maximum decrease	Maximum Increase	Average	Maximum decrease	Maximum Increase	Average	Maximum decrease	Maximum Increase	Average	Maximum decrease
Construction	January		-0.16			-0.3			-0.6			-1.0	
	February		-0.19			-0.4			-0.7			-1.2	
	March		-0.15			-0.3			-0.6			-0.9	
	April		0.00			0.0			0.0			0.0	
	May		-0.02			0.0			-0.1			-0.1	
	June		-0.05			-0.1			-0.2			-0.3	
	July		-0.07			-0.2			-0.3			-0.5	
	August		-0.19			-0.4			-0.7			-1.2	
	September		-0.18			-0.4			-0.7			-1.1	
	October		-0.22			-0.5			-0.8			-1.4	
	November		-0.32			-0.7			-1.2			-2.0	
	December		-0.33			-0.7			-1.3			-2.1	
Operations	January	-	-17.5	-29.1	-	-19.7	-33.6	-	-19.2	-32.1	-	-3.2	-5.0
	February	-	-17.6	-29.2	-	-19.8	-33.6	-	-19.3	-32.1	-	-3.2	-5.0
	March	-	-12.1	-19.0	8.7	-2.4	-13.3	7.7	-2.6	-12.9	-	-6.8	-9.1
	April	-	-0.2	-0.3	49.9	37.6	0.0	48.4	35.7	0.0	4.8	-14.4	-24.7
	May	-	-0.4	-0.6	49.9	37.3	0.0	48.3	35.4	-0.1	2.7	-14.6	-24.8
	June	-	-2.3	-4.8	49.8	35.1	-0.1	48.1	33.2	-0.2	0.7	-15.0	-24.9
	July	-	-4.3	-7.7	49.6	32.7	-0.2	47.6	30.9	-0.3	-	-15.5	-24.7
	August	-	-11.3	-20.0	44.8	20.0	-5.3	42.5	18.6	-5.6	-	-13.3	-19.7
	September	-	-9.4	-17.0	48.1	22.3	-3.2	45.7	20.8	-3.6	-	-13.4	-21.2
	October	-	-11.6	-18.3	26.5	9.6	-6.2	24.7	8.7	-6.3	-	-11.0	-15.8
	November	-	-18.3	-28.4	-	-20.1	-32.5	-	-19.6	-31.1	-	-3.6	-6.6
	December	-	-18.7	-29.7	-	-21.0	-34.4	-	-20.4	-32.8	-	-3.1	-5.0
Post-Closure	January	-	-18.8	-22.7	11.3	-13.6	-25.0	11.2	-11.8	-22.3	4.0	-0.5	-10.3
	February	-	-21.9	-22.7	-	-21.7	-25.0	-	-19.2	-22.3	4.0	2.7	-4.2
	March	-	-12.8	-14.0	4.0	1.5	-1.8	4.4	2.1	-0.9	-	-6.4	-7.4
	April	-	-0.2	-0.2	35.0	35.0	-	33.0	33.0	-	-	-19.5	-19.5
	May	-	-1.5	-2.8	34.2	33.5	-	32.3	31.6	-	-	-19.3	-19.4
	June	-	-3.2	-4.2	32.7	31.7	-	31.0	30.0	-	-	-19.0	-19.2
	July	-	-5.4	-6.6	30.4	29.2	-	28.9	27.9	-	-	-18.5	-18.8
	August	-	-14.6	-15.8	20.9	13.1	-	20.4	13.1	-	-	-11.5	-15.5
	September	-	-11.9	-13.6	25.3	15.8	-	24.4	15.5	-	-	-12.4	-17.4
	October	-	-11.1	-11.9	17.2	15.9	-	16.8	15.6	-	-	-13.1	-13.7
	November	-	-4.4	-9.9	32.5	26.6	-	30.7	25.3	-	-	-16.6	-18.7
	December	-	-12.7	-22.7	23.0	7.9	-25.0	22.1	8.1	-22.3	4.0	-9.1	-15.1

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_MonthlyChange_07222025_CCM.xlsm?web=1

Notes:

Construction stage is only 1.5 years in duration. Results reflect maximum monthly percent change for months which occur twice in the construction period.
Blank rows represent periods where an increase or decrease in flows is not expected based on model results.

Monthly streamflow during Operations in Four Creek (WQ03, WQS21, WQS20 and WQS03DS) decrease by up to 34% and increase up to 48% (Table 4-6). Diversion channels and mine plan optimizations reduced the Project's footprint as much as practical. However, the open pit and the Management Ponds route water that would normally flow to Four Creek towards Goathorn Creek via the Tenas Control Pond discharge. This reduces the catchment area for Four Creek while the C02 channel diversion increases the catchment area.

Monthly flow in Four Creek varies from upstream to downstream (Table 4-6). WQS21 and WQS20, located adjacent to the East Management Pond, gain flow, or lose insignificant flow during open water season months. During the winter, flow at these locations decreases. Flow at WQS03DS decreases year-round during Operations. This decrease is most apparent during the open water season months.

The causes of these changes in flow are:

- Winter flow at WQS03, WQS20 and WQS21 decreases from the drawdown of the groundwater table by the adjacent open pit. Flow decreases proportionally to the expansion of the open pit (Table 4-6). At closure, the open pit is backfilled and floods. The groundwater table rises but not to pre mining levels. Post-closure flow is lower in Four Creek than baseline conditions.
- WQS03DS is located downstream of the open pit and the East and North Management Ponds. The drawdown of the groundwater table by the open pit is countered by the mounding of groundwater under the East and North Management Ponds. Water seeps from these Management Ponds to the Four Creek in the long-term during Post-closure. Accounting for both conditions, there is still a net reduction of winter streamflow in Operations and a net increase in winter streamflow after mine closure.
- A diversion channel south of the East Management Pond will direct undisturbed surface runoff towards Four Creek throughout Operations and Post-closure. In the Pre-Mining case, this area would report to Four Creek downstream of the outlet of the proposed C02 channel, increasing surface runoff in the upstream portion of the creek (e.g., WQS20 and WQS21). The increased flow in the upstream prediction nodes (WQS20 and WQS21) is highest in early Operations when the catchment area reporting to the diversion channel is largest. As the footprint of the open pit expands, the diversion's catchment area decreases and flow decreases. At closure, a portion of the backfilled open pit will drain towards the diversion channel, increasing open-water season flow by approximately 30% long-term. These percent changes assume 100% of the diverted area reports to Four Creek, however the hydraulic designs include a flow control structure which will limit erosion from individual flow events up to the 1 in 10-year event (SRK 2021a).
- Downstream (e.g., WQS03DS), the effect of the diversion partially mitigates the reduction of streamflow. The catchment area reduction is reduced from pre-mining conditions in Operations and Post-closure.

Appendix F includes the results for prediction nodes in other streams (Table F-1, Table F-2, and Table F-3 for Tenas Creek, Goathorn Creek, Telkwa River and Bulkley River, respectively).

Tenas Creek flow may decrease by up to 11% during low flow periods (April and August) in Operations because of groundwater drawdown and catchment area reductions. The seepage from Management

Ponds counters some of this flow reduction by the end of Operations and into Post-closure. The maximum monthly flow is just 3% less than average monthly flow.

Goathorn Creek flows are expected to be reduced by up to 8% during low flow periods in Operations. Flows downstream of the Project discharge may also increase by up to 6% in Operations and 11% after closure due to routing of water that would otherwise have reported to the Tenas Creek catchment.

The Project may reduce monthly average flows in the Telkwa River downstream of Goathorn Creek by less than 2% in Operations and an increase of 1% in Post-closure due to seepage from Management Ponds. Bulkley River monthly streamflow changes are negligible (less than 0.1%).

4.3.3 Project Case Results for High and Low Flows

The changes to high and low flow were evaluated using Alternative Assessment cases 4 and 5 at each modelled node. Summary tables with results for Alternative Assessment cases are presented in Appendix F.

High Flows and Alternative Assessment Case 4: Three Consecutive Wet Years

In general, the relative change to high flows is driven by the relative change to stream catchment area. As such, high flows are reduced at prediction nodes and stream sections where the catchment area (and MAD as presented in Section 4.3.1) decreases.

The catchment area will increase for two prediction nodes on Four Creek, downstream of the C02 channel discharge. A control structure has been designed to mitigate high flows in Four Creek at prediction nodes WQS20 through WQS21 in Four Creek from C02 high runoff conditions (SRK 2021d).

Discharge from Tenas Control Pond in Operations and North Management Pond in Post-closure may also increase streamflow in Goathorn Creek. This was assessed in Alternative Assessment Case 4 with three consecutive wet years (1 in 10-year wet return periods) to examine the expected discharge rates under more extreme conditions. The results show a potential increase over baseline streamflow of 13% at WQSEA1 and 2% further downstream at WQS05 during spring freshet (Table F-4, Appendix F). Further downstream in the Telkwa River, the change relative to baseline is negligible under consecutive wet years.

The Tenas Control Pond will provide additional attenuation up to the 1 in 10-year flood event, reducing the peak flows in tributaries to Goathorn Creek and downstream in Goathorn Creek. This attenuation has not been incorporated into the water and load balance model but is expected to reduce the expected change in streamflow in Goathorn Creek during high flow events.

Low Flows and Alternative Assessment Case 5: 7Q10 Low Flow

Seasonally flow is lowest in the winter when streamflow is primarily baseflow (i.e., groundwater discharge). The annual low flow is most sensitive to changes in groundwater table and the stream's catchment area. Alternative Assessment Case 5 was also included to evaluate changes to 7Q10 flow rates in stream prediction nodes. Change to low flows are presented in Table F-5 (Appendix F) for each

Project stage, based on the minimum monthly average flow projected for modelled conditions and the most downstream node on each stream.

Extreme low flows are expected to be lower than Pre-Mining conditions by the same percentage as monthly average baseflow. Low flows in Four Creek and Tenas Creek downgradient of the open pit could be reduced by 54% and 7% respectively.

4.3.4 Other Alternative Assessment Cases

Results for the alternative assessment cases are presented in Appendix F and summarized in Table 4-7. Alternative Assessment Case 1 (see Section 2.4.2) is the sensitivity groundwater seepage case. Streamflow changes are likely in Four, Tenas and Goathorn creeks but these changes are negligible in the Telkwa River and Bulkley River (Appendix F, Tables F-6 to F-10 and Figure F-3).

Table 4-7: Summary of Change to Streamflow for Alternative Assessment Cases

Alternative Assessment Case	Stream	Prediction nodes Affected	Project-related Effects
Case 1: High Groundwater Seepage	Four Creek	WQS21 WQS20	Reduction in winter streamflow equal to 100% from drawdown of groundwater table from open pit (Table F-6 and F-7)
	Tenas Creek	WQS22 WQS04	Reduction to MAD remains less than 10%, however monthly flow during Operations decreases more than 10% for the winter months (Table F-6 and F-8) with maximum increases of 30% also for the winter months. Similar effects are also seen in Post-closure.
Case 4: Consecutive Wet Years (High Flow)	Goathorn Creek	WQSEA1, WQS06 WQS05	Increased Project discharge rates to Goathorn Creek, increase the maximum monthly over baseline streamflow by of 13% at WQS06 and 2% further downstream at WQS05 (Table F-4)
Case 5: Low Flow	Four Creek	WQS03DS	Extreme low flows are expected to be reduced over Base Case conditions by the same percentage as monthly average baseflow (Table F-5)
	Tenas Creek	WQS04	

Source: this table was compiled in the text

4.4 Change to Stream Water Quality

Water quality model results in the receiving environment are presented in summary tables by node and are screened against the natural variability within each stream and the selected WQG.

Results are presented as monthly average and maximum concentrations in winter (November through April) and summer (May to October) to demonstrate seasonal variability. Results are colored red where the average or maximum monthly water quality is expected to exceed the applicable guideline value.

Baseline data (50th and 95th percentile from monitoring results) were also compared against the applicable guideline value.

Appendix G provides each prediction node summary table under the Project Case conditions, as well as for other assessment cases,

The only parameters exceeding water quality guidelines under the Project Case are dissolved cobalt in Four Creek for a period of four years in Post-closure, which did not exceed in the water quality baseline data, and dissolved copper in Goathorn Creek and total aluminum in Telkwa River, which are known to be elevated and exceed water quality guidelines in the baseline data.

Note that water quality results are only presented for prediction nodes that are located downstream of the Project (i.e., receiving discharge or seepage). Prediction nodes upstream of interactions are expected to continue to have baseline or pre-mining water quality. Similarly, prediction nodes on Four Creek and Tenas Creek only experience a change in stream water quality after closure, resulting from Management Ponds seeping to groundwater. For these prediction nodes, only the Post-closure water quality results are presented, and operations water quality is expected to equal baseline conditions. Goathorn Creek, Telkwa River and Bulkley River prediction nodes include operation water quality to express the change from expected Project discharges.

4.4.1 Project Case Results

Chemical constituents (or parameters) were identified in this section if the maximum monthly average concentrations from the model results exceeded the water quality guideline in any month. Summary tables present the prediction nodes which exceed, along with the average long-term winter and summer concentrations and the baseline 50th and 95th percentile concentrations. Results are presented for water quality parameters in Appendix G.

The following general observations can be made for changes in concentrations in the receiving streams:

- Higher concentrations of parameters for which the source is mining (e.g. sulfate, cobalt, selenium, nitrate) occur more frequently during the winter months from seepage discharge to the receiving environment(s) during periods of low flow, and therefore low dilution / assimilation capacity.
- Similarly, an increase in concentrations for parameters for which the source is mining are driven by seepage from the Management Ponds and occur at prediction nodes along Tenas Creek and Four Creek located downstream of the West, North and East Management Ponds.
- The stream concentrations peak approximately 25 years after the peak concentrations are expected in each Management Pond, reflecting the delay in seepage migration described in Section 3.8.3.
- The dissolved cobalt exceedance found in Four Creek occurs only in Post-closure and for a duration of four years. There are no exceedances in the stream expected during Operations. Only the prediction nodes downstream of infrastructure (WQS03DS in Four Creek) experience changes to water quality in these systems, for a few years only.
- Increase to Goathorn Creek water quality parameter concentrations from the Project impacts occur from Project discharge during Operations and typically are only a single month. The only WQG

exceedance recorded in Goathorn Creek is dissolved copper and its source is mainly from background loading. The Project contribution to the load is less than 1% during the exceedance months.

- Model results for total aluminum and dissolved copper in Telkwa show exceedances of the water quality guideline. Like Goathorn Creek, the source of both parameters is the background loading, with the Project's contribution even lower at less than 1%. Furthermore, the Project does not have exceedances for total aluminum in Goathorn Creek.

Dissolved Cobalt

The water quality guideline for dissolved cobalt is 0.00056 mg/L in Four Creek, which is exceeded in Closure for maximum monthly values calculated for the winter months, occurring for four years in the model results. Average winter conditions show modelled results below the water quality guideline. Table 4-8 summarizes the exceedances of WQG for dissolved cobalt.

Table 4-8: Dissolved cobalt Exceedances for Project Case Conditions

Node	WQG [mg/l]	Background Concentration [mg/l]		Project Case Modelled Concentrations [mg/l]				Max Multiplier (2)	Project Stage (1)
		P50	P95	Max Summer	Max Winter	Long-term Average Summer	Long-term Average Winter		
Four Creek									
WQS03_DS	0.00056	0.000050	0.00014	0.00052	0.00063	0.00017	0.00019	1.1	PC

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm?web=1

Figure 4-12 presents the modelled dissolved cobalt concentrations for prediction nodes that exceed the WQG in the Project Case.

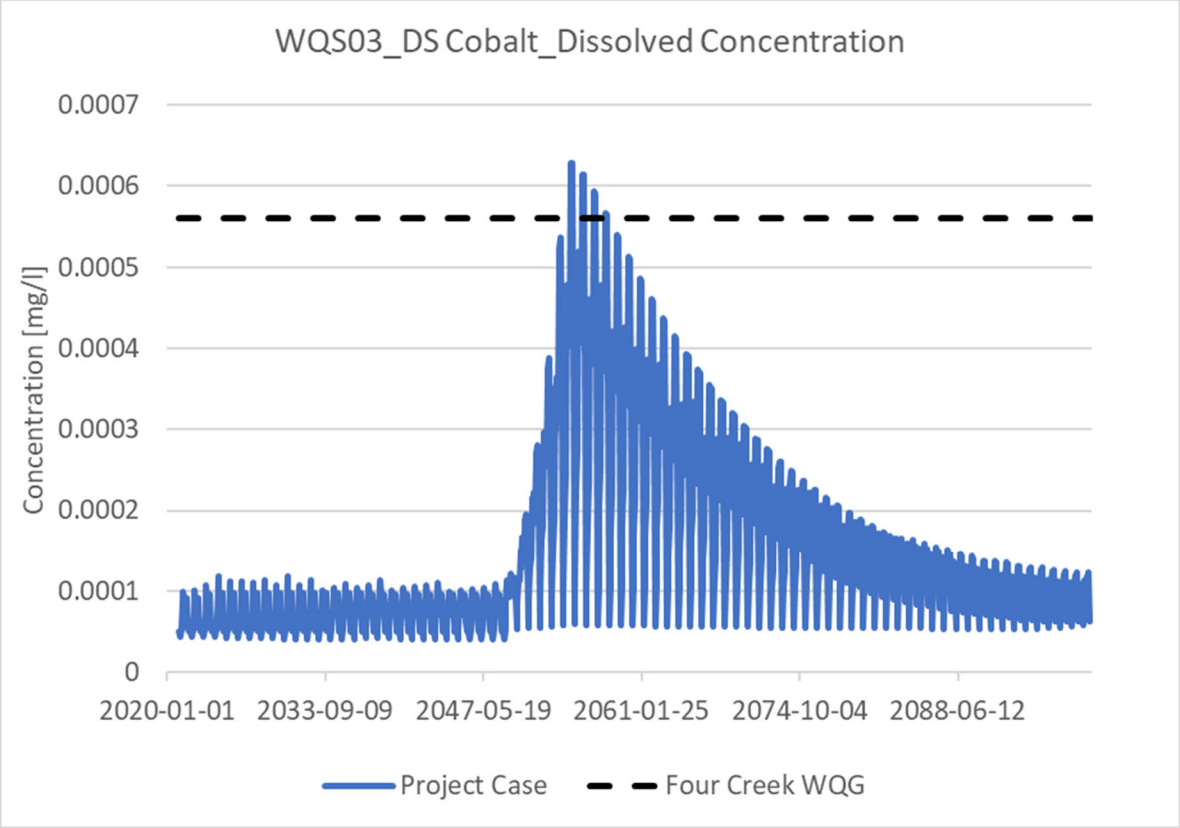


Figure 4-12: Modelled Dissolved cobalt Concentrations for Prediction nodes with Exceedances of WQG in Project Case.

Dissolved Copper

The water quality guideline for dissolved copper is 0.0013mg/L in Goathorn Creek, which is exceeded in Operations and Closure for maximum monthly values calculated for summer and winter months. Average winter conditions show modelled results below the water quality guideline, likely driven by lower P50 background concentrations for that season. Table 4-9 shows exceedances in the baseline data for copper in Goathorn by up to 4 times the WQG for the 95th percentile baseline data in the winter and the summer, and exceedance equal to the WQG for the 50th percentile baseline data in the summer months. The load from the Project contributing to the dissolved copper modelled results is less than 1% of the total load found in the Goathorn Creek.

The water quality guideline for dissolved copper is 0.0008mg/L in the Telkwa River, and it is also exceeded in Operations and Closure, only in the summer months with the maximum monthly model results. Like Goathorn Creek, the Project contributes less than 1% of the load for copper in the Telkwa River. The 95th percentile values from the baseline data exceed by up to 2 times the WQG in the summer and winter months.

Table 4-9 summarizes the exceedances of WQG for dissolved copper.

Table 4-9: Dissolved copper Exceedances for Project Case Conditions

Node	WQG [mg/l]	Background Concentration [mg/l]				Project Case Modelled Concentrations [mg/l]				Max Multiplier (2)	Project Stage (1)
		P50 summer	P50 winter	P95 summer	P95 winter	Max Summer	Max Winter	Long-term Average Summer	Long-term Average Winter		
Goathorn Creek											
WQSEA1	0.0013	0.0013	0.0010	0.0034	0.0041	0.0016	0.0010	0.0014	0.00092	1.2	CN, OP, PC,
WQS06	0.0013	0.0013	0.0010	0.0034	0.0041	0.0017	0.0014	0.0014	0.00099	1.3	
WQS05	0.0013	0.0013	0.0010	0.0034	0.0041	0.0019	0.0022	0.0016	0.0016	1.5	
Telkwa River											
WQS09	0.0008	0.0007	0.0005	0.0017	0.0011	0.00080	0.00056	0.00073	0.00054	1.0	CN, OP

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm?web=1

Notes

1. Project stage acronyms: PC=Post-Closure, OP=Operations, CN=Construction
2. Maximum exceedance multiplier is a ratio of the maximum monthly water quality result over the water quality guideline (WQG)
3. Results are highlighted in red where they exceed the water quality guideline.

Figure 4-13 presents the modelled dissolved copper concentrations for prediction nodes that exceed the WQG in the Project Case.



Figure 4-13: Modelled Dissolved copper Concentrations for Prediction nodes with Exceedances of WQG in Project Case.

Source:
https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm?web=1

Total Aluminum

The WQG for total aluminum is 0.192 mg/l, which is exceeded in Telkwa River during the summer, likely driven by high TSS values which result in higher background concentrations. Table 4-10 summarizes the exceedances for total aluminum. As noted in the table, the background concentrations from the baseline data exceed for the 50th and 95th percentile values in the summer by up to 10 times the WQG, and the 95th percentile values in the winter months by 1.5 times the WQG. The Project contributes less than 1% of the load for total aluminum in the model results for the Telkwa River.

Table 4-10: Total aluminum Exceedances for Project Case Conditions

Node	WQG [mg/l]	Background Concentration [mg/l]				Project Case Modelled Concentrations [mg/l]				Max Multiplier (2)
		P50 summer	P50 winter	P95 summer	P95 winter	Max Summer	Max Winter	Long-term Average Summer	Long-term Average Winter	
Telkwa River										
WQS09	0.19	0.25	0.04	1.8	0.34	0.26	0.050	0.24	0.036	2.0

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm?web=1

Notes:

1. Project stage acronyms: PC=Post-Closure, OP=Operations, CN=Construction
2. Maximum exceedance multiplier is a ratio of the maximum monthly water quality result over the water quality guideline (WQG)
3. Results are highlighted in red where they exceed the water quality guideline.

Figure 4-14 presents the modelled total aluminum concentrations for prediction nodes that exceed the WQG in the Project Case.

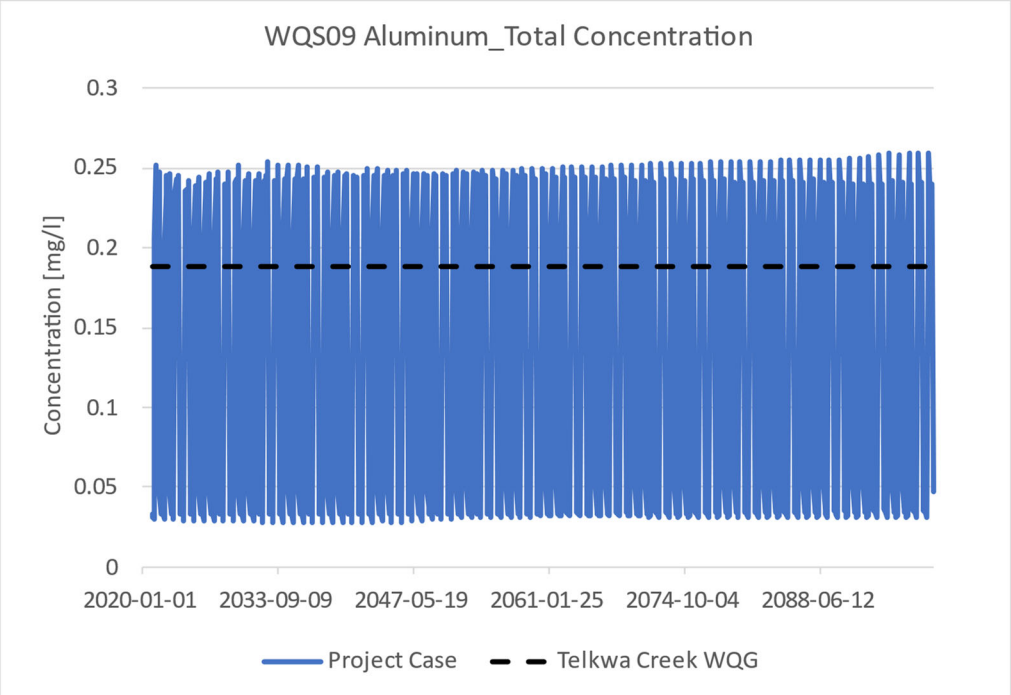


Figure 4-14: Modelled Total Aluminum Concentrations for Node WQS09 with Exceedances of WQG in Project Case

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm?web=1

Additional Observations

Total aluminum baseline 95th percentile concentrations for all streams (Four, Tenas, Goathorn Creeks as well as Telkwa and Bulkley River) are above the WQG. Four Creek 95th percentile baseline concentrations for dissolved iron are also above the WQG. The 95th percentile baseline concentrations for total iron are above WQG for Telkwa and Bulkley River. Dissolved copper 95th percentile baseline concentrations are above the WQG in Goathorn Creek, Telkwa River and Bulkley River.

4.4.2 Alternative Assessment Case Results

Alternative assessment cases include upper and lower range inputs for groundwater, geochemical source terms and hydrology. Each alternative input has been assessed on an individual basis with expected conditions (Project Case) for other parameters. Results focus on the prediction nodes and critical modeling periods associated with each case and are presented in Appendix G, tables G-10 though G-27.

Table 4-11 summarizes the additional changes to water quality under the alternative assessment cases. Results are described in the following sub-sections.

Table 4-11: Water Quality Exceedances under Alternative Assessment Cases

Alternative Assessment Case	Streams Affected	Additional Exceedances (Prediction nodes)	Comments
Case 1: High Groundwater Seepage	N/A	N/A	Despite increased seepage rates from Management Ponds, no additional exceedance is found in Four Creek or Tenas Creek. Decreased concentrations found in Four Creek as decreased groundwater seepage from open pit.
Case 2: High Source Terms	Tenas Creek, Four Creek, Goathorn Creek	Nitrite-Nitrogen (FC-03DS) Dissolved cobalt (FC-03DS, TC-22,04, GC-EA1,06,Ops only, GC-05 Ops and Closure) Total Selenium (FC-03DS, TC-22,04, GC-EA1,06,05 Closure only)	Critical period during low flow (winter months) in closure when Management Pond seepage dominates streamflow
Case 3: Consecutive Dry Years	no change expected	no change expected	Addressed with Low Flow scenario (Case 5). No results presented
Case 4: Consecutive Wet Years	Goathorn Creek only	no new exceedances	Expected Increased Project discharge rate to Goathorn Creek during critical period during EMP overflow, which increases freshet discharge in 2030. No results presented
Case 5: Low Flow	Four Creek	Nitrite-nitrogen (FC-03DS) Dissolved Cobalt (FC-03DS) Dissolved Nickel (FC-03DS) Total Selenium (FC-03DS)	All additional exceedances are driven by groundwater seepage from Management Ponds and effect the Four Creek downstream prediction nodes the most. Overall increases the average long-term values, but the not the monthly maximum values in the winter
Case 7: increased precipitation (10%)	no change expected	no new exceedances	Checked to see if additional exceedances from increased discharge

Notes:
FC = Four Creek, TC = Tenas Creek, GC = Goathorn Creek, TR = Telkwa River, BR = Bulkley River
Prediction nodes identified for each parameter represent additional exceedances beyond what is expected under Project Case conditions.

Alternative Assessment Case 1: High Case Groundwater

Appendix G tables G-10 through G-27 present the stream concentrations under high case groundwater seepage rates for prediction nodes that are downstream of Project facilities. Results reflect a combination of higher seepage rates from the Management Ponds and higher drawdown from the open pit, resulting in an increase in load at some prediction nodes and a decrease in flow at others. This case results in no flow in the upstream Four Creek prediction nodes WQS20 and WQS21 during the winter.

Despite increased load in Tenas Creek, no additional exceedance is recorded in this case. Water quality in the downstream node at WQS03DS in Four Creek improves relative to baseline because of the overall reduction in streamflow from open pit drawdown.

Alternative Assessment Case 2: High Source Terms

Case 2 applies high case geochemical source terms. Appendix G tables G-10 through G-27 present the monthly maximum and average long-term concentrations throughout relevant Project stages.

Additional parameters that exceed the WQG beyond what was exceeded in Project Case conditions include dissolved cobalt, total selenium, and nitrite-nitrogen.

The high source terms are expected to result in exceedances of the total aluminum WQG as well as dissolved copper WQG as it was already exceeding in the Project Case, but both remain below the 95th percentile for baseline datasets.

Additionally, dissolved cobalt is exceeded in new streams for this alternative Case besides Four Creek: it exceeds in Tenas Creek downstream of the Project (WQS22 and 04) in Closure, as well as in Goathorn Creek during Operations (WQSEA1, WQS06 and WQS05) as well as in Closure in WQS05 only.

High source term results are incorporated as the worst-case as part of the initial dilution zone modeling for Goathorn Creek downstream of the Project discharge (SRK 2025c) and in groundwater effects assessment and the Human Health effects assessment.

Alternative Assessment Case 4: Three Consecutive Wet Years (2028-2029-2030)

Three 1 in 10-year wet year precipitation scenarios were repeated in year 2028, 2029 and 2030, to simulate a period where we see the highest discharge during Operations, namely when East Management Pond is full. This results in the maximum Project discharge to Goathorn Creek when water quality is expected to be its worst for most parameters. In this scenario, no additional exceedances beyond what was presented in Project Case were observed.

Alternative Assessment Case 5: Low Flow Conditions

Case 5 assumes that streams experience the 7Q10 low flow condition year-round. Results presented in Appendix G tables reflect maximum concentrations from the model results.

Additional parameters that exceed the WQGs beyond what was exceeded in Project Case conditions include: nitrite, dissolved cobalt, dissolved nickel and, total selenium.

Downstream Four Creek prediction nodes present these exceedances when compared to water quality guidelines for the stream.

Low flow conditions are also evaluated as part of the initial dilution zone modeling for Goathorn Creek downstream of the Project discharge (SRK 2025c).

Alternative Assessment Case 7: 10% increased precipitation

Case 7 assumes increased precipitation by 10% to see how sensitive the water quantity and quality results are with small changes to the modelled average climate conditions. Results presented in Appendix G tables reflect maximum concentrations from the model results.

The only parameter exceeding WQGs in this case was total selenium in Goathorn Creek during Closure. The increase to the Project discharge during Operations does not result in new exceedances, because discharge is restricted to the open water season, when flows are highest. Exceedance in Closure occurs in April when receiving environment flows are often still low.

4.4.3 Additional Water Quality Parameters

Change in water quality to other measurable water quality parameters were evaluated external to the GoldSim model using conservative assumptions and, in some cases, qualitative considerations. Additional parameters include stream temperature, total suspended solids (TSS) and turbidity, pH and alkalinity, conductivity (EC) and total dissolved solids (TDS), and polycyclic aromatic hydrocarbons (PAHs).

This assessment focuses on the smaller streams, including Tenas, Four and Goathorn Creeks. The results presented above for modelled concentrations in Telkwa and Bulkley River show no measurable difference above baseline conditions and therefore the parameters listed above are also expected to remain unchanged.

Stream Temperature

A mass balance approach was utilized to evaluate the change in stream temperature from the Project discharge into Goathorn Creek. Change in temperature is not anticipated to be significant in other streams receiving Project discharge via groundwater pathways.

Temperature predictions in the Tenas Control Pond and management ponds were not developed as part of this work. As a conservative estimate, pond temperature was assumed to be equal to ambient air temperature. Monthly maximum Project temperature derived from long-term time series (SRK 2024a) were applied to the ponds. For air temperatures below freezing, pond water temperature was conservatively assumed to be 0°C. Maximum monthly Project discharge (Table 4-12) was considered from the Tenas Control Pond during operation and the NMP after closure.

Monthly mean flow in Goathorn Creek at node WQSEA1 (SRK 2024a) was considered for in-stream flow conditions, along with monthly average temperature. Stream temperature was obtained from the 2017-2019 baseline monitoring at WQS06 (ERM 2019). The temperature was highest in August, with average and maximum values of 13.8°C and 14.7°C, respectively.

The maximum increase in stream temperature from Project discharge was determined to be 0.4 °C during operation and 1.4 °C after closure (Table 4-12). These changes are within the natural variability of the stream temperature (i.e. difference between average and maximum recorded temperature). Estimates are expected to be conservative in terms of relative change in temperature to the receiving environment. For example, high temperature in April (Post-closure maximum case) is unlikely to occur, since the peak discharge is associated with spring snowmelt, when water temperatures would be close to freezing.

Table 4-12: Estimated monthly temperature change in Goathorn Creek

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tenas Control Pond (OP) [1]												
Pond Temperature (°C) [2]	2	0	3.5	7.2	10.1	20	18.6	16.9	13.7	11.5	1.5	0.5
Discharge Rate (m^3/s) [3]	-	-	-	-	0.255	0.174	0.101	0.035	0.035	0.035	-	-
North Management Pond (CL) [1]												
Pond Temperature (°C) [2]	2	0	3.5	7.2	10.1	20	18.6	16.9	13.7	11.5	1.5	0.5
Discharge Rate (m^3/s) [3]	0.033	0.009	0.127	0.304	0.082	0.021	0.009	0.007	0.006	0.055	0.085	0.046
Goathorn Creek												
Baseline Temperature (°C) [4]	0.1	0	0.1	3.3	4.6	7	10.2	13.8	7.7	3.4	1.3	0
Mean Flow (m^3/s)	0.22	0.18	0.19	1.36	5.1	5.09	3.06	1.54	1.23	1.12	0.79	0.34
Final Temperature (OP) (°C)	0.1	0.0	0.1	3.3	4.9	7.4	10.5	13.9	7.9	3.6	1.3	0.0
Temperature Change (OP) (°C)	0.0	0.0	0.0	0.0	0.3	0.4	0.3	0.1	0.2	0.2	0.0	0.0
Final Temperature (PC) (°C)	0.3	0.0	1.5	4.0	4.7	7.1	10.2	13.8	7.7	3.8	1.3	0.1
Temperature Change (PC) (°C)	0.2	0.0	1.4	0.7	0.1	0.1	0.0	0.0	0.0	0.4	0.0	0.1

Source:https://srk.sharepoint.com/sites/NA1CT027.003/Internal/700_Temperature_Model/Telkwa_TemperatureGHC_rk_updateCCM_20250723.xlsx?web=1

Notes:

1. Project stage acronyms: OP=Operations, PC=Post-Closure
2. Corresponds to Project maximum air temperature (SRK 2024a)
3. Maximum monthly discharge rate from the pond
4. Corresponds to average temperature at WQS06 based on baseline monitoring (ERM 2019)

Turbidity and Total Suspended Solids

Background concentrations of TSS and turbidity in the Tenas Project streams were obtained from 2017-2019 baseline water quality monitoring (ERM 2019) and updated with dataset up to 2024. The 50th and 95th percentile concentrations of these parameters in Tenas Creek, Four Creek and Goathorn Creek are outlined in Table 4-13. A relationship was developed between TSS, and turbidity based on linear regression considering the baseline monitoring data of streams (Figure 4-15).

Table 4-13: Baseline total suspended solids (TSS) and turbidity in the streams

Parameter	Unit	Four Creek		Goathorn Creek		Tenas Creek		All Creeks	
		P50	P95	P50	P95	P50	P95	P50	P95
Total suspended solids	mg/L	3	21	1.5	16	1.5	37	1.5	26
Turbidity	NTU	1.6	22	1.1	13	1.4	32	1.3	17

Source: https://srk.sharepoint.com/sites/NA1CT027.003/Internal/100_Data_Analysis/2023%20Updates/SurfaceWQ_BaselineData_rev14_cc_CCM_20250514.xlsx?web=1

Note: P50 and P95 corresponds to 50th and 95th percentile concentration, respectively

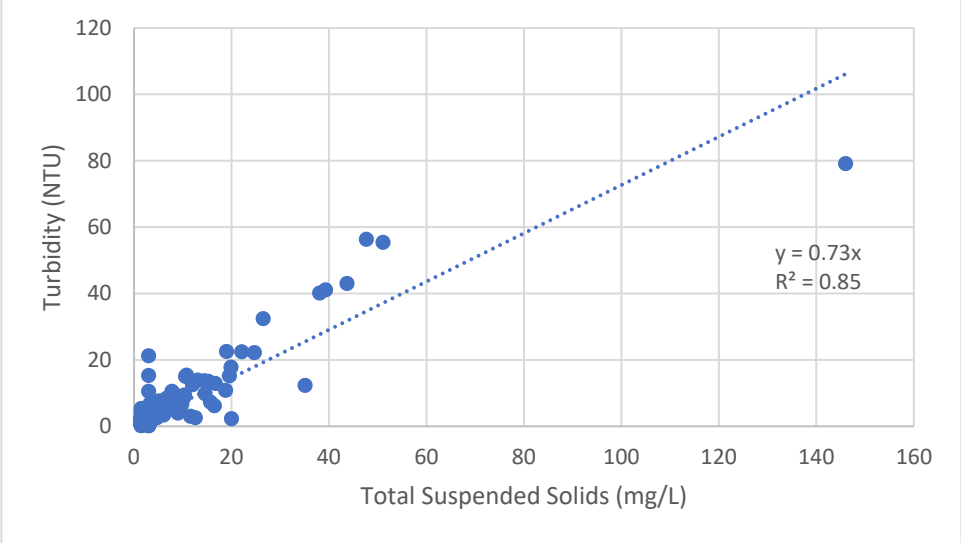


Figure 4-15: Relationship between TSS and turbidity for Goathorn, Tenas, and Four creeks

Source: https://srk.sharepoint.com/sites/NA1CT027.003/Internal/100_Data_Analysis/2023%20Updates/SurfaceWQ_BaselineData_rev14_cc_CCM_20250514.xlsx?web=1

TSS in Four Creek and Tenas Creek is expected to remain unchanged, as there will be no Project discharge to these streams. Suspended particles are expected to be removed during groundwater transport to these creeks. The Tenas Control Pond only discharges in open water period (May – October) during operation and will be decommissioned after closure. Suspended sediments are settled in the pond prior to discharge to a tributary of Goathorn Creek. It was assumed that TSS is discharged from the Tenas Control Pond towards Goathorn Creek at a constant concentration of 35 mg/L.

TSS in Goathorn Creek was calculated based on mass balance approach considering maximum Project discharge with background loading estimated from baseline monitoring. TSS corresponding to the 50th percentile value of 1.5 mg/L was used for Goathorn Creek background concentration. With monthly mean flow representing in-stream flow condition, the estimated TSS varied from 2.2 – 3.1 mg/L (Table 4-14). Turbidity was obtained using the linear relationship shown in Figure 4-15. The maximum turbidity in the creek after Project discharge was estimated to be 2.3 NTU.

TSS and turbidity levels in Goathorn Creek are expected to increase due to discharge from Tenas Control Pond, however the results are within the natural variability of baseline monitoring data (i.e., less than 95th percentile baseline concentration).

Table 4-14: Estimated TSS and turbidity in Goathorn Creek due to Tenas Control Pond discharge

Parameter	Open Water Period					
	May	Jun	Jul	Aug	Sep	Oct
Tenas Control Pond						
Maximum discharge rate (m^3/s)	0.255	0.174	0.101	0.035	0.035	0.035
Goathorn Creek						

Parameter	Open Water Period					
	May	Jun	Jul	Aug	Sep	Oct
Mean flow (m^3/s)	5.1	5.1	3.1	1.6	1.2	1.1
TSS (mg/L) [1]	3.1	2.6	2.6	2.2	2.4	2.5
Turbidity (NTU) [2]	2.3	1.9	1.9	1.6	1.8	1.8

Source: https://srk.sharepoint.com/sites/NA1CT027.003/Internal/500_Water_Balance/OtherParameters/Telkwa_OtherWQ_parameters_v1_rk_20250723_CCM.xlsx?web=1

Notes:

1. Estimated based on mass balance approach.
2. Estimated from the relationship between TSS and turbidity developed from baseline monitoring data.

pH and Alkalinity

Figure 4-16 shows the measured pH and alkalinity in Four Creek, Goathorn Creek and Tenas Creek from the 2017-2019 baseline water quality monitoring (ERM 2019) and updated with data up to 2024, which includes historical measurements from 2006 to 2008. Measured pH and alkalinity in these streams ranged from 7.2 to 8.5 and 26 to 222 mg-$CaCO_3$/L, respectively. The mean pH in Four Creek, Goathorn Creek and Tenas Creek was 7.9, 7.8 and 8.0, respectively.

Based on geochemical characterization of mine water, expected pH in the management ponds is 8.0 (Appendix E). Considering the similar pH in management ponds and baseline monitoring data of various streams, the Project is not expected to alter the in-stream pH or alkalinity.

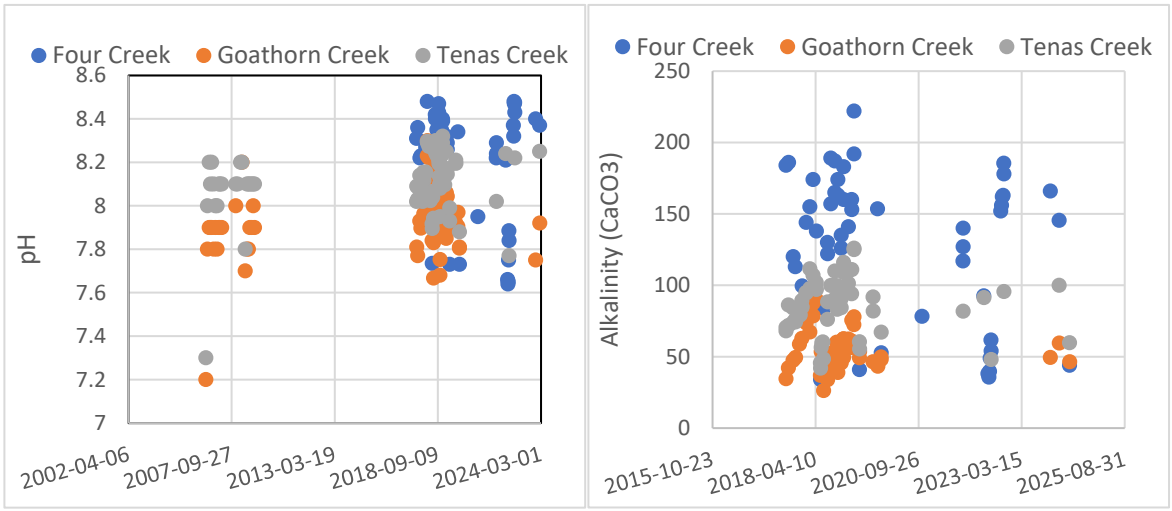


Figure 4-16: Measured (a) pH and (b) Alkalinity in Four Creek, Goathorn Creek and Tenas Creek

Source: https://srk.sharepoint.com/sites/NA1CT027.003/Internal/100_Data_Analysis/2023%20Updates/SurfaceWQ_BaselineData_rev14_cc_CCM_20250514.xlsx?web=1

Specific Conductance and Total Dissolved Solids

Specific conductance (SC) is correlated with total dissolved solids (TDS) and can be expressed by a linear relationship. Based on the 2017-2019 baseline water quality monitoring (ERM 2019) with updated data up to 2024, correlations were developed for Four Creek, Goathorn Creek and Tenas Creek (Figure 4-17). The 50th and 95th percentile background concentrations of TDS and SC in each stream are outlined in Table 4-15.

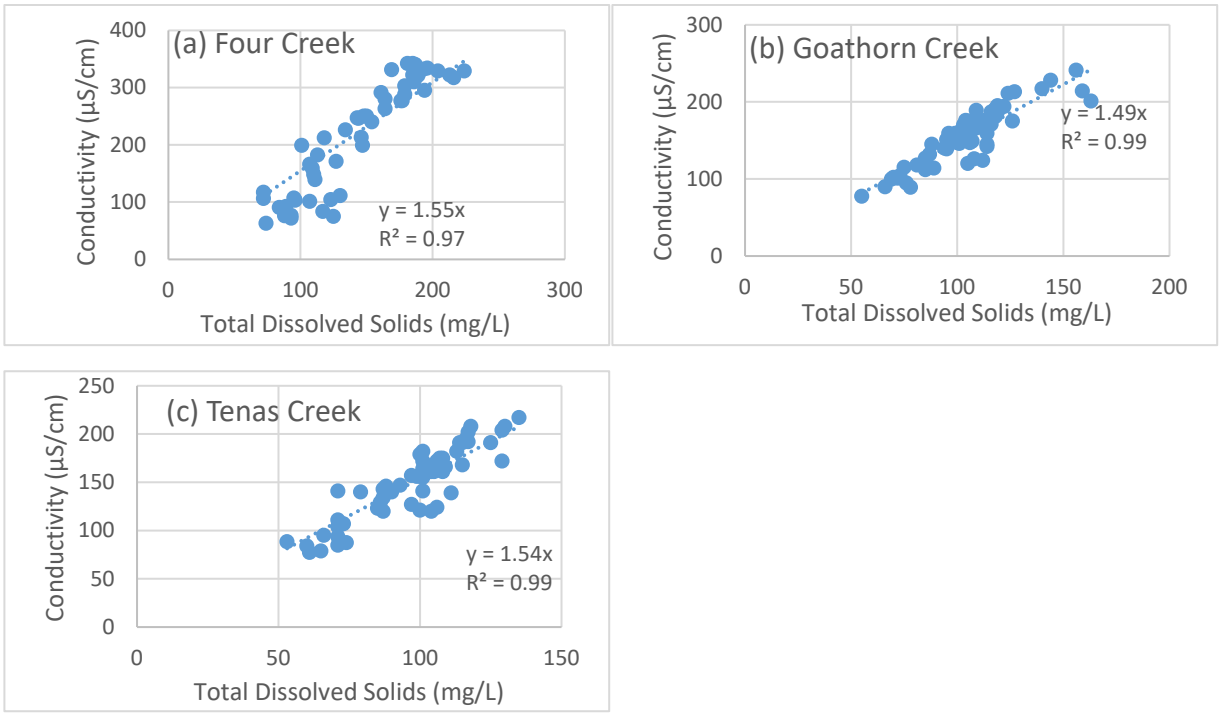


Figure 4-17: Relationship between TDS and specific conductance for (a) Four Creek, (b) Goathorn Creek, and (c) Tenas Creek

The TDS concentrations during Project Operations were calculated based on dissolved metal concentrations and alkalinity from the water and load balance model results for the Project Case. The model results from the prediction nodes with the highest concentrations in each stream were selected, including WQS03DS for Four Creek, WQS04 for Tenas Creek and WQS06 for Goathorn Creek. Calculated TDS concentrations are presented in Figure 4-18.

Maximum TDS in Four Creek, Goathorn Creek and Tenas Creek is estimated to be 233 mg/L, 160 mg/L and 182 mg/L, respectively, which is above the 95th percentile background concentration of individual streams (Table 4-15). TDS reaches its maximum level in Goathorn Creek in Post-Closure when uncontrolled discharges occur from North Management Pond. The maximum winter result is greater than 10% above the 95th percentile background concentration. Summer and winter long-term average TDS in Goathorn Creek are below or close to the 50th percentile baseline concentration. In Four Creek and

Tenas Creek, TDS also reaches its maximum levels in Post-Closure as a result of seepage from management ponds. In both creeks, the maximum values are within 10% of the 95th percentile baseline value. The long-term average TDS concentration in Four Creek is within the stream's natural variability (below 95th percentile), and the winter concentrations in Tenas Creek is within 10% of the 95th percentile baseline value through 2100.

EC was calculated using the regression relationship developed for the Project streams (Figure 4-17) and the calculated TDS concentrations at prediction nodes WQS03DS, WQS04 and WQS06 (Figure 4-18). Long-term average (summer and winter) SC are below the 50th percentile background concentration of individual streams during operation (Table 4-15). The average SC in Goathorn Creek remains below the 50th percentile background level during Post-closure as well. The maximum expected SC in Goathorn Creek is 237 µS/cm, which is above the 95th percentile baseline concentration. Like TDS, this is expected to occur as a result of Project discharge during low flow months in Post-Closure. In Four Creek and Tenas Creek, SC increases in winter months in Post-closure as a result of groundwater seepage from the management ponds. Concentrations are slightly (less than 10%) above the 95th percentile background values in Four Creek during winter months in Post-Closure, however the long-term average concentration (i.e. 2100) is within the baseline range. Tenas Creek concentrations of SC peak in Post-Closure and modeling results during winter months continue to be greater than the 95th percentile baseline value through 2100, though they remain less than 10% over the 95th percentile background values. 10% is considered within the variability of analytical results.

Table 4-15: TDS and SC estimate for Project Case condition

Parameter	Stream (Node)	Background Concentration		Project Stage [1]	Project Case Concentrations						
		P50	P95		Maximum Summer	Maximum Winter	Long-term Average Summer	Long-term Average Winter	Max Multiplier	Long-term Multiplier	Years with >10 % increase above 95th percentile baseline
TDS (mg/L)	Four Creek (WQS03DS)	150	220	OP	187	145	141	131	0.8	0.6	
				PC	183	233	150	160	1.1	0.7	0
	Tenas Creek (WQS04)	100	140	OP	101	116	90	100	0.8	0.7	
				PC	105	160	93	121	1.1	0.9	9
	Goathorn Creek (WQS06)	110	140	OP	129	124	99	107	0.9	0.8	
				PC	104	182	94	143	1.3	1.02	45
SC (µS/cm)	Four Creek (WQS03DS)	250	340	OP	289	224	218	203	0.8	0.6	
				PC	284	360	231	248	1.1	0.7	0
	Tenas Creek (WQS04)	160	220	OP	150	173	134	149	0.8	0.7	
				PC	156	237	138	180	1.1	0.8	0
	Goathorn Creek (WQS06)	170	210	OP	199	191	153	165	0.9	0.8	
				PC	160	280	144	221	1.3	1.1	48

Source: https://srk.sharepoint.com/sites/NA1CT027.003/Internal/500_Water_Balance/OtherParameters/Telkwa_OtherWQ_parameters_v1_rk_20250723_CCM.xlsx?web=1

Notes:

1. Project stage acronyms: OP=Operations, PC=Post-Closure
2. Modeling results that are greater than the 95th percentile baseline value by more than 10% are flagged in red

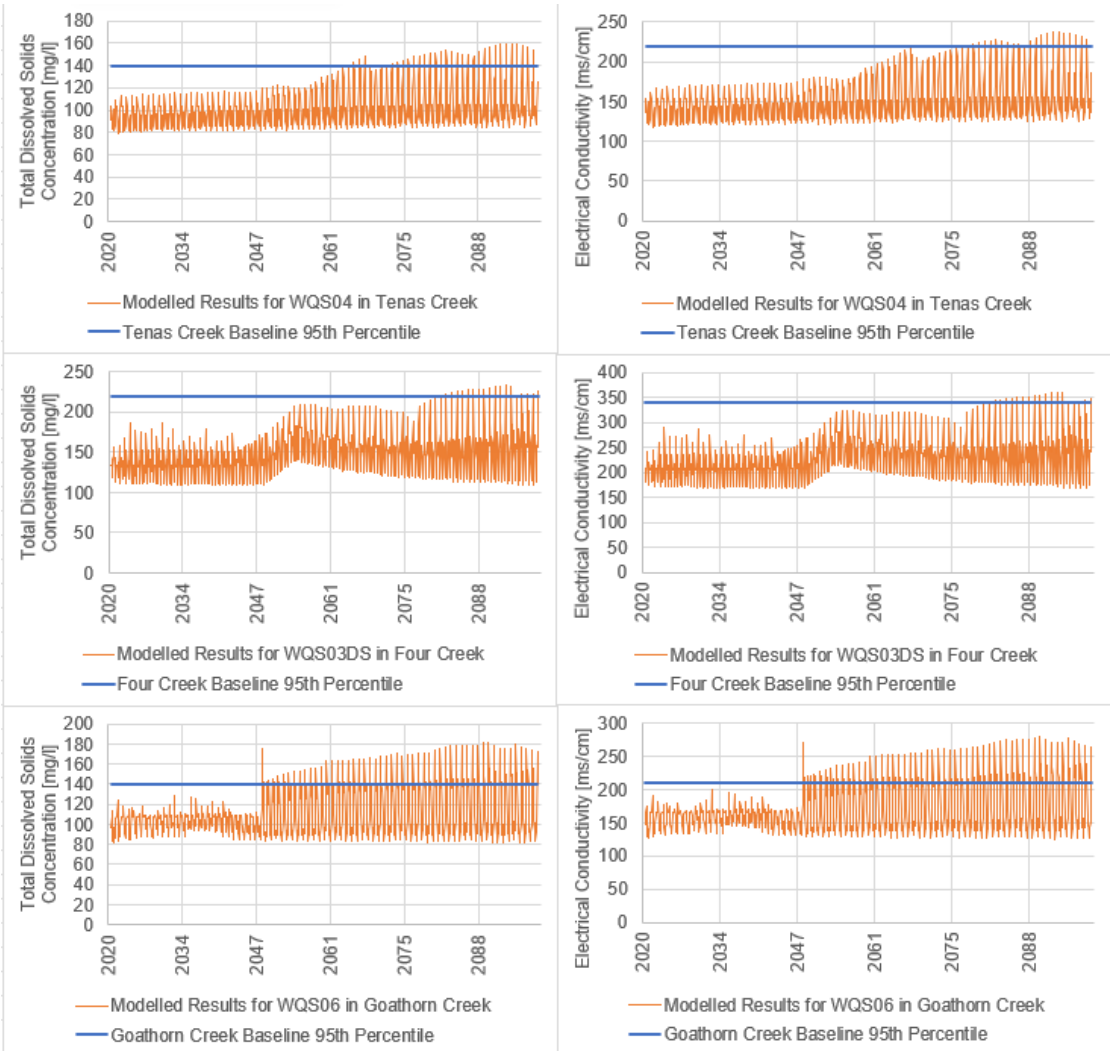


Figure 4-18: Modelled TDS and SC Results for Tenas Creek, Four Creek, and Goathorn Creek

PAHs

Polycyclic Aromatic Hydrocarbons (PAHs) will be controlled and mitigated through emergency response plans and spill response plans. No change in stream PAH concentrations is expected.

4.4.4 Exceedance Drivers and Mitigations

The sources of total selenium, dissolved cobalt and dissolved nickel is the runoff and seepage from Non-PAG rock backfill in the open pit, the buttresses, and Management and Control Ponds dams. Non-PAG areas will be covered with overburden progressively throughout Operations and into closure and reclamation. This will limit the long-term loading.

The source of nitrite-nitrogen is the blasting residue released with runoff and seepage from both PAG and Non-PAG rock. The blasting residuals model assumes a fixed percentage of load from the ANFO/Emulsion mixture is released per mass of placed rock. Assumptions are consistent with Best Practice and available literature (Ferguson and Leask 1988) but are expected to be conservative.

Other exceedances were mainly due to baseline concentrations being naturally high, such as for dissolved copper and total aluminum. Continued monitoring of the streams for their characterization has been ongoing since 2017 on a regular basis.

5 Summary of Receiving Environment Results

The following sections summarize the model results for the receiving environment. Results are discussed by stream (5.1) and in context within the RSA (5.2).

5.1 Summary of Model Results for Streams

5.1.1 Four Creek

Results indicate the following for Four Creek:

- Streamflow is reduced from baseline because the Project footprint occupies a portion of the existing Four Creek catchment.
- During open-water season months, streamflow is increased over baseline by diversions, capturing and diverting upstream runoff to portions of Four Creek.
- During the winter, baseflow is reduced in upstream prediction nodes during winter months from the open pit drawing down the groundwater table.
- Seepage from the Management and Control Ponds may increase the winter baseflow and result in elevated water quality concentrations for constituents of potential concern.

Based on conservative modelling of Four Creek (i.e. not accounting for the perched groundwater system, as described in Section 3.8), modelled results show that the Project will affect Four Creek. MAD downstream of the C02 channel will increase. MAD will decrease downstream because the Project decreases the size of the Four Creek catchment. However, based on most recent report examining whether Four Creek is perched (i.e. disconnected from the groundwater recharge) [SLR, 2025], it has shown that the upper reach of Four Creek is very likely perched, and therefore would not be directly impacted by the decrease in size of the Four Creek catchment.

High case groundwater seepage rates presented in Alternative Assessment Case 1 could reduce baseflow during winter months at prediction nodes directly downstream of the open pit (WQS20 and 21). However, based on most recent report examining whether Four Creek is perched (i.e. disconnected from the groundwater recharge) [SLR, 2025], it has shown that the upper reach of Four Creek is very likely perched, and therefore would not be directly impacted by the decrease in size of the Four Creek catchment.

Baseline water quality monitoring show that exceedances have occurred in Four Creek for total aluminum, and dissolved iron. After closure, groundwater seepage from the East Management Pond results in exceedance of water quality guidelines for dissolved cobalt during the winter months (4 years in total) and otherwise increases of concentrations for modelled parameters, in the downstream reach of Four Creek (WQS03DS). Alternative cases (case 2 and case 5) showed additional exceedances for the following parameters:

- Total selenium WQG is exceeded in both summer and winter months during Post-closure for both alternative cases by up to 2.7 times (highest total Selenium concentrations found in Alt Case 5). The long-term winter and summer results in 2100 are below the guideline.
- The nitrite WQG is exceeded in winter months by up to 2.9 times the guideline with some exceedances in summer months (both in Alt Cases 2 and 5, with highest concentrations found in Alt Case 5).
- The dissolved cobalt WQG is exceeded up to 70 times for alternative case 5, and up to 4 times for alternative case 2. No exceedances occur in summer. Long-term average winter and summer results are below the WQG.

Change in water quality in Four Creek was also evaluated for selected additional parameters:

- Stream temperature, TSS, and turbidity is expected to remain unchanged, as there will be no Project discharge to this creek. Suspended particles are settled in the management and control ponds, and are expected to be removed during groundwater transport.
- Maximum TDS and conductivity were above the 95th percentile baseline concentration for TDS and conductivity during Post-closure in the Project Case, but the change was within 10% of the baseline value. Long-term average concentrations of these parameters are within the natural variability of baseline monitoring data (i.e., less than 95th percentile baseline concentration) through 2100.
- No change is expected for in-stream pH, alkalinity, and PAH concentration.

5.1.2 Tenas Creek

Like Four Creek, changes to Tenas Creek streamflow are governed by the following Project interactions:

- Project footprint, which occupies up to 7% of the existing Tenas Creek catchment and reduces the streamflow over baseline conditions in portions of the creek that are downstream of the Project. The change ins most apparent during open-water season months when runoff rates govern streamflow.
- Groundwater table drawdown from open pit mining, which will reduce the baseflow contributions to Tenas Creek in prediction nodes adjacent to the open pit by up to 6%.
- Management Pond seepage may be minimized through implementation of liners; however, some seepage is expected to reach Tenas Creek, resulting in net increase in baseflow rates towards the end of mining and into Post-closure as well as higher water quality concentrations for constituents of concern.

Streamflow in segments of Tenas Creek will be reduced by less than 10%. The sensitivity case for groundwater seepage rates presented in Alternative Assessment Case 1 could further reduce baseflow during winter at prediction nodes directly downstream of the open pit.

Baseline water quality monitoring show that exceedances have occurred historically in Tenas Creek for total aluminum, based on 50th and 95th percentile values from baseline data calculated for the stream.

Groundwater seepage from the West and North Management Ponds in the Post-closure period results in higher concentrations of modelled parameters downstream of the Project, but no exceedances of WQG was shown to occur for the Project Case. However, Alternative case 2 (high source term) showed exceedance for the following parameter:

- The total selenium WQG is exceeded at downstream prediction nodes WQS22 and WQS04 in winter months during Post-closure by up to 1.5 times the guideline.
- The dissolved cobalt WQG is exceeded at downstream prediction nodes WQS22 and WQS04 in winter months during Post-closure up to 1.8 times the guideline.

Change in water quality in Tenas Creek was also evaluated for selected additional parameters:

- Stream temperature, TSS and turbidity is expected to remain unchanged, as there will be no Project discharge to this creek. Suspended particles are settled in the management and control ponds and are expected to be removed during groundwater transport.
- Maximum TDS and conductivity were above the 95th percentile baseline concentration for TDS and conductivity during Post-closure in the Project Case, however results were within 10% of the natural variability. Long-term average concentrations of these parameters are within the natural variability of baseline monitoring data (i.e., within 10% of the 95th percentile baseline concentration) through 2100.
- No change is expected for in-stream pH, alkalinity, and PAH concentration.

5.1.3 Goathorn Creek

The Project interacts with Goathorn Creek through surface discharge, open pit mining and Management Pond seepage, however based on the larger catchment area, the change to streamflow is less than in Four Creek and Tenas Creek.

- Groundwater table drawdown from open pit mining will reduce the baseflow contributions in prediction nodes upstream and directly downstream of the open pit. This includes WQS13 and WQS06US. The change relative to baseline is expected to be less than 3%.
- Seepage from Management Ponds counters the drawdown from open pit mining, however an overall reduction in winter baseflow is still expected. Seepage will increase overall water quality concentrations. This does not cause new exceedances in the stream.
- Project discharge from the Tenas Control Pond in Operations and the North Management Pond at closure will change streamflow downstream in Goathorn Creek at WQSEA1, WQS06 and WQS05. Despite diverting water from Tenas Creek to Goathorn, streamflow is lower in some open water months because of evaporative and seepage losses from the Project facilities. Streamflow increases at closure, when vegetated covers are in-place on Management Ponds. The Tenas Control Pond discharges in May through October. Baseline data indicate freshet usually occurs in April. During Operations in April, streamflow at WQSEA1 decreases. After the Tenas Control Pond is decommissioned, the NMP will discharge by gravity to a tributary of Goathorn Creek, which increases discharge in April after closure.

- Additional withdrawal from Goathorn Creek during Operations has been included in model results for up to 2.5% of baseline flows. This water is not used by the Project (i.e., water covers do not depend on this flow rate), and it is included as contingency source only.
- An increase in streamflow from consecutive wet years tested in Alternative Assessment Case 4 and Case 7 could result in a net increase of up to 10% in monthly average streamflow at downstream prediction nodes.

Baseline water quality monitoring show exceedances in Goathorn Creek for total aluminum, and dissolved copper based on 50th and 95th percentile values from baseline data calculated for the stream. Exceedance of water quality guideline expected to occur for the following parameters, in Operations and in Closure, therefore not driven by Project discharge under the Project Case results:

- Exceedances of the dissolved copper WQG occur in winter and summer during the operation and Post-closure phases in the Project Case, but results are within the natural variability of baseline monitoring data (i.e., less than the 95th percentile from baseline datasets). Because these exceedances are driven by naturally elevated concentrations of dissolved copper in the background, the concentrations do not decrease over time.

While no other exceedances were recorded for the Project Case, Alternative Case 2 had exceedances for the following parameters:

- Exceedances for total selenium by up to 1.5 times the WQG, occurring only in Closure during the winter months. These exceedances are below the WQG by 2100.
- Exceedances for dissolved cobalt by up to 1.5 times the WQG, occurring in Operations during the monthly maximum summer months, which corresponds to the higher discharge rates when EMP overflows in 2030. This likely could be mitigated through lower discharge in the Creek.
- Exceedances for dissolved cobalt by up to 1.1 times the WQG, occurring in Closure only in WQS05 during the monthly maximum winter months, which corresponds to seepage from the Project reaching the Creek in Post-closure. These exceedances occur for less than 10 year in the model results.

Both Alternative Case 7 and Alternative Case 4, which produces increased discharge from the Project did not record any additional exceedances in Operations or Closure.

Change in water quality in Goathorn Creek was also evaluated for selected additional parameters:

- Due to Project discharge, maximum increase in stream temperature was estimated to be 0.4 °C during operation and 1.4 °C in Post-closure. These changes are within natural variability compared to baseline stream temperature monitoring.
- TSS and turbidity levels are expected to increase due to discharge from Tenas Control Pond and North Management Pond particularly, however results are within the natural variability of baseline monitoring data (i.e., less than 95th percentile baseline concentration).
- Maximum TDS and conductivity were above the 95th percentile baseline value by more than 10% during Post-Closure in the Project Case. This is likely driven by discharge from North Management

Pond during low flow months, which likely could be mitigated based on learnings through Operations.

- No change is expected for in-stream pH, alkalinity, and PAH concentration.

Short term elevated concentrations can be prevented by controlled discharge from the ponds and active monitoring of downstream flow conditions and pond water quality.

5.1.4 Telkwa River

Minor increases in winter flows and decreases in open water season flows could occur during Operations at Telkwa River node WQS09, downstream of the confluence with Goathorn Creek. The reduction in open water season flows results from evaporative losses from the Management Ponds and end pit lake. Decreased flow in winter is from less groundwater discharge to the streams. Over time, the water levels in the Management Ponds result in a small (~1%) increase in baseflow conditions (Appendix F, Table F-3).

Baseline water quality exceedances have occurred in Telkwa River for total aluminum, dissolved copper, and total iron. Model results show exceedances of the total aluminum WQG in summer during the operation and Post-closure phases in the Project Case. However, the results are less than the natural variability recorded in the baseline monitoring data (i.e. less than the 95th percentile from baseline datasets). Exceedances of the WQG of dissolved copper are experienced in summer throughout operation phase only but results are less than the 50th percentile from baseline data.

No additional water quality exceedances are expected beyond what has been experienced historically based on Project Case conditions or Alternative Assessment cases.

5.1.5 Bulkley River

The Bulkley River at node WQS11 receives Project discharge from the Rail Infrastructure Sedimentation Pond. The change to MAD is less than a 0.01% increase from the higher runoff coefficient for the stockpile area compared to natural conditions.

WQS12 is located on Bulkley River downstream of the Telkwa River confluence. Changes described for the Telkwa River propagate into the Bulkley River but have a much smaller effect in relation to baseline, with a maximum percent reduction of less than 0.1%.

Baseline water quality monitoring show that exceedances have occurred in the Bulkley River for total aluminum, dissolved copper, and total iron. Model results show no during the operation and Post-closure phases in the Project Case.

No additional water quality exceedances are expected beyond what has been experienced historically. This is consistent for the Project Case as well as the Alternative Assessment cases.

5.2 Summary in Context with Regional Study Area

5.2.1 Change to Streamflow

Table 5-1 and Table 5-2 summarize the change to mean annual discharge and seasonal flow distribution, respectively, with the affected streams' watershed, the LSA and the RSA. Results are based on the Project Case.

The change to mean annual discharge and the seasonal streamflow distribution reflect the area where the annual average flows or the monthly average flows are either reduced by more than 10% or increased by more than 30% relative to pre-mining conditions. The effects are local to Four Creek, however in the case of seasonal flow distribution, the effect propagates further upstream and includes node WQS03.

Table 5-1: Summary of Change to Mean Annual Discharge for Project Case

Stream	Four Creek
Prediction nodes Affected	WQS20, WQS21, WQS03DS
Project Stage	Operation, Post-Closure
Affected Area [km^2]	7.6
Total Stream Area [km^2]	11.0
% of Total Stream Area Affected by Project	69%
% of LSA Affected by Project (1)	3.6%
% of RSA Affected by Project (2)	0.5%

Notes:

1. LSA is 208.3 km^2
2. RSA is 1430 km^2

Table 5-2: Summary of Change to Seasonal Flow Distribution for Project Case

Stream	Four Creek
Prediction nodes Affected	WQS03, WQS20, WQS21, WQS03DS
Project Stage	Operation, Post-Closure
Affected Area [km^2]	11.0
Total Stream Area [km^2]	11.0
% of Total Stream Area Affected by Project	100%
% of LSA Affected by Project (1)	5%
% of RSA Affected by Project (2)	0.8%

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Results\Results_Streams_MonthlyChange_07132021_sab.xlsm

Notes:

1. LSA is 208.3 km^2

2. RSA is 1430 km^2

High flows are expected to be reduced over baseline conditions for prediction nodes with reduced catchment areas. For the segment of Four Creek with an increase in catchment area, downstream of the diversion channel, an engineering control structure will limit the discharge during extreme events, sending excess water to the East Management Pond. Similarly, the Tenas Control Pond will have the ability to control high flood events by having the capacity to attenuate flows up to the 1 in 10-year flood event. As a result, the change in high flows is expected to be minimal.

Low flows are expected to be reduced in Operations along sections of Tenas and Four creeks from the drawdown of the groundwater table around the open pit. Extreme low flows will be similarly affected. The rate of change to low flows is captured in the discussion of winter flow in the seasonal streamflow distribution results (Table 5-2).

5.2.2 Change to Stream Water Quality

Table 5-3 summarizes the change to surface water quality under the Project Case in context within the affected streams' watershed, the LSA and the RSA. The Project Case represents the expected outcomes based on reasonably conservative assumptions and Project characterization and is used to support the EA.

According to the definitions in the EA, affected areas are identified where a water quality model result exceeds both the relevant WQG and the variability in the background water quality (95th percentile). The only parameter in the model that exceeds both background water quality and the WQG is dissolved cobalt in Four Creek. In the case of specific conductance and total dissolved solids, where no WQG is available, the model results show that only Goathorn Creek is expected to be affected, with model results greater than 10% above the 95th percentile background water quality in Post-Closure.

As a result, only Four and Goathorn creeks are presented as being affected by the Project (Table 5-3).

While model results show exceedances for total aluminum and dissolved copper in Goathorn Creek and Telkwa River, these results are driven by the elevated concentrations in the background data. The incremental increase because of the Project is minimal (<1%), as described in Section 4.4.1. Therefore, these areas are not presented as being affected by the Project.

Table 5-3: Summary of Change to Water Quality for Project Case

Stream	Four Creek	Goathorn Creek	Total Affected
Prediction nodes Affected	WQS03DS	WQSEA1, WQS06, WQS05	
Parameters with Exceedances of water quality guidelines (1)	Dissolved Cobalt	N/A	
Additional Parameters greater than baseline (2)	N/A	TDS, SC	
Project Stage	Post-Closure	Post-Closure	Post-Closure
Affected Area [km^2]	5.7	6.7	12.4
Total Stream Area [km^2]	11.0	195	206
% of Total Stream Area Affected by Project	52%	3%	6.0%
% of LSA Affected by Project (3)	3%	3.2%	6.0%
% of RSA Affected by Project (4)	0.4%	0.5%	0.9%

Notes:

1. Exceedances occur for a minimum of 1-month under Project Case
2. Exceedances are in relation to the 95th percentile of baseline monitoring data and occur for a minimum of 1-month under Project Case
3. LSA is 208.3 km^2
4. RSA is 1430 km^2

The affected area in Four Creek represents the catchment area between nodes WQS20 and WQS03DS. This area is expected to be significantly lower based on the perched nature of the majority of the creek (SLR 2025). Due to the uncertainty associated with the extents of the perched vs. unperched creek segments, the full area between these nodes was carried forward into the EA.

6 Conclusions and Recommendations

A water and load balance model has been developed based on Feasibility-level Project characterization, including hydrology, geochemical source terms, groundwater modeling, and the detailed mine plan and associated water management systems. The model produced time series of monthly flows and water quality within the Project infrastructure and in the receiving environment throughout the life of mine to 2100.

Within the Project facilities, the model demonstrates the minimum water cover target of 0.5m within 6 months of PAG rock placement can be maintained in all Management Ponds during Operations and a water cover target of 1.5 m for Post-closure. Temporary water cover reductions may be experienced under extreme dry or highly constrained periods, however sufficient water is expected to be available within other facilities (Tenas Control Pond, other Management Ponds or Goathorn Creek) to manage the water covers and PAG rock is subsequently covered with 0.5 m of water within 6-months of placement.

The Project has the potential to interact with receiving environment water quantity and water quality via four primary mechanisms:

- Reduction of natural catchment area, resulting in an equal reduction to streamflow over baseline conditions.
- Change in winter groundwater seepage (baseflow) to streams because of open pit mining (groundwater drawdown) and mounding of groundwater from increased head in Management Ponds and the Tenas Control Pond (increased seepage rates).
- Seepage from the West Management Ponds, the Tenas Control Pond will have elevated concentrations relative to baseline conditions, resulting in potential exceedances of WQG in the receiving environment for dissolved cobalt.
- Project discharge to the downstream environment may result in changes to streamflow and water quality.

Discharging facilities (Rail Infrastructure Sedimentation Pond, Tenas Control Pond and North Management Pond) have effluent concentrations that are higher than the WQGs for the following parameters of concerns in the end-of-pipe effluent: total selenium , nitrate-nitrogen, nitrite-nitrogen, sulfate, total aluminum, dissolved cadmium, dissolved cobalt, dissolved copper, total iron, total molybdenum, dissolved nickel, total thallium and dissolved zinc during active discharge periods under Project Case conditions, and only resulted in one exceedance from the Project discharge once in the stream, only in Closure in Four Creek for a few years (4 consecutive years). The high source term case (Alternative Assessment Case 2) may require additional mitigation measures to manage selenium concentrations for short periods of time in the Tenas Control Pond/North Management Pond.

Stream results are screened against applicable guidance to evaluate the change resulting from the Project on the environment, which include:

- Whether streamflow is increased by more than 30% or decreased by more than 10% relative to baseline conditions.

- Whether seasonal flow distribution changes.
- Changes to high and low flows.
- Whether stream water quality exceeds relevant water quality guidelines when exceedances did not occur historically (within natural variability).

Changes to streamflow are summarized as follows:

- Change in streamflow is expected to occur in Four Creek, from an increase in flow from diversion channels and a reduction in flow from groundwater drawdown and catchment reductions. The change relative to baseline is greater than 10% reduction to mean annual discharge, with higher changes monthly.
- Tenas Creek will experience months, predominantly in April and August, with up to 10% reduction to baseline streamflow, however the change to mean annual discharge is less than 10% throughout Operations and closure periods.
- Goathorn Creek flows are expected to be reduced by up to 6% in low flow months in Operations, while increasing by up to 8% during freshet. The overall change to mean annual discharge is a reduction of 4% in Operations and 1% Post-closure.
- Both Telkwa and Bulkley Rivers experience less than 1% change relative to baseline conditions due to the relatively small Project footprint with respect to the total catchment areas of each river.

WQG exceedances is expected under Project Case conditions for dissolved cobalt in Four Creek for a period of four years, as well as for dissolved copper and total aluminum in Goathorn Creek and Telkwa River, which are naturally elevated in the background concentrations. The baseline water quality records already show exceedances for these parameters as part of the natural variability of the stream.

Elevated levels of TDS and EC are also expected in Tenas, Four and Goathorn Creeks downstream of the Project because of seepage from management ponds and discharge from the Project. Results in Tenas and Four creeks are within 10% of the 95th percentile from baseline data in each stream, however the results in Goathorn Creek are up to 30% increase relative to the 95th percentile baseline data. This effect occurs in the Post-Closure Phase only.

The change to both stream water quantity and quality were further evaluated in terms of the affected area within the spatial boundaries of the Project, including the local stream watersheds, the LSA and the RSA.

- In terms of water quality, the only modelled prediction node that is expected to experience long-term exceedances of the WQGs and the 95th percentile of background data is in Four Creek at node WQS03DS for dissolved cobalt for a period of four years. In addition, the modelled TDS and SC concentrations are expected to be above the 95th percentile of background monitoring by more than 10% in Goathorn Creek during Post-Closure. The affected area includes the lower portions of Four and Goathorn creeks, which is an area equal to 12.4 km^2. This affected area represents approximately 6% of the LSA and less than 1% of the RSA.
- In terms of water quantity, the modelled prediction nodes that experience a change to mean annual discharge greater than 10% reduction or 30% increase include WQS21, WQS20 and WQ03DS, which encompasses an area equal to 7.6 km^2. This affected area represents approximately 3.6% of the LSA and 0.5% of the RSA.

The results from this study and report will be used as part of the EA Application.

Recommendations:

- Continue to collect water quality and quantity data throughout project implementation.
- Model to be reviewed and updated as-needed annually with results from monitoring.
- No additional strategies to reduce concentrations in Management Ponds and Control Ponds are recommended at this point as there are no exceedances resulting from the Project. However, contingencies measures are put in place to mitigate any deviations from these results, as recommended in the conclusions of the BAT assessment report (SRK 2025a). Contingencies include in-situ Gravel Bed reactors treatment in Management Ponds and Active treatment post Tenas Control Pond.

6.1 Risks and Limitations and Opportunities

Risks and limitations of the model are summarized below based on assumptions and data incorporated into the model:

- The Project area rainfall-runoff model simulates an earlier freshet onset than the Goathorn Creek rainfall-runoff model, based on the median elevation and climate correction factors (Section 3.1.7). The modelled increase over pre-mining conditions during freshet at closure may not be as prominent as the model estimates since the rock covers will likely remain frozen for a longer period once vegetation is established due to the relatively flat slopes in comparison to the natural topography.
- Rainfall-runoff models are developed based on constant monthly runoff coefficients, calibrated from historical records. Changes to the timing of spring freshet or other annual hydrologic phenomenon which may be expected with climate change projections could result in changes to the monthly runoff rates. These types of effects are not currently captured in the water balance model. Additional climate change -related risks include:
  - Increased occurrence of wildfires which could result in higher runoff during rainfall and snowmelt events (because of reduction of vegetative cover, hydrophobic soils, etc.), and could result in greater sediment loading to the receiving environment(s),
  - Changes in hydrograph seasonality, which could result in shifting low flows to the summer months which coincide with planned discharges and could reduce dilution / assimilation capacity in the receiving environment(s), and
  - Altered interactions with natural groundwater system, which could result in reduced baseflow contributions and could reduce dilution/ assimilation capacity in the receiving environment(s) during winter or summer months.
- Ongoing collection of hydrometric and meteorological data will be completed through the subsequent Project design phases. The Project climatic records, as well as the calibrated rainfall-runoff models should be revisited based on additional data collected on-site, specifically to improve the characterization of Tenas Creek and Four Creek, which have limited records.

- The water balance for the historic years was calibrated based on measured site data. Any error in this data collection would directly affect the reliability of the model calibration.
- Solubility limits were not universally applied in the model. Consequently, some parameters may precipitate prior to reaching the modelled concentrations.
- The model treated all reservoirs as perfectly mixed containers. This mixing occurred instantaneously at every time step and may not be reflective of actual conditions.
- Groundwater and impacted seepage flows are based on hydrogeologic models which are based on a limited hydrogeologic dataset.
- Uncertainty in MAP and evaporation predictions.
- Additional limitations of input data are discussed in topic-specific reports.

Opportunities:

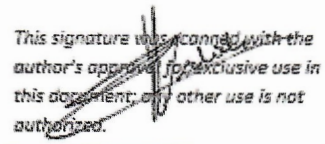
- The primary driver of increased water quality concentrations in the receiving environment is seepage from Management Ponds and the Tenas Control Pond. The model assumes that 100% of the mass of constituents leaving the Management Ponds via seepage eventually reaches the streams, without any attenuation. Constituents transported through groundwater pathways may be attenuated through dispersion and advection mechanisms, which could ultimately improve the water quality discharging downstream. In addition, the extended period between when seepage leaves the facility and discharges to surface water provides a significant time for intervention or mitigation measures to be employed. Active groundwater monitoring will be incorporated into the monitoring plans to capture the rate and concentrations of migration of the seepage plume.
- Increase efficiency of liners in Management Ponds and the Tenas Control Pond in terms of minimizing seepage rates could be investigated to reduce the amount of load entering the receiving environment via groundwater pathways (SRK 2025b).
- Active monitoring of pond water quality in tandem with in-stream water quality along with streamflow is expected to enable control of pond discharges to reduce the occurrence of exceedances in Goathorn Creek during Operations.

Contingencies (SRK 2025a and b):

- Organic carbon addition to the covered management ponds Post-closure to create reducing conditions to decrease selenium mobility using Gravel Bed reactor within the management ponds.
- Active water treatment plant of water collected in management and control ponds.
- Increasing water stored through low flow period in the summer and discharge more during freshet when dilution capacity is greater.
- Utilize the 2.5% water withdrawal from Goathorn Creek in Project's overall water management plan.
- Evaluate the construction schedule of the management ponds and potentially build the dams earlier to create additional storage before PAG placement is required.

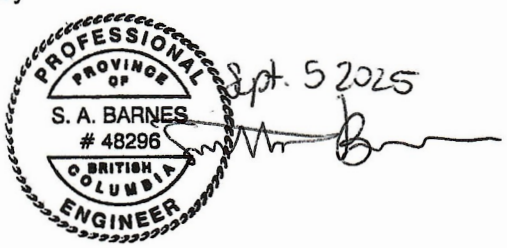
Closure

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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Appendix A Prediction Node Climate Adjustment Memo

Memo

To:	File	**Client:**	Telkwa Coal Limited
From:	Camilo Gallard Samantha Barnes	**Project No:**	1CT027.003
Cc:		**Date:**	January 12, 2021
Subject:	Prediction Node Streamflow Assessment to Support Water and Load Balance Model		

1 Introduction

An Environmental Assessment (EA) is being completed for the Tenas Project (the "Project") near Smithers B.C, which includes a water and load balance model to evaluate impacts to downstream creeks and rivers. Prediction nodes included in the model include locations along Tenas Creek, Four Creek, Goathorn Creek, Telkwa River and Bulkley River, as defined in the Tenas Project Water and Load Balance Report (SRK 2021a).

The following memorandum presents the methodology for evaluating streamflow within each watercourse and at each prediction node. Results are incorporated into the water and load balance model to develop water quality and quantity estimates pre- and post-mining.

1.1 Supporting Information

1.1.1 Climate Data

A detailed meteorological analysis was presented in the 2021 Hydrometeorological Baseline and Model Development Report (SRK Consulting, 2021b). The Project climate timeseries described in this work were used as an input for this analysis.

1.1.2 Regional Hydrometric Data

Water Survey of Canada (WSC) is the national authority responsible for the collection, interpretation and dissemination of standardized water resource data in Canada. Four WSC regional stations maintain long term records on streams and locations relevant to the Project as illustrated on Figure 1-1. These stations have more than 10 years of data and catchment areas ranging between 125 km^2 to 8940 km^2. Table 1-1 shows a summary of the metadata for these stations.

Table 1-1: Summary of Regional Hydrometric Stations

Station ID	Station Name	Longitude	Latitude	Area (km^2)	First Year	Last Year
08EE008	GOATHORN CREEK NEAR TELKWA	54.65	-127.12	125	1960	2016
08EE020	TELKWA RIVER BELOW TSAI CREEK	54.61	-127.50	367	1975	2018
08EE004	BULKLEY RIVER AT QUICK	54.62	-126.90	7340	1930	2018
08EE005	BULKLEY RIVER NEAR SMITHERS	54.77	-127.13	8940	1945	2018

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.002 2017-18 permitting Support (Phase 2)\0200_SurfaceWater\Hydrology\R files\Flows_update_rev06.Rmd

1.1.3 Project Hydrometric Data

Four hydrometric stations were installed at the Project in 2017.

- Tenas-Hydro was established on Tenas Creek upstream of the confluence with Goathorn.
- Goathorn-Hydro was established on Goathorn Creek upstream of the Goathorn-Tenas confluence.
- Telkwa-Hydro was established on the Telkwa River upstream of the confluence with Goathorn Creek.
- Four-Hydro was established on Four Creek in April 2020, upstream of the confluence with Goathorn Creek.

Table 1-2 summarizes the metadata for these stations, and their location and catchment delineations are shown in Figure 1-1. The Goathorn-Hydro station is located at the same location as the WSC Goathorn station (08EE008).

Table 1-2: Summary of Local Hydrometric Stations

Station Name	Longitude	Latitude	Area (km^2)	Average Catchment Elevation (masl)	Start of Record
Four Hydro	54.62	-127.14	11.0	985	April 2020
Tenas-Hydro	54.62	-127.19	47.4	1181	May 2017
Goathorn-Hydro	54.65	-127.12	121.6	1243	May 2017
Telkwa-Hydro	54.65	-127.17	966.9	1243	May 2017

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.002 2017-18 permitting Support (Phase 2)\0200_SurfaceWater\Hydrology\R files\Flows_update_rev06.Rmd

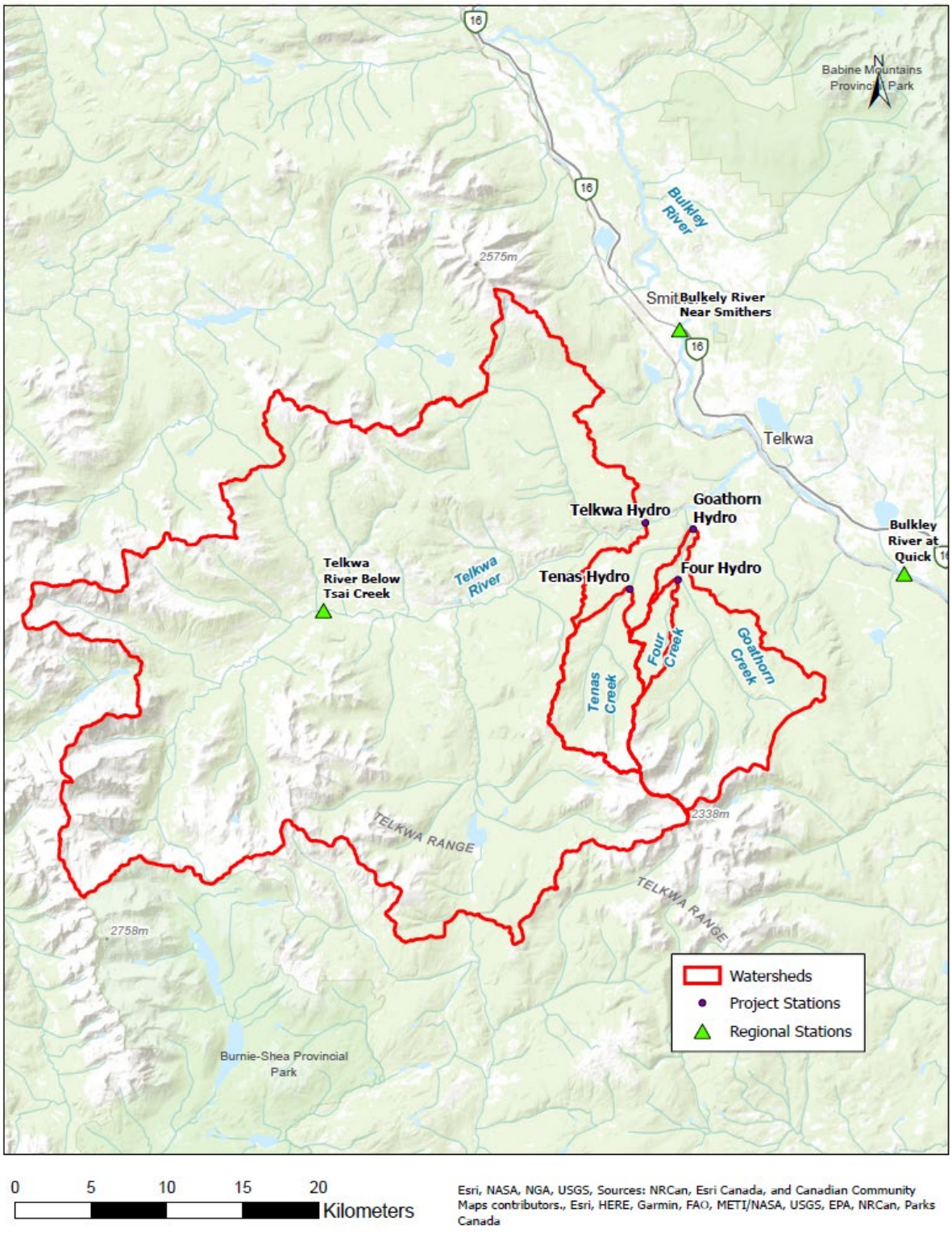


Figure 1-1: Regional and Project Hydrometric Stations

Source: \\srk.ad\dfs\na\van\Projects \01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\!080_Deliverables\Hydromet Baseline Update\040_Figures\Figure3.1_Hydrometric_Stations_20201023.jpg

Project records and regional records were compared and patched together as described in SRK 2021b to provide the long-term flow timeseries that were used in this analysis.

2 Location of Prediction Nodes

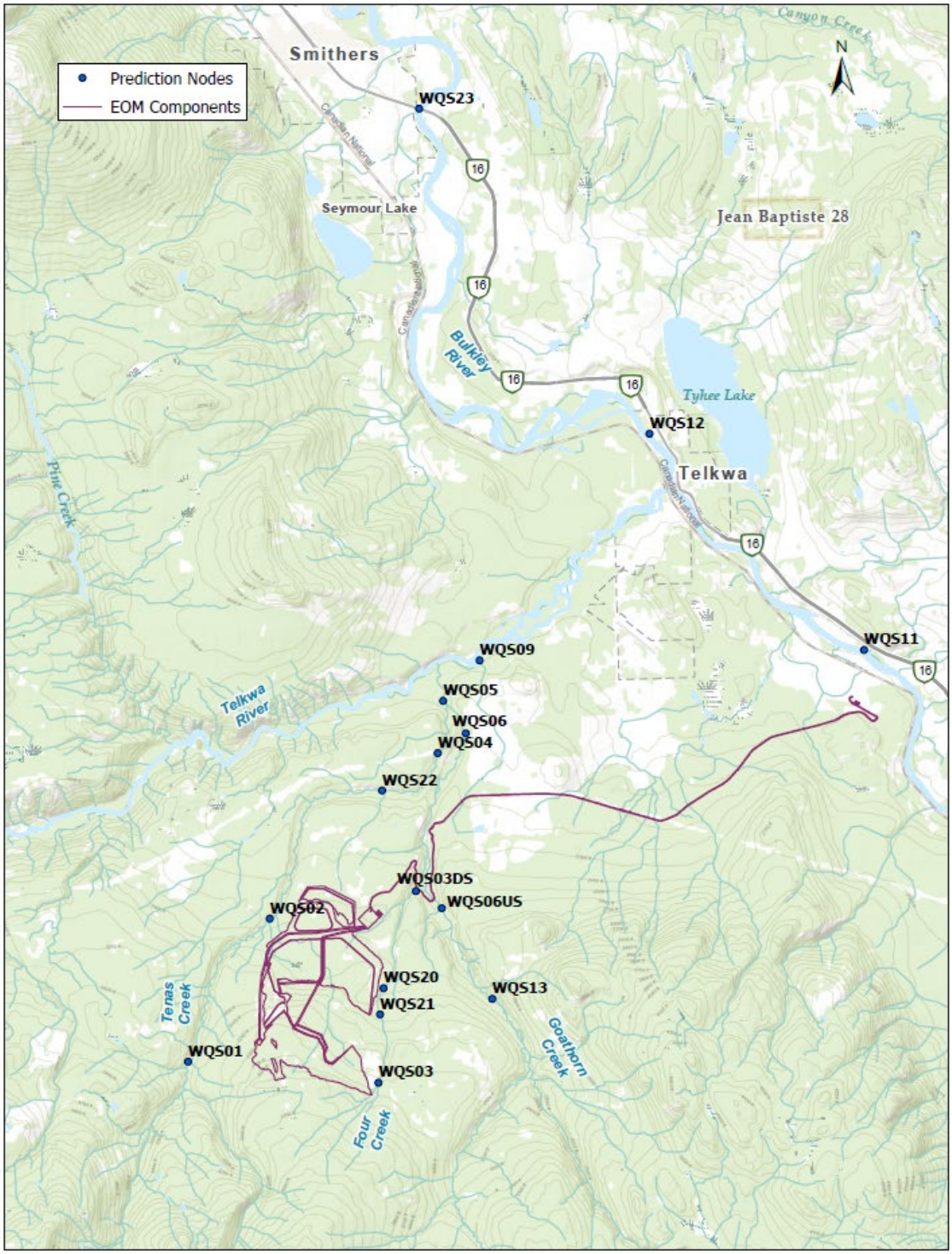
A total of 16 in-stream prediction nodes were selected for the water and load balance to evaluate impacts from the Project, including nodes along Tenas Creek, Four Creek, Goathorn Creek, Telkwa River and Bulkley River.

Project infrastructure will result in changes to the catchment area contributing to each prediction node. Table 2-1 summarises the prediction node coordinates, as well as associated catchment area pre- and post-mining. Node locations are presented in Figure 2-1. Figure 2-2 and Figure 2-3, present the catchment area for each node under pre- and post-mining conditions, respectively.

Table 2-1: Receiving Environment Prediction Nodes, from Upstream to Downstream

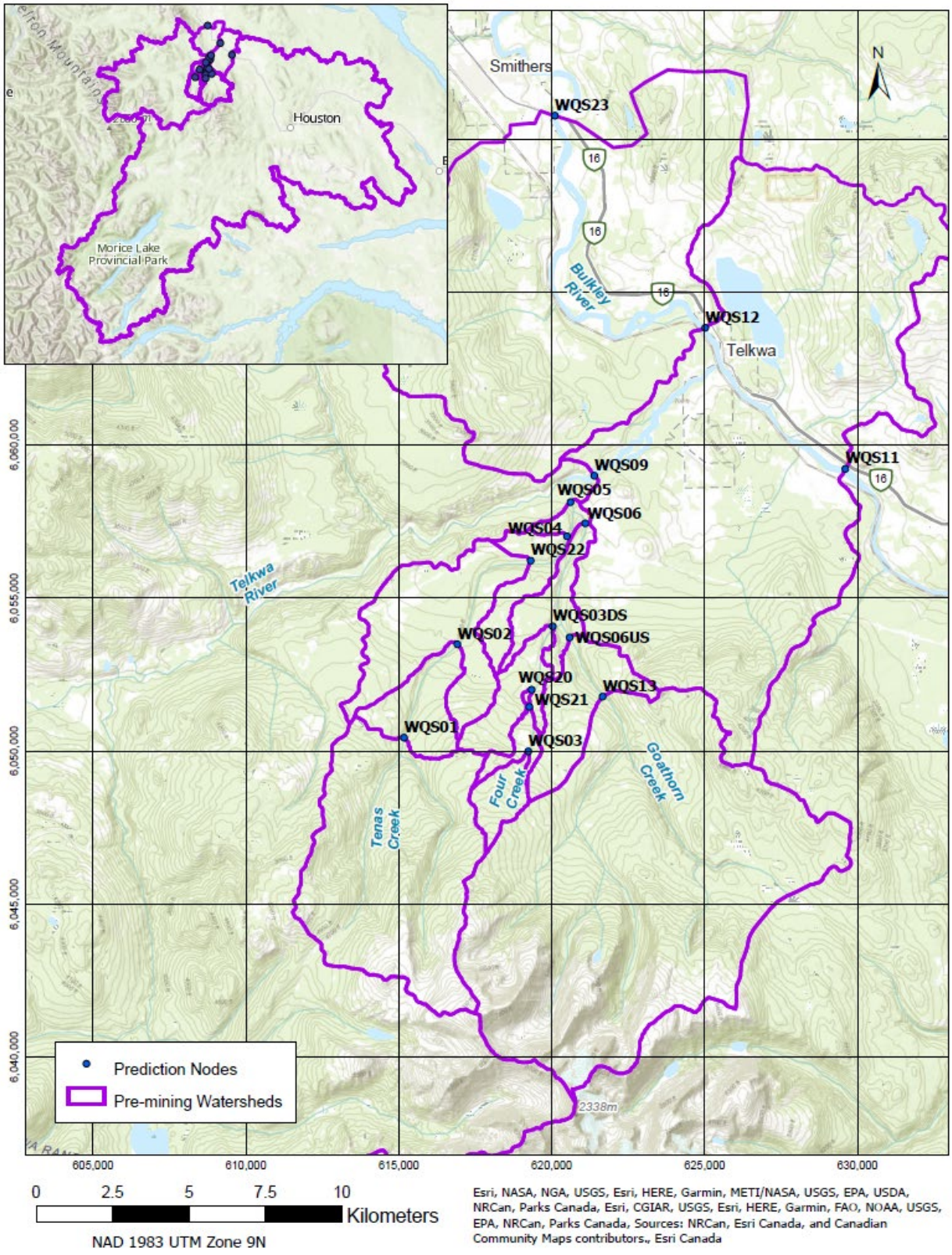
Prediction Node	Stream and Description	Coordinates NAD 1983 UTM Zone 9N (m)		Total Catchment Area (km^2)	
		Easting	Northing	Pre-mining	Post-mining
WQS01	Tenas Creek, upstream of Project	615,171	6,050,438	40.7	40.7
WQS02	Tenas Creek, adjacent to Project	616,914	6,053,490	47.6	47.0
WQS22	Tenas Creek, upstream of Project discharge (Unnamed Stream below Tenas Pond)	619313	6056222	65.7	61.9
WQS04	Tenas Creek, downstream of Project discharge (Unnamed Stream below Tenas Pond)	620,499	6,057,020	70.8	65.9
WQS03	Four Creek, upstream of Project	619,235	6,049,989	3.3	3.9
WQS21	Four Creek, upstream of East Management Pond	619269	6051446	5.2	4.9
WQS20	Four Creek, downstream of East Manageemnt Pond	619344	6052005	5.3	5.0
WQS03DS	Four Creek, downstream of Project, upstream of confluence with Goathorn Creek	620,034	6,054,076	10.9	6.9
WQS13	Goathorn Creek, upstream of Project	620,867	6,049,161	97.9	97.9
WQS06US	Goathorn Creek, upstream of Tenas Creek and Four Creek	620,587	6,053,711	107.1	107.1
WQS06	Goathorn Creek, upstream of Tenas Creek, downstream of Four Creek	621,100	6,057,441	123.5	119.1
WQS05	Goathorn Creek, downstream of Tenas Creek	620,615	6,058,133	195.5	186.2
WQS09	Telkwa River, downstream of Goathorn Creek	621,394	6,058,998	1198.9	1189.6
WQS11	Bulkley River, upstream of Telkwa River, downstream of Rail Load Out Pad	629,601	6,059,221	7175.0	7175.0
WQS12	Bulkley River, downstream of Telkwa River	625,021	6,063,831	8505.8	8496.5
WQS23	Bulkley River, at Smithers	620,102	6,070,765	8609.8	8600.5

Source: Generated in report.



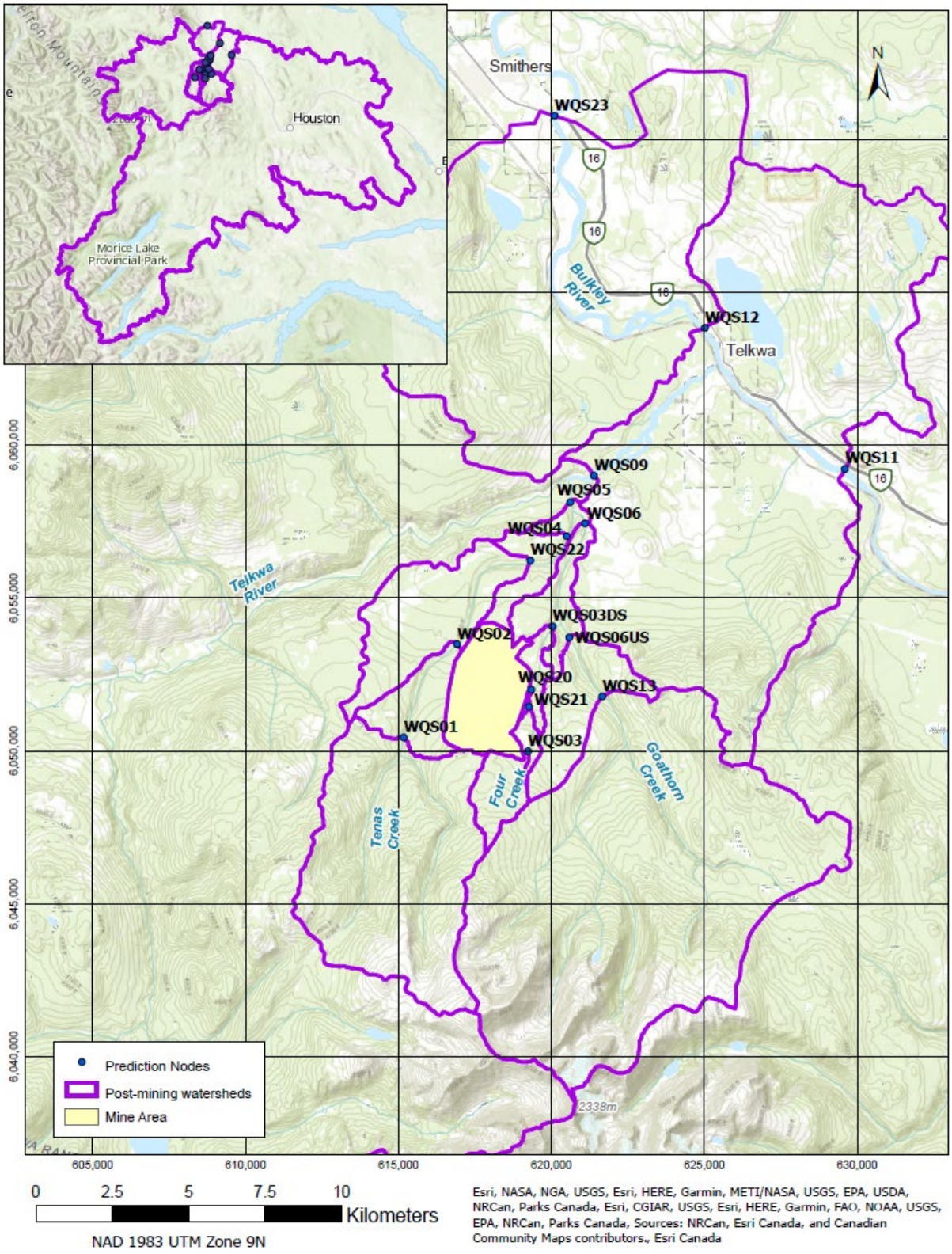
Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\!040_AutoCAD\1.GIS\Telkwa_reviewed_catchments032020.aprx

Figure 2-1: Prediction Nodes Location



Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\!040_AutoCAD\1.GIS\Telkwa_reviewed_catchments032020.aprx

Figure 2-2: Prediction Nodes Catchment Areas Pre-Mining



Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\l040_AutoCAD\1.GIS\Telkwa_reviewed_catchments032020.aprx

Figure 2-3: Prediction Nodes Catchment Areas Post-Mining

3 Streamflow Methodology

Correction factors were developed to apply the Project climate timeseries (SRK 2021b) for the catchments of Four Creek, Tenas Creek, Goathorn Creek, Telkwa River, and Bulkley River. These corrected climatic datasets, along with extended streamflow time series (SRK 2021b) were used to calibrate monthly runoff coefficients for each stream. Streamflow at each prediction node was then derived from the corresponding watershed climate timeseries and runoff calibration.

3.1 Climate Analysis

3.1.1 Methodology

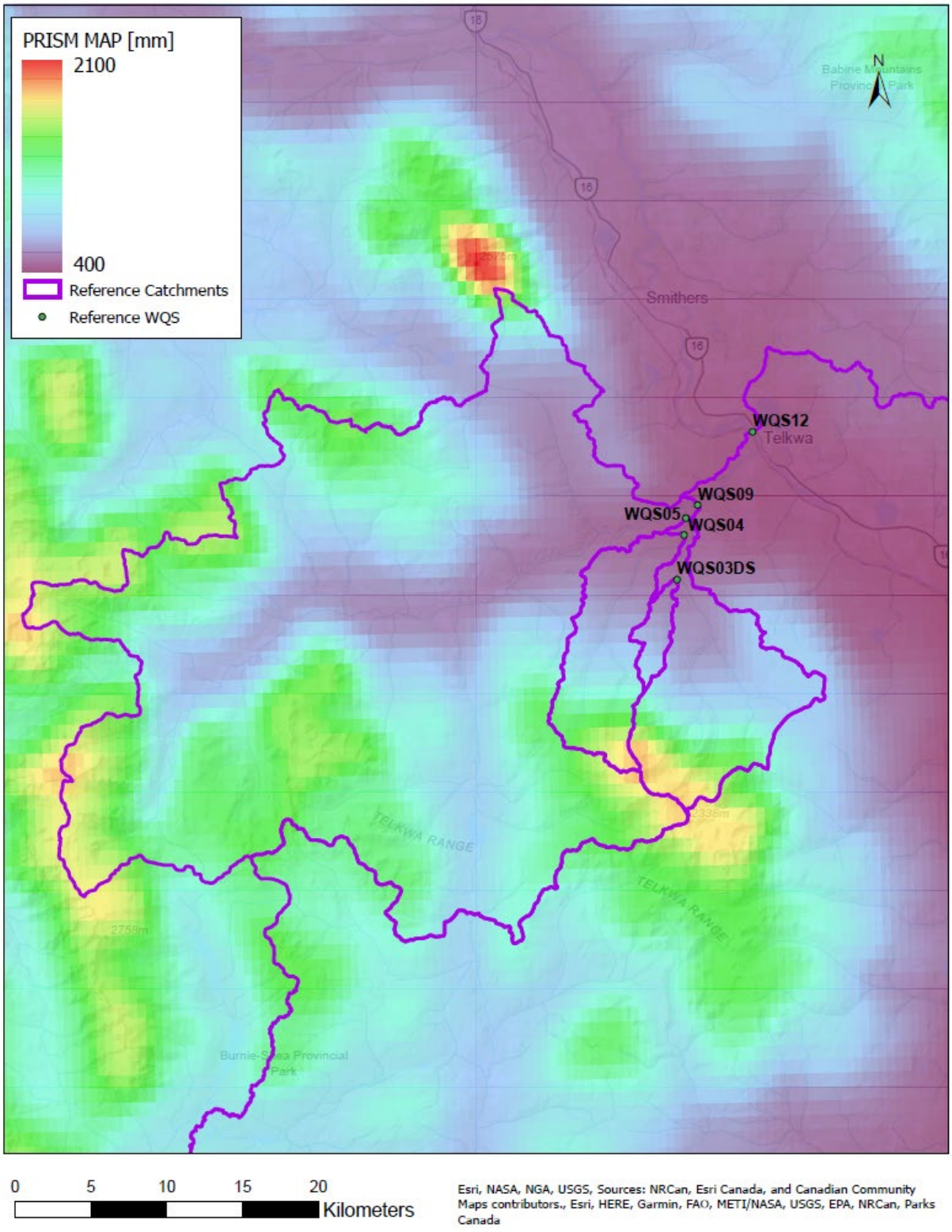
To estimate the average climate conditions for the main Project watersheds accounting for orographic trends, climate correction factors were developed based on the PRISM reanalysis dataset, consistently with SRK 2021b.

PRISM is a climate-elevation regression model, used to generate a reanalysis dataset that provides precipitation and maximum and minimum temperature averages on a monthly timestep for the Pacific Region of Canada and the northwestern USA.

For each stream, a prediction node was selected to define a reference catchment area. PRISM datasets were then averaged over each of these catchments with an iterative raster calculation tool built in ArcGIS Pro (ESRI 2020) to obtain monthly averages for precipitation and temperature parameters for each area. For this analysis:

- Four Creek was represented by WQS03DS catchment area
- Tenas Creek was represented by WQS04 catchment area
- Goathorn Creek was represented by WQS05 catchment area
- Telkwa River was represented by WQS09 catchment area
- Bulkley River was represented by WQS12 catchment area

An illustration of a PRISM dataset and the reference catchments is presented in Figure 3-1.



Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\l040_AutoCAD\1.GIS\Telkwa_PRISMMAP.aprx

Figure 3-1: PRISM Mean Annual Precipitation (MAP) Dataset and Reference WQS and Catchments

The obtained monthly averages were then compared to the reference Project location PRISM results to obtain monthly correction coefficients for each climate parameter.

3.1.2 Climate correction coefficients

Monthly correction coefficients were calculated for the monthly maximum, average and minimum temperatures, as well as precipitation based on the ratio of Project records (SRK 2021b) and the PRISM datasets for each stream. These are presented for each watershed in Table 3-1, Table 3-2, Table 3-3 and Table 3-4 respectively.

Table 3-1: Monthly Precipitation Correction Factors

Month	Four Creek	Tenas Creek	Goathorn Creek	Telkwa River	Bulkley River
Jan	1.30	1.84	1.88	2.06	1.74
Feb	1.19	1.68	1.71	1.89	1.81
Mar	1.42	2.00	2.03	2.29	2.07
Apr	1.39	1.81	1.87	2.05	1.83
May	1.04	1.28	1.26	1.31	1.14
Jun	1.15	1.18	1.23	1.19	1.09
Jul	1.13	1.11	1.16	1.10	1.03
Aug	1.03	1.28	1.28	1.31	1.17
Sep	1.09	1.52	1.53	1.60	1.33
Oct	1.09	1.53	1.56	1.79	1.70
Nov	1.37	1.92	1.94	2.20	1.95
Dec	1.36	1.92	1.96	2.22	1.93

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\PredictionNodes\WQS_Climate_Correction_Coefs_20200420.xlsx

Table 3-2: Monthly Maximum Daily Temperature Correction Addends

Month	Four Creek	Tenas Creek	Goathorn Creek	Telkwa River	Bulkley River
Jan	-0.23	-0.59	-0.67	-0.68	-0.20
Feb	-0.53	-1.32	-1.50	-1.69	-0.81
Mar	-0.71	-1.83	-2.20	-2.37	-1.08
Apr	-1.00	-2.20	-2.67	-2.85	-1.49
May	-1.25	-2.52	-2.93	-3.38	-1.76
Jun	-1.00	-2.38	-2.73	-3.32	-1.64
Jul	-0.97	-2.31	-2.65	-3.18	-1.48
Aug	-0.87	-2.19	-2.53	-3.01	-1.30
Sep	-0.72	-1.89	-2.23	-2.58	-0.86
Oct	-0.82	-1.75	-2.10	-2.32	-0.95
Nov	-0.40	-1.23	-1.39	-1.54	-0.57
Dec	-0.23	-0.67	-0.73	-0.85	-0.35

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\PredictionNodes\WQS_Climate_Correction_Coefs_20200420.xlsx

Table 3-3: Monthly Average Daily Temperature Correction Addends

Month	Four Creek	Tenas Creek	Goathorn Creek	Telkwa River	Bulkley River
Jan	-0.24	-0.45	-0.52	-0.45	-0.27
Feb	-0.37	-0.88	-0.98	-1.03	-0.73
Mar	-0.43	-1.27	-1.54	-1.66	-0.93
Apr	-0.68	-1.64	-1.96	-2.13	-1.19
May	-0.78	-1.74	-2.03	-2.29	-1.26
Jun	-0.74	-1.81	-2.06	-2.46	-1.38
Jul	-0.80	-1.77	-2.00	-2.33	-1.24
Aug	-0.51	-1.48	-1.71	-2.00	-0.92
Sep	-0.43	-1.28	-1.51	-1.73	-0.70
Oct	-0.55	-1.17	-1.46	-1.50	-0.58
Nov	-0.30	-0.93	-1.08	-1.16	-0.43
Dec	-0.04	-0.32	-0.36	-0.37	-0.15

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\PredictionNodes\WQS_Climate_Correction_Coefs_20200420.xlsx

Table 3-4: Monthly Minimum Daily Temperature Correction Addends

Month	Four Creek	Tenas Creek	Goathorn Creek	Telkwa River	Bulkley River
Jan	-0.26	-0.32	-0.37	-0.22	-0.34
Feb	-0.20	-0.44	-0.47	-0.37	-0.65
Mar	-0.14	-0.70	-0.89	-0.94	-0.78
Apr	-0.37	-1.07	-1.25	-1.41	-0.88
May	-0.30	-0.96	-1.12	-1.20	-0.75
Jun	-0.47	-1.23	-1.38	-1.58	-1.12
Jul	-0.63	-1.23	-1.35	-1.48	-1.00
Aug	-0.14	-0.77	-0.88	-0.99	-0.55
Sep	-0.14	-0.67	-0.78	-0.87	-0.54
Oct	-0.27	-0.58	-0.82	-0.66	-0.21
Nov	-0.19	-0.63	-0.78	-0.77	-0.30
Dec	0.16	0.03	0.01	0.10	0.04

Source: Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\PredictionNodes\WQS_Climate_Correction_Coefs_20200420.xlsx

3.2 Runoff model

3.2.1 Methodology

Surface runoff is defined as the total amount of surface water discharged from a watershed and is frequently presented as the depth of water distributed evenly throughout the watershed area.

A daily rainfall-runoff model was generated to support streamflow estimations and to provide Project-specific runoff rates. The runoff model for the Project Area was developed using a

snowmelt model, a minimum baseflow function, a lag time, recession coefficient and monthly runoff coefficients for each of the main catchments. Monthly runoff coefficients were calibrated automatically within GoldSim by optimizing the Nash Sutcliffe Efficiency, based on the difference between observed and modelled daily flow. Observed flows, in this case, were the extended records for each of the local hydrometric stations, described in Section 1.1.3. The calibration is described in SRK 2021b.

Precipitation was converted to runoff using a two-step process. The first step converts precipitation to either rainfall or snowfall using the SNOW-17 snow accumulation and ablation model described in SRK 2021b. The output from the snowmelt model is a daily effective precipitation value, representing the sum of rainfall and snowmelt available for runoff.

The second step uses a function from the Snowmelt Runoff Model (SRM), a program and methodology designed to simulate and forecast daily streamflow in mountain basins (J. Martinec, 2008). Each day, water produced from snowmelt and rainfall is superimposed on the calculated recession flow and transformed into a daily discharge from the basin. The discharge is calculated as the minimum of baseflow or runoff from snowmelt and rainfall, according to Equation 1:

$$Q_{n+1} = minimum\ of \begin{cases} C \times P_{eff} \times \frac{A \times 10{,}000}{86{,}400} \times (1 - k_{n+1}) + Q_n \times k_{n+1} \\ B\,x\,A \end{cases} \quad \text{Eq [1]}$$

Where:

Q = average daily discharge [m^3/s]

C = monthly runoff coefficient expressing losses as a ratio (runoff/precipitation)

P_{eff} = Effective precipitation as the sum of snowmelt and rainfall

A = area of the basin [km^2]

k = recession coefficient indicating the decline of discharge in a period without snowmelt or rainfall, $k = \frac{Q_{m+1}}{Q_m}$ where m, m+1 are the sequence of days during a true recession flow period

n = sequence of days during the discharge computation period, also referred to as the lag time.

B = unit baseflow [m^3/s]

Calibration of recession coefficients, *k*, monthly runoff coefficients, *C*, and unit baseflow, *B*, were developed in GoldSim by optimizing the Nash Sutcliffe Efficiency based on the difference between observed and modelled daily discharge. A separate calibration model was prepared for Four Creek, Goathorn Creek, Telkwa River, Bulkley River, and Tenas Creek.

Long term daily flow records at each prediction node were calculated based on corresponding hydrometric station synthetic flow records, minimum unit baseflow values (SRK 2021b), n values and Equation (1).

3.2.2 Rainfall-Runoff Model Inputs

Table 3-3 presents the rainfall-runoff model parameters calibrated for each stream, also presented in SRK 2021b.

Table 3-5: Rainfall-Runoff Model Inputs

Location		Goathorn	Telkwa	Tenas	Bulkley	Four	Project
Minimum Unit Baseflow [L/s/km^2]		1.8	4.1	0.43	3.0	0.3	1.1
Lag Time [days]		1	1	1	1	1	1
Recession		0.9	0.92	0.91	0.96	0.90	0.905
Runoff Coefficient	January	1	1	1	1	1	1
	February	1	1	1	1	1	1
	March	1	1	1	1	1	1
	April	0.42	1	0.45	0.76	0.5	0.43
	May	0.27	0.83	0.32	0.50	0.01	0.30
	June	0.20	0.38	0.17	0.36	0.1	0.18
	July	0.46	0.59	0.09	0.88	0.05	0.28
	August	0.33	0.74	0.03	0.22	0.05	0.18
	September	0.29	0.54	0.19	0.48	0.08	0.24
	October	0.29	0.69	0.28	0.47	0.03	0.28
	November	0.56	0.5	0.88	0.81	0.9	0.72
	December	1	1	1	1	0.4	1

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Model\RunoffCalibration\Project_RunoffModel.gsm

Parameters were assigned to each node as follows:

- Tenas Creek runoff coefficients were applied to all Tenas Creek nodes including WQS01, WQS02, WS22, WQS04, as well as nodes on Four Creek, due to a lack of continuous Four Creek flow data at this time of the study, including WQS03, WQS21, WQS20, WQS03DS.
- Goathorn Creek runoff coefficients were applied to all Goathorn nodes including WQS13, WQS06US, WQS06, WQS05.
- Telkwa River runoff coefficients were applied to WQS09.
- Bulkley River runoff coefficients were applied to WQS11, WQS12 and WQS23.

4 Summary

The water and load balance model, developed in support of the Telkwa Project EA, uses a daily precipitation and temperature record generated for the Project (SRK 2021b) to simulate water volumes within the Project facilities and in the receiving environment. In order to account for the range in topography, from the Telkwa River valley to the upper reaches of the Goathorn and Tenas Creek watersheds, correction factors are required to account for orographic gradients of temperature and precipitation. These correction factors were established based on a published climate-elevation regression model (PRISM), that provides precipitation and maximum and minimum temperature averages on a monthly timestep for the Pacific Region of Canada and the northwestern USA.

Monthly climate correction factors were developed for each of the five watercourses surrounding the Telkwa Project, including Four Creek, Tenas Creek, Goathorn Creek, Telkwa River and Bulkley River, based on the Project-specific records for daily maximum and minimum temperature, and daily precipitation. A calibrated rainfall-runoff model was developed for each stream using the adjusted climate parameters and a series of other runoff-related constants, as described in SRK 2021b. The model allows for estimation of streamflow based on precipitation and temperature inputs for the Project.

Note that based on the methodology applied, the low flow conditions are governed by a constant baseflow value which was selected to match the average low flow in summer and winter months. Extreme low flow conditions, such as the 7-day low flow event for a range of return periods, cannot be directly estimated from this method. Extreme low flows are calculated externally from this modeling approach and are presented in SRK 2021b and utilized in water balance modeling.

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

5 References

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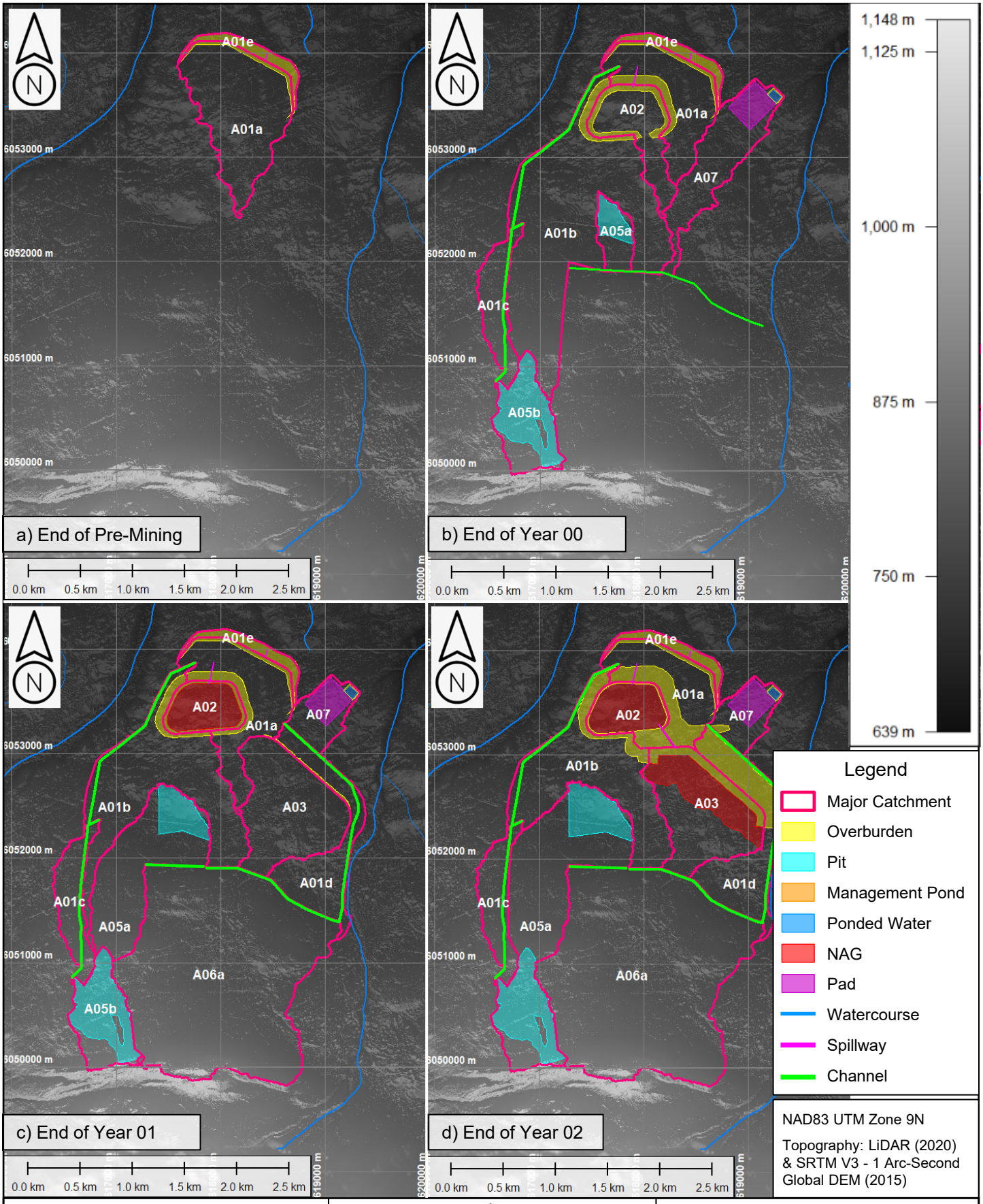
[Obedkoff *et al*] C. H. Coulson & W. Obedkoff, 1998. British Columbia Streamflow Inventory. Province of British Columbia, Ministry of Environment Lands and Parks.

[PCIC 2020] Pacific Climate Impacts Consortium. “Data Portal.” Accessed: 20 March 2020. URL: www.pacificclimate.org/data

[SRK 2021a] Tenas Project Water and Load Balance Report. SRK, 2021. Prepared for Telkwa Coal Limited. Vancouver BC

[SRK 2021b] Tenas Project Hydrometeorological Baseline and Model Development Report. SRK, 2021. Prepared for Telkwa Coal Limited. Vancouver BC

Appendix B Catchment Area Summaries



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Water Management Design

Major Catchments

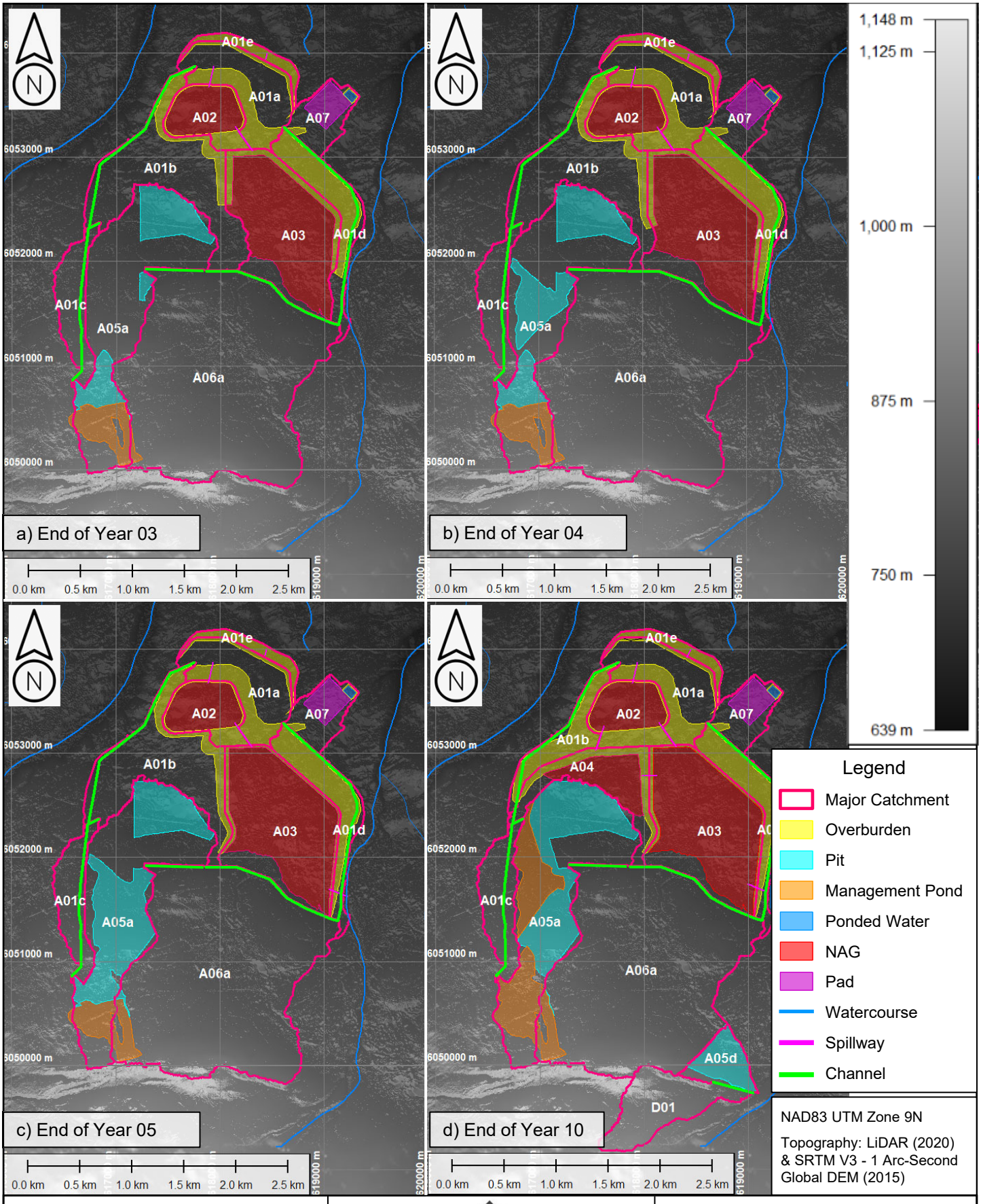
End of Pre-Mining to End of Year 02

Job No: 1CT027.003

Filename: Telkwa_WMCatchments_1CT027-003_rev00_nf.pptx

Tenas Project – EA Water Management

Date:	Approved:	Figure:
July 2021	SAB	B-1



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TELKWA COAL LIMITED

Water Management Design

Major Catchments

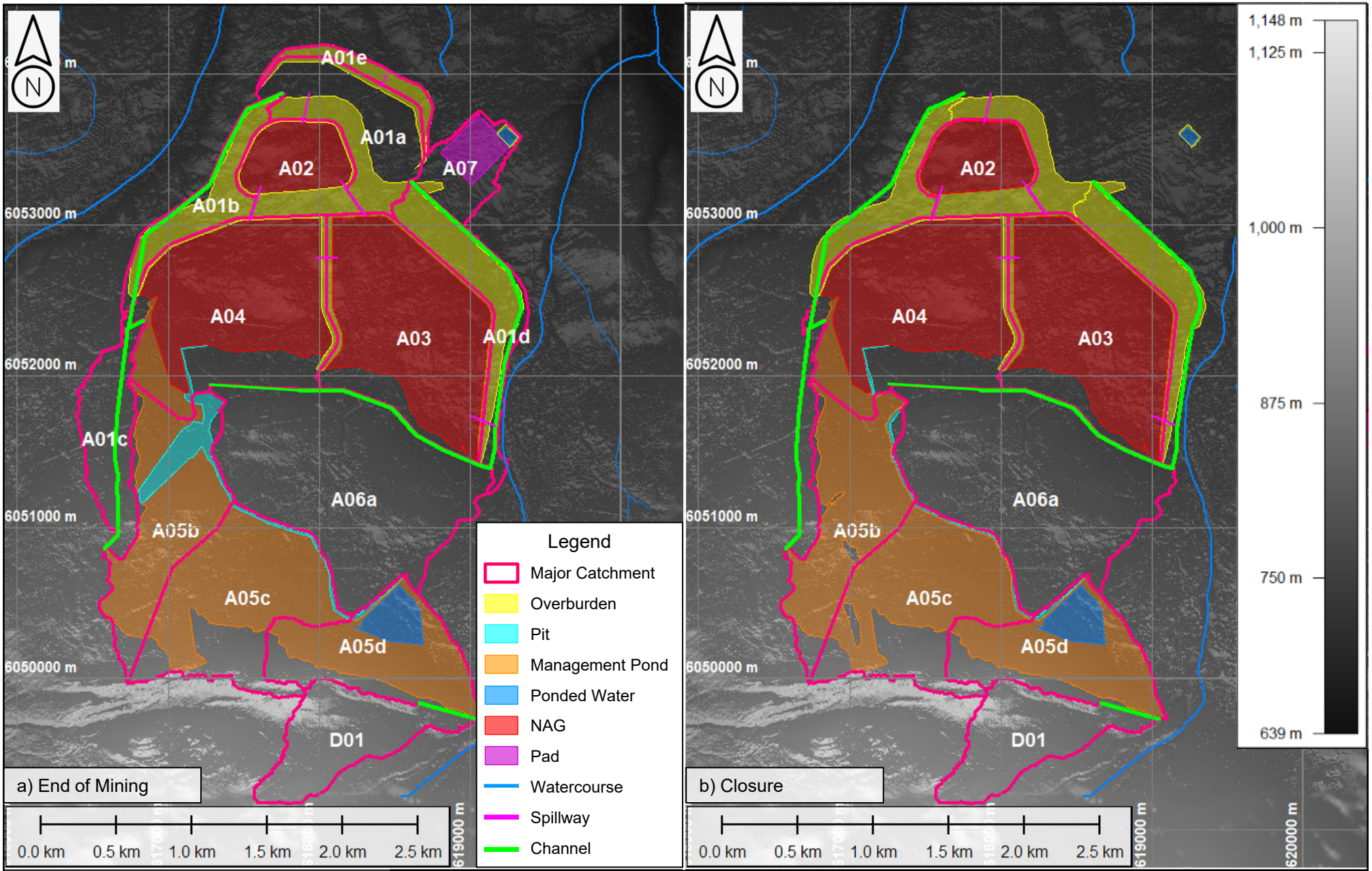
End of Year 03 to End of Year 10

Job No: 1CT027.003

Filename: Telkwa_WMCatchments_1CT027-003_rev00_nf.pptx

Tenas Project – EA Water Management

Date:	Approved:	Figure:
July 2021	SAB	B-2



Datum: NAD83 UTM Zone 9N

Topography: LiDAR (2020) & SRTM V3 - 1 Arc-Second Global DEM (2015)

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Job No: 1CT027.003

Filename: Telkwa_WMCatchments_1CT027-003_rev00_nf.pptx

TELKWA COAL LIMITED

Tenas Project – EA Water Management

Water Management Design

Major Catchments

End of Mining and Closure

Date:	Approved:	Figure:
July 2021	SAB	B-3

Table B 1: A01a (Tenas Control Pond) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A01a	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	1	0.99	0.049	0	0	0	0	0
	EOY0	2022-12-31	0.67	0.54	0.13	0	0	0	0	0
	Y1	2023-03-01	0.74	0.59	0.14	0	0	0	0	0
	EOY1	2023-12-31	0.74	0.59	0.14	0	0	0	0	0
	EOY2	2024-12-31	0.59	0.33	0.25	0	0	0	0	0
	EOY3	2025-12-31	0.59	0.33	0.25	0	0	0	0	0
	EOY4	2026-12-31	0.59	0.33	0.25	0	0	0	0	0
	EOY5	2027-12-31	0.59	0.33	0.25	0	0	0	0	0
	EOY10	2032-12-31	0.59	0.33	0.25	0	0	0	0	0
	EOM	2043-12-31	0.59	0.33	0.25	0	0	0	0	0
	SOC	2044-01-01	0	0	0	0	0	0	0	0
	Closure	2100-01-01	0	0	0	0	0	0	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 2: A01b (Channel C03 South to Tenas Control Pond) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A01b	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	2.7	2.7	0.065	0	0	0	0	0
	EOY1	2023-12-31	1.3	1.2	0.065	0	0	0	0	0
	EOY2	2024-12-31	1.1	1	0.12	0	0	0	0	0
	EOY3	2025-12-31	1.1	0.92	0.15	0	0	0	0	0
	EOY4	2026-12-31	0.98	0.81	0.17	0	0	0	0	0
	EOY5	2027-12-31	0.97	0.8	0.18	0	0	0	0	0
	EOY7	2029-12-31	0.3	0.051	0.25	0	0	0	0	0
	EOY10	2032-12-31	0.3	0.051	0.25	0	0	0	0	0
	EOM	2043-12-31	0.3	0.051	0.25	0	0	0	0	0
	SOC	2044-01-01	0	0	0	0	0	0	0	0
	Closure	2100-01-01	0	0	0	0	0	0	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 3: A01c (Channel C03 North to Tenas Control Pond) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A01c	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	0.33	0.33	0	0	0	0	0	0
	EOY1	2023-12-31	0.33	0.33	0	0	0	0	0	0
	EOY2	2024-12-31	0.34	0.34	0	0	0	0	0	0
	EOY3	2025-12-31	0.34	0.34	0	0	0	0	0	0
	EOY4	2026-12-31	0.34	0.34	0	0	0	0	0	0
	EOY5	2027-12-31	0.34	0.34	0	0	0	0	0	0
	EOY10	2032-12-31	0.4	0.4	0	0	0	0	0	0
	EOM	2043-12-31	0.4	0.4	0	0	0	0	0	0
	SOC	2044-01-01	0	0	0	0	0	0	0	0
	Closure	2100-01-01	0	0	0	0	0	0	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 4: A01d (Channel C01 to Tenas Control Pond) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A01d	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	0	0	0	0	0	0	0	0
	Y1	2023-03-01	0.6	0.58	0.018	0	0	0	0	0
	EOY1	2023-12-31	0.6	0.58	0.018	0	0	0	0	0
	EOY2	2024-12-31	0.7	0.43	0.27	0	0	0	0	0
	EOY3	2025-12-31	0.44	0.14	0.3	0	0	0	0	0
	EOY4	2026-12-31	0.43	0.12	0.31	0	0	0	0	0
	EOY5	2027-12-31	0.43	0.11	0.32	0	0	0	0	0
	EOY10	2032-12-31	0.43	0.11	0.32	0	0	0	0	0
	EOM	2043-12-31	0.43	0.11	0.32	0	0	0	0	0
	SOC	2044-01-01	0	0	0	0	0	0	0	0
	Closure	2100-01-01	0	0	0	0	0	0	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 5: A02 (North Management Pond) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A02	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	0.48	0.38	0.1	0	0	0	0	0
	EOY1	2023-12-31	0.32	0	0.06	0	0	0.26	0	0
	EOY2	2024-12-31	0.38	0	0.086	0	0	0.29	0	0
	EOY3	2025-12-31	0.38	0	0.086	0	0	0.29	0	0
	EOY4	2026-12-31	0.38	0	0.086	0	0	0.29	0	0
	EOY5	2027-12-31	0.38	0	0.086	0	0	0.29	0	0
	EOY10	2032-12-31	0.43	0	0.14	0	0	0.29	0	0
	EOM	2043-12-31	0.43	0	0.14	0	0	0.29	0	0
	SOC	2044-01-01	0.43	0	0.14	0	0	0.29	0	0
	Closure	2100-01-01	0.43	0	0.14	0	0	0.29	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 6: A03 (East Management Pond) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A03	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	0	0	0	0	0	0	0	0
	Y1	2023-03-01	0.92	0.92	0	0	0	0	0	0
	EOY1	2023-12-31	0.92	0.92	0	0	0	0	0	0
	EOY2	2024-12-31	0.91	0.43	0.12	0	0	0.35	0	0
	EOY3	2025-12-31	1.2	0.099	0.14	0	0	0.94	0	0
	EOY4	2026-12-31	1.3	0.14	0.14	0	0	1	0	0
	EOY5	2027-12-31	1.3	0.13	0.096	0	0	1.1	0	0
	EOY10	2032-12-31	1.3	0.13	0.096	0	0	1.1	0	0
	EOM	2043-12-31	1.3	0.13	0.096	0	0	1.1	0	0
	SOC	2044-01-01	1.3	0.13	0.096	0	0	1.1	0	0
	Closure	2100-01-01	1.3	0.13	0.096	0	0	1.1	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 7: A04 (West Management Pond) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A04	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	0	0	0	0	0	0	0	0
	EOY1	2023-12-31	0	0	0	0	0	0	0	0
	EOY2	2024-12-31	0	0	0	0	0	0	0	0
	EOY3	2025-12-31	0	0	0	0	0	0	0	0
	EOY4	2026-12-31	0	0	0	0	0	0	0	0
	EOY5	2027-12-31	0	0	0	0	0	0	0	0
	EOY7	2029-12-31	0.56	0.12	0.17	0	0	0.27	0	0
	EOY10	2032-12-31	0.56	0.12	0.17	0	0	0.27	0	0
	EOM	2043-12-31	1.4	0.25	0.058	0.0099	0.12	0.95	0	0
	SOC	2044-01-01	1.4	0.25	0.058	0.0067	0.12	0.95	0	0
	Closure	2100-01-01	1.4	0.25	0.058	0.0067	0.12	0.95	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 8: A05a (Pit Backfill Area North) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A05a	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	0.27	0.18	0	0.092	0	0	0	0
	EOY1	2023-12-31	1.4	0.92	0	0.51	0	0	0	0
	EOY2	2024-12-31	1.6	1	0	0.57	0	0	0	0
	EOY3	2025-12-31	1.6	1.2	0	0.42	0	0	0	0
	EOY4	2026-12-31	1.7	0.98	0	0.67	0	0	0	0
	EOY5	2027-12-31	1.6	0.78	0	0.87	0	0	0	0
	EOY10	2032-12-31	1.7	0.41	0	0.75	0.5	0	0	0
	EOM	2043-12-31	0	0	0	0	0	0	0	0
	SOC	2044-01-01	0	0	0	0	0	0	0	0
	Closure	2100-01-01	0	0	0	0	0	0	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 9: A05b (Pit Backfill Area West) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A05b	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	0.48	0.13	0	0.35	0	0	0	0
	EOY1	2023-12-31	0	0	0	0	0	0	0	0
	EOY2	2024-12-31	0	0	0	0	0	0	0	0
	EOY3	2025-12-31	0	0	0	0	0	0	0	0
	EOY4	2026-12-31	0	0	0	0	0	0	0	0
	EOY5	2027-12-31	0	0	0	0	0	0	0	0
	EOY10	2032-12-31	0	0	0	0	0	0	0	0
	EOM	2043-12-31	0.81	0.21	0	0.12	0.47	0	0	0
	SOC	2044-01-01	0.81	0.098	0	0.015	0.69	0	0	0
	Closure	2100-01-01	0.81	0.098	0	0.015	0.69	0	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 10: A05c (Pit Backfill Area South) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A05c	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	0	0	0	0	0	0	0	0
	EOY1	2023-12-31	0	0	0	0	0	0	0	0
	EOY2	2024-12-31	0	0	0	0	0	0	0	0
	EOY3	2025-12-31	0	0	0	0	0	0	0	0
	EOY4	2026-12-31	0	0	0	0	0	0	0	0
	EOY5	2027-12-31	0	0	0	0	0	0	0	0
	EOY10	2032-12-31	0	0	0	0	0	0	0	0
	EOM	2043-12-31	1	0.27	0	0.023	0.73	0	0	0
	SOC	2044-01-01	1	0.29	0	0.021	0.71	0	0	0
	Closure	2100-01-01	1	0.29	0	0.021	0.71	0	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 11: A05d (Pit Backfill Area East and Pit Lake) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A05d	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	0	0	0	0	0	0	0	0
	EOY1	2023-12-31	0	0	0	0	0	0	0	0
	EOY2	2024-12-31	0	0	0	0	0	0	0	0
	EOY3	2025-12-31	0	0	0	0	0	0	0	0
	EOY4	2026-12-31	0	0	0	0	0	0	0	0
	EOY5	2027-12-31	0	0	0	0	0	0	0	0
	EOY10	2032-12-31	0.24	0.035	0	0.21	0	0	0	0
	EOM	2043-12-31	0.73	0.15	0	0.0073	0.47	0	0.1	0
	SOC	2044-01-01	0.73	0.15	0	0.0064	0.47	0	0.1	0
	Closure	2100-01-01	0.73	0.15	0	0.0064	0.47	0	0.1	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 12: A06a (Channel C02 to Four Creek) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A06a	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	0	0	0	0	0	0	0	0
	Y1	2023-03-01	3.2	3.2	0	0	0	0	0	0
	EOY1	2023-12-31	3.2	3.2	0	0	0	0	0	0
	EOY2	2024-12-31	3.2	3.2	0	0	0	0	0	0
	EOY3	2025-12-31	3.2	3.2	0	0	0.015	0	0	0
	EOY4	2026-12-31	3.2	3.2	0	0	0.015	0	0	0
	EOY5	2027-12-31	3.2	3.1	0	0.0069	0.082	0	0	0
	EOY10	2032-12-31	3.1	3	0	0.0026	0.087	0	0	0
	EOM	2043-12-31	1.6	1.6	0	0	0	0	0	0
	SOC	2044-01-01	1.6	1.6	0	0	0	0	0	0
	Closure	2100-01-01	1.6	1.6	0	0	0	0	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Table B 13: A07 (Coal Processing Plant) Sub-Catchment Summary through the LOM

Area	Phase	Start Date	Major Catchment Area (km^2)	Sub-Catchment Area (km^2)						
				Natural	Overburden	Pit	Non-Acid Generating Rock	Management Pond	Ponded Water	Pad
A07	Start	2021-01-01	0	0	0	0	0	0	0	0
	EOPM	2021-12-31	0	0	0	0	0	0	0	0
	EOY0	2022-12-31	1.5	1.4	0.0047	0	0	0	0.007	0.11
	Y1	2023-03-01	0.28	0.17	0.0047	0	0	0	0.007	0.11
	EOY1	2023-12-31	0.28	0.17	0.0047	0	0	0	0.007	0.11
	EOY2	2024-12-31	0.28	0.16	0.014	0	0	0	0.007	0.11
	EOY3	2025-12-31	0.28	0.16	0.014	0	0	0	0.007	0.11
	EOY4	2026-12-31	0.28	0.16	0.014	0	0	0	0.007	0.11
	EOY5	2027-12-31	0.28	0.16	0.014	0	0	0	0.007	0.11
	EOY10	2032-12-31	0.28	0.16	0.014	0	0	0	0.007	0.11
	EOM	2043-12-31	0.28	0.16	0.014	0	0	0	0.007	0.11
	SOC	2044-01-01	0	0	0	0	0	0	0	0
	Closure	2100-01-01	0	0	0	0	0	0	0	0

Sources: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Inputs\Catchments\Telkwa_WMCatchments_1CT027-003_rev10_sab_nf.xlsx

Appendix C Stage-Storage Relationships

Table C- 1: Management Pond Stage-Storage-Elevation Relationships

Elevation [masl]	Cumulative volumes [m3]			Surface Area [m2]		
	North MP	East MP	West MP	North MP	East MP	West MP
753.0	-	-	1	-	-	-
753.5	-	-	158	-	-	-
754.0	-	-	906	-	-	-
754.5	-	-	2,332	-	-	3,085
755.0	-	-	4,404	-	-	4,363
755.5	-	-	7,105	-	-	5,670
756.0	-	-	10,512	-	-	7,150
756.5	-	-	14,868	-	-	9,240
757.0	-	-	20,458	-	-	11,650
757.5	-	-	27,329	-	-	14,210
758.0	-	-	36,011	-	-	16,740
758.5	-	-	46,879	-	-	22,650
759.0	-	-	59,579	-	-	26,000
759.5	-	-	73,865	-	-	29,350
760.0	-	-	89,696	-	-	32,330
760.5	-	-	106,984	-	-	35,040
761.0	-	-	125,555	-	-	37,650
761.5	-	-	145,444	-	-	40,240
762.0	-	-	166,661	-	-	42,880
762.5	-	-	189,282	-	-	45,680
763.0	-	-	213,354	-	-	48,560
763.5	-	-	238,832	-	-	51,300
764.0	-	-	265,706	-	-	54,100
764.5	-	-	293,983	-	-	56,800
765.0	-	-	323,643	-	-	59,500
765.5	-	-	354,661	-	-	62,100
766.0	-	-	387,023	-	-	64,800
766.5	-	-	420,676	-	-	67,200
767.0	-	-	455,502	-	-	69,500
767.5	-	-	491,462	-	-	71,700
768.0	-	-	528,531	-	-	74,000
768.5	-	-	566,688	-	-	76,100
769.0	-	-	605,936	-	-	78,300
769.5	-	-	646,276	-	-	81,900
770.0	-	-	687,695	-	-	85,500
770.5	-	-	730,173	-	-	87,900
771.0	-	-	773,697	-	-	90,100
771.5	-	-	818,248	-	-	92,100
772.0	-	-	863,781	-	-	94,100

Elevation [masl]	Cumulative volumes [m3]			Surface Area [m2]		
	North MP	East MP	West MP	North MP	East MP	West MP
772.5	-	-	910,295	-	-	96,100
773.0	-	-	957,801	-	-	98,200
773.5	-	-	1,006,315	-	-	100,200
774.0	-	-	1,055,844	-	-	102,300
774.5	-	-	1,106,399	-	-	104,400
775.0	-	-	1,157,984	-	-	106,500
775.5	-	-	1,210,602	-	-	108,700
776.0	-	-	1,264,266	-	-	110,800
776.5	-	-	1,322,177	-	-	113,000
777.0	-	-	1,381,203	-	-	115,100
777.5	-	-	1,441,272	-	-	117,100
778.0	-	-	1,502,357	-	-	119,100
778.5	-	-	1,564,448	-	-	121,100
779.0	-	-	1,627,554	-	-	123,100
779.5	-	-	1,691,688	-	-	125,100
780.0	-	-	1,756,845	-	-	127,100
780.5	-	-	1,823,031	-	-	129,100
781.0	-	-	1,890,246	-	-	131,100
781.5	-	-	1,958,490	-	-	133,200
782.0	-	-	2,027,767	-	-	135,200
782.5	-	-	2,098,078	-	-	137,200
783.0	-	-	2,169,433	-	-	139,200
783.5	-	-	2,241,912	-	-	141,500
784.0	-	-	2,315,618	-	-	143,900
784.5	-	-	2,390,689	-	-	146,900
785.0	-	-	2,467,148	-	-	149,600
785.5	-	-	2,545,068	-	-	152,600
786.0	-	-	2,624,532	-	-	155,600
786.5	-	-	2,705,621	-	-	158,900
787.0	-	-	2,788,365	-	-	162,200
787.5	-	-	2,872,732	-	-	165,300
788.0	-	-	2,958,701	-	-	168,500
788.5	-	-	3,046,286	-	-	171,800
789.0	-	-	3,135,510	-	-	175,100
789.5	-	-	3,226,391	-	-	181,100
790.0	-	-	3,319,017	-	-	186,900
790.5	-	-	3,413,568	-	-	191,000
791.0	-	-	3,510,406	-	-	194,800
791.5	-	-	3,609,548	-	-	201,700
792.0	-	-	3,711,020	-	-	206,800
792.5	-	-	3,815,026	-	-	212,700

Elevation [masl]	Cumulative volumes [m3]			Surface Area [m2]		
	North MP	East MP	West MP	North MP	East MP	West MP
793.0	-	-	3,921,701	-	-	218,000
793.5	-	-	4,030,771	-	-	222,300
794.0	-	-	4,141,625	-	-	225,700
794.5	-	-	4,254,107	-	-	229,000
795.0	-	-	4,368,103	-	-	232,000
795.5	-	-	4,483,523	-	-	234,800
796.0	-	-	4,599,998	-	-	236,900
796.5	-	-	4,717,374	-	-	238,800
797.0	-	-	4,835,632	-	-	240,600
797.5	-	-	4,954,783	-	-	242,300
798.0	-	-	5,075,065	-	-	244,000
798.5	-	-	5,196,508	-	-	246,700
799.0	-	-	5,319,055	-	-	248,700
799.5	-	-	5,442,668	-	-	250,600
800.0	-	-	5,567,360	-	-	252,500
800.5	-	-	5,703,541	-	-	254,500
801.0	-	-	5,840,754	-	-	256,400
801.5	-	-	5,978,984	-	-	258,400
802.0	-	-	6,118,222	-	-	260,300
802.5	-	-	6,258,458	-	-	262,200
803.0	-	-	6,399,688	-	-	264,200
803.5	-	-	6,541,941	-	-	266,300
804.0	-	-	6,685,320	-	-	268,400
804.5	-	-	6,829,891	-	-	271,000
805.0	-	-	6,975,848	-	-	273,400
805.5	-	-	7,123,275	-	-	276,200
806.0	-	-	7,272,139	-	-	278,700
806.5	-	-	7,422,418	-	-	281,400
807.0	-	-	7,574,057	-	-	283,900
807.5	-	-	7,727,015	-	-	286,500
808.0	-	-	7,881,221	-	-	288,900
808.5	-	-	8,036,607	-	-	291,100
809.0	-	-	8,193,067	1,623	-	293,400
809.5	466	-	8,350,557	3,093	-	301,900
810.0	1,123	-	8,509,021	5,470	-	310,200
810.5	6,738	-	8,668,394	12,480	-	313,600
811.0	14,942	-	8,828,629	20,760	-	315,500
811.5	25,958	-	8,989,676	37,090	-	317,100
812.0	40,193	-	9,151,508	59,600	-	318,500
812.5	76,609	-	9,322,278	72,200	-	319,900
813.0	118,602	-	9,493,790	85,900	-	321,300

Elevation [masl]	Cumulative volumes [m3]			Surface Area [m2]		
	North MP	East MP	West MP	North MP	East MP	West MP
813.5	166,062	-	9,666,027	97,600	-	322,700
814.0	218,864	-	9,838,972	112,400	-	323,900
814.5	282,474	-	10,012,613	127,800	-	325,200
815.0	350,375	-	10,186,927	140,500	-	326,500
815.5	422,631	-	10,361,900	152,100	-	327,800
816.0	499,164	-	10,537,565	160,600	-	329,100
816.5	583,548	-	10,713,986	169,400	-	330,700
817.0	671,440	-	10,891,236	180,300	-	332,300
817.5	763,219	-	11,069,348	191,700	-	333,900
818.0	859,037	-	11,248,364	201,200	-	335,600
818.5	965,501	-	11,428,354	211,800	-	337,600
819.0	1,076,237	-	11,609,434	224,100	-	339,900
819.5	1,190,980	-	11,791,627	234,400	-	342,500
820.0	1,309,466	-	11,974,937	241,900	-	346,000
820.5	1,434,190	42	12,159,426	249,100	337	351,000
821.0	1,561,375	320	12,345,385	255,800	1,451	359,400
821.5	1,690,649	1,051	12,533,323	259,400	3,827	368,800
822.0	1,821,642	2,547	12,724,378	262,100	8,610	378,000
822.5	1,953,991	10,772	12,920,878	264,600	16,980	389,400
823.0	2,087,586	23,020	13,121,001	267,100	28,270	398,200
823.5	2,222,431	42,014	13,325,122	269,600	47,530	407,200
824.0	2,358,531	69,014	13,533,487	272,100	66,400	421,800
824.5	2,495,890	108,864	13,773,078	274,600	83,200	432,700
825.0	2,634,515	155,702	14,017,326	277,100	101,600	444,900
825.5	2,774,409	209,671	14,266,365	279,600	118,300	456,600
826.0	2,915,579	270,911	14,520,354	282,200	133,200	468,200
826.5	3,058,027	343,147	14,782,602	284,700	147,800	479,000
827.0	3,201,761	422,036	15,049,146	287,300	163,100	490,400
827.5	3,346,783	507,460	15,320,163	289,900	177,800	501,000
828.0	3,493,100	599,289	15,595,810	292,400	192,400	513,000
828.5	3,640,717	703,243	15,879,423	295,000	208,400	527,000
829.0	3,789,638	813,949	16,167,983	297,600	224,300	541,000
829.5	3,939,867	931,380	16,461,317	300,200	241,100	564,000
830.0	4,091,411	1,055,505	16,759,159	304,100	258,100	587,000
830.5	4,091,411	1,192,641	17,063,436	304,100	275,600	600,000
831.0	4,091,411	1,336,892	17,372,266	304,100	295,200	613,000
831.5	4,091,411	1,488,259	17,685,485	304,100	314,000	626,000
832.0	4,091,411	1,646,749	18,003,104	304,100	332,600	638,000
832.5	4,091,411	1,824,665	18,325,865	304,100	354,900	649,000
833.0	4,091,411	2,011,258	18,653,252	304,100	384,600	660,000
833.5	4,091,411	2,206,866	18,985,405	304,100	406,100	671,000

Elevation [masl]	Cumulative volumes [m3]			Surface Area [m2]		
	North MP	East MP	West MP	North MP	East MP	West MP
834.0	4,091,411	2,411,944	19,322,219	304,100	426,200	682,000
834.5	4,091,411	2,638,892	19,664,854	304,100	453,800	694,000
835.0	4,091,411	2,875,363	20,012,850	304,100	481,300	706,000
835.5	4,091,411	3,121,632	20,366,250	304,100	511,000	718,000
836.0	4,091,411	3,378,045	20,724,973	304,100	538,000	731,000
836.5	4,091,411	3,657,995	21,103,457	304,100	560,000	744,000
837.0	4,091,411	3,945,452	21,488,639	304,100	581,000	761,000
837.5	4,091,411	4,240,427	21,880,228	304,100	604,000	777,000
838.0	4,091,411	4,542,927	22,277,967	304,100	626,000	795,000
838.5	4,091,411	4,868,144	22,684,794	304,100	650,000	810,000
839.0	4,091,411	5,200,592	23,095,603	304,100	682,000	823,000
839.5	4,091,411	5,540,912	23,510,114	304,100	705,000	834,000
840.0	4,091,411	5,889,745	23,928,082	304,100	732,000	846,000
840.5	4,091,411	6,268,822	24,349,506	304,100	760,000	853,000
841.0	4,091,411	6,655,128	24,774,109	304,100	784,000	860,000
841.5	4,091,411	7,049,047	25,201,772	304,100	808,000	868,000
842.0	4,091,411	7,450,979	25,632,372	304,100	831,000	875,000
842.5	4,091,411	7,879,514	26,066,229	304,100	855,000	882,000
843.0	4,091,411	8,316,596	26,502,750	304,100	880,000	890,000
843.5	4,091,411	8,762,626	26,941,945	304,100	904,000	899,000
844.0	4,091,411	9,218,008	27,384,013	304,100	931,000	909,000
844.5	4,091,411	9,692,452	27,829,546	304,100	948,000	918,000
845.0	4,091,411	10,172,779	28,278,292	304,100	962,000	927,000
845.5	4,091,411	10,659,065	28,730,361	304,100	975,000	936,000
846.0	4,091,411	11,151,404	29,185,855	304,100	988,000	945,000
846.5	4,091,411	11,652,757	29,645,829	304,100	1,003,000	955,000
847.0	4,091,411	12,160,557	30,109,510	304,100	1,017,000	964,000
847.5	4,091,411	12,674,872	30,576,987	304,100	1,030,000	974,000
848.0	4,091,411	13,195,774	31,048,346	304,100	1,044,000	985,000
848.5	4,091,411	13,724,465	31,534,080	304,100	1,058,000	996,000
849.0	4,091,411	14,259,242	32,023,612	304,100	1,071,000	1,008,000
849.5	4,091,411	14,800,183	32,517,015	304,100	1,084,000	1,023,000
850.0	4,091,411	15,347,364	33,014,397	304,100	1,096,000	1,040,000
850.5	4,091,411	15,902,340	33,517,598	304,100	1,110,000	1,051,000
851.0	4,091,411	16,463,011	34,025,340	304,100	1,121,000	1,063,000
851.5	4,091,411	17,029,425	34,538,001	304,100	1,132,000	1,075,000
852.0	4,091,411	17,601,633	35,055,618	304,100	1,145,000	1,089,000

Table C- 2: Tenas Control Pond Stage-Storage-Elevation Relationship

Elevation [masl]	Cuml. Volume [m^3]	Surface Area [m^2]
785.5	-	-
786.0	87	202
786.5	534	837
787.0	1,321	1,751
787.5	2,541	3,043
788.0	4,450	5,052
788.5	8,418	9,207
789.0	14,799	15,886
789.5	24,228	21,913
790.0	36,986	29,776
790.5	55,181	38,774
791.0	77,681	49,509
791.5	105,167	59,643
792.0	137,796	71,412
792.5	178,238	83,315
793.0	224,187	96,529
793.5	275,891	108,818
794.0	333,501	122,351
794.5	399,936	135,701
795.0	472,619	150,138
795.5	551,708	164,821
796.0	637,362	180,687
796.5	733,838	195,054
797.0	836,404	210,125
797.5	945,189	224,448
798.0	1,060,335	239,564
798.5	1,187,144	256,691
799.0	1,321,141	274,806
799.5	1,462,424	290,253
800.0	1,611,092	306,428

Table C- 3: Pit Lake Stage-Volume Relationship

Elevation [masl]	Volume [m^3]	Elevation [masl]	Volume [m^3]	Elevation [masl]	Volume [m^3]
823	-	861	703,627	899	4,817,737
824	1,013	862	740,918	900	5,031,452
825	3,080	863	779,333	901	5,252,152
826	6,375	864	819,038	902	5,478,455
827	10,887	865	860,129	903	5,710,202
828	16,526	866	902,719	904	5,947,304
829	23,203	867	947,026	905	6,189,626
830	30,886	868	993,339	906	6,437,193
831	39,526	869	1,041,923	907	6,689,938
832	49,059	870	1,095,005	908	6,947,581
833	59,429	871	1,153,134	909	7,209,925
834	70,600	872	1,214,687		
835	82,554	873	1,279,964		
836	95,292	874	1,349,137		
837	108,821	875	1,422,472		
838	123,122	876	1,500,607		
839	138,177	877	1,583,875		
840	153,974	878	1,672,615		
841	170,595	879	1,766,753		
842	187,854	880	1,866,647		
843	205,785	881	1,972,436		
844	224,453	882	2,083,348		
845	243,890	883	2,199,315		
846	264,108	884	2,320,391		
847	285,126	885	2,446,467		
848	306,981	886	2,577,434		
849	329,726	887	2,713,361		
850	354,571	888	2,854,404		
851	381,678	889	3,000,718		
852	409,754	890	3,155,048		
853	438,772	891	3,317,654		
854	468,710	892	3,485,835		
855	499,551	893	3,659,558		
856	531,296	894	3,838,809		
857	563,937	895	4,023,575		
858	597,486	896	4,213,854		
859	631,936	897	4,409,654		
860	667,315	898	4,610,917		

Appendix D Background Water Quality

Parameter	Units	Receiving Water Quality																			
		Four Creek				Goathorn Creek				Tenas Creek				Telkwa River				Bulkley River			
		Average	P50	P95	Count	Average	P50	P95	Count	Average	P50	P95	Count	Average	P50	P95	Count	Average	P50	P95	Count
Temperature	degC	3	2	10	60	4	3	12	86	4	2	13	65	5	4	11	95	8	8	15	96
Conductivity	µS/cm	230	250	340	54	160	170	210	111	160	160	220	87	92	93	130	154	62	59	79	105
pH		8	8	9	54	8	8	8	111	8	8	8	87	8	8	8	152	8	8	8	132
Total Dissolved Solids	mg/L	150	150	220	54	110	110	140	88	100	100	140	64	66	68	90	87	49	49	67	70
Total Suspended Solids	mg/L	7	3	21	54	5	2	16	88	7	2	37	64	9	4	40	87	11	2	43	70
Hardness	mg-$CaCO_3$/L	110	130	170	56	74	75	100	117	75	77	110	93	43	40	65	123	29	28	37	90
Alkalinity, total	mg-$CaCO_3$/L	130	140	190	35	55	54	85	86	83	85	110	64	42	43	63	89	30	28	36	72
Chloride	mg/L	0.41	0.25	0.53	56	0.34	0.25	0.50	118	0.34	0.25	0.52	93	0.32	0.25	0.50	124	0.42	0.25	0.78	82
Fluoride	mg/L	0.05	0.05	0.07	48	0.03	0.03	0.04	85	0.03	0.03	0.05	71	0.03	0.03	0.04	96	0.02	0.02	0.04	62
Ammonia, total	mg-N/L	0.004	0.003	0.011	29	0.004	0.003	0.007	89	0.004	0.003	0.009	78	0.005	0.003	0.010	137	0.006	0.005	0.017	130
Nitrate	mg-N/L	0.041	0.016	0.170	48	0.047	0.043	0.084	87	0.019	0.005	0.060	73	0.024	0.012	0.076	101	0.018	0.013	0.041	77
Nitrite	mg-N/L	0.001	0.001	0.001	48	0.001	0.001	0.002	87	0.002	0.001	0.002	73	0.001	0.001	0.005	101	0.003	0.002	0.005	136
Sulfate	mg/L	7.2	2.1	26	48	25	25	38	99	3.1	2.6	7.3	84	5.6	5.6	9	109	4.1	4	5.0	66
Aluminum, total	mg/L	0.23	0.08	1.10	56	0.17	0.03	0.66	117	0.27	0.05	1.70	93	0.34	0.12	1.50	117	0.29	0.09	1.20	82
Aluminum, dissolved	mg/L	0.10	0.03	0.43	56	0.03	0.01	0.12	103	0.03	0.01	0.14	81	0.03	0.02	0.09	108	0.06	0.01	0.10	74
Antimony, total	mg/L	0.00008	0.00005	0.00011	56	0.00008	0.00006	0.00013	117	0.00013	0.00012	0.00024	93	0.00005	0.00005	0.00005	117	0.00007	0.00005	0.00010	82
Antimony, dissolved	mg/L	0.00007	0.00005	0.00010	56	0.00006	0.00005	0.00010	103	0.00011	0.00010	0.00023	81	0.00005	0.00005	0.00005	108	0.00006	0.00005	0.00010	74
Arsenic, total	mg/L	0.0006	0.0007	0.0010	56	0.0003	0.0002	0.0006	117	0.0005	0.0005	0.0009	93	0.0003	0.0002	0.0006	117	0.0003	0.0002	0.0007	82
Arsenic, dissolved	mg/L	0.0006	0.0006	0.0008	56	0.0002	0.0002	0.0003	103	0.0004	0.0004	0.0005	81	0.0002	0.0002	0.0003	108	0.0002	0.0001	0.0003	74
Barium, total	mg/L	0.08	0.08	0.13	56	0.06	0.06	0.07	117	0.04	0.04	0.05	93	0.04	0.04	0.05	117	0.03	0.03	0.04	82
Barium, dissolved	mg/L	0.08	0.08	0.13	56	0.06	0.06	0.07	103	0.03	0.03	0.04	81	0.04	0.04	0.05	108	0.02	0.02	0.03	74
Beryllium, total	mg/L	0.00007	0.00005	0.00010	56	0.00005	0.00005	0.00010	117	0.00005	0.00005	0.00010	93	0.00005	0.00005	0.00005	117	0.00006	0.00005	0.00010	82
Beryllium, dissolved	mg/L	0.00007	0.00005	0.00010	56	0.00005	0.00005	0.00010	103	0.00005	0.00005	0.00010	81	0.00005	0.00005	0.00005	108	0.00006	0.00005	0.00010	74
Boron, total	mg/L	0.012	0.011	0.020	56	0.010	0.005	0.050	117	0.017	0.015	0.050	93	0.010	0.005	0.050	117	0.007	0.005	0.010	79
Boron, dissolved	mg/L	0.012	0.010	0.019	56	0.010	0.005	0.050	103	0.017	0.014	0.050	81	0.010	0.005	0.050	108	0.006	0.005	0.010	74
Cadmium, total	mg/L	0.000007	0.000006	0.000018	56	0.000014	0.000010	0.000039	117	0.000006	0.000005	0.000020	93	0.000015	0.000010	0.000035	117	0.000008	0.000007	0.000018	82
Cadmium, dissolved	mg/L	0.000005	0.000005	0.000011	56	0.000011	0.000008	0.000033	103	0.000003	0.000003	0.000006	81	0.000006	0.000006	0.000010	108	0.000004	0.000003	0.000007	74
Calcium, total	mg/L	24	26	36	56	22	23	30	116	23	23	32	90	14	14	20	116	10	9	12	88
Calcium, dissolved	mg/L	24	26	37	56	23	24	32	103	23	23	33	81	14	13	20	108	10	9	12	78
Chromium, total	mg/L	0.0005	0.0004	0.0015	56	0.0003	0.0002	0.0008	117	0.0005	0.0003	0.0018	93	0.0003	0.0002	0.0010	117	0.0004	0.0002	0.0010	82
Chromium, dissolved	mg/L	0.0003	0.0003	0.0007	56	0.0001	0.0001	0.0004	103	0.0003	0.0003	0.0004	81	0.0001	0.0001	0.0002	108	0.0001	0.0001	0.0003	74
Cobalt, total	mg/L	0.0001	0.0001	0.0004	56	0.0001	0.0001	0.0005	117	0.0002	0.0001	0.0010	93	0.0002	0.0001	0.0009	117	0.0002	0.0001	0.0006	82
Cobalt, dissolved	mg/L	0.0001	0.0001	0.0001	56	0.0001	0.0001	0.0001	103	0.0001	0.0001	0.0001	81	0.0001	0.0001	0.0001	108	0.0001	0.0001	0.0001	74
Copper, total	mg/L	0.0017	0.0012	0.0037	56	0.0019	0.0013	0.0051	117	0.0016	0.0010	0.0049	93	0.0014	0.0010	0.0041	117	0.0012	0.0008	0.0026	82
Copper, dissolved	mg/L	0.0016	0.0011	0.0033	56	0.0016	0.0011	0.0036	103	0.0013	0.0009	0.0025	81	0.0007	0.0006	0.0016	108	0.0008	0.0006	0.0016	76
Iron, total	mg/L	0.21	0.078	0.78	56	0.18	0.04	0.7	117	0.23	0.043	1.2	93	0.46	0.29	1.3	117	0.34	0.12	1.3	85
Iron, dissolved	mg/L	0.08	0.02	0.35	56	0.04	0.02	0.12	104	0.04	0.02	0.14	82	0.11	0.09	0.26	109	0.08	0.03	0.15	76
Lead, total	mg/L	0.00007	0.00005	0.00020	56	0.00007	0.00003	0.00023	117	0.00007	0.00003	0.00038	93	0.00033	0.00012	0.00120	117	0.00014	0.00006	0.00050	82
Lead, dissolved	mg/L	0.00004	0.00003	0.00008	56	0.00003	0.00003	0.00005	103	0.00003	0.00003	0.00005	81	0.00004	0.00003	0.00010	108	0.00004	0.00003	0.00005	74
Lithium, total	mg/L	0.00140	0.00140	0.00180	56	0.00059	0.00050	0.00110	117	0.00063	0.00050	0.00110	93	0.00053	0.00050	0.00100	117	0.00055	0.00050	0.00100	79

Parameter	Units	Receiving Water Quality																			
		Four Creek				Goathorn Creek				Tenas Creek				Telkwa River				Bulkley River			
		Average	P50	P95	Count	Average	P50	P95	Count	Average	P50	P95	Count	Average	P50	P95	Count	Average	P50	P95	Count
Lithium, dissolved	mg/L	0.00130	0.00130	0.00180	56	0.00055	0.00050	0.00100	103	0.00054	0.00050	0.00100	81	0.00052	0.00050	0.00050	108	0.00055	0.00050	0.00100	74
Magnesium, total	mg/L	13	14	20	56	4	4	6	116	5	4	7	90	2	2	3	116	2	2	2	88
Magnesium, dissolved	mg/L	13	14	20	56	4	4	7	103	4	4	7	81	2	2	4	108	2	2	3	78
Manganese, total	mg/L	0.005	0.002	0.018	56	0.008	0.004	0.029	117	0.011	0.004	0.056	93	0.025	0.019	0.075	117	0.021	0.012	0.053	82
Manganese, dissolved	mg/L	0.002	0.001	0.007	56	0.003	0.002	0.008	104	0.003	0.002	0.006	82	0.009	0.007	0.022	109	0.007	0.005	0.014	76
Mercury, total	mg/L	0.000006	0.000004	0.000012	56	0.000003	0.000003	0.000005	92	0.000004	0.000003	0.000009	69	0.000003	0.000003	0.000007	95	0.000003	0.000003	0.000005	74
Mercury, dissolved	mg/L	0.000005	0.000003	0.000010	56	0.000004	0.000003	0.000005	92	0.000003	0.000003	0.000006	69	0.000003	0.000003	0.000003	95	0.000003	0.000003	0.000005	74
Molybdenum, total	mg/L	0.0002	0.0002	0.0004	56	0.0007	0.0005	0.0006	117	0.0001	0.0001	0.0002	93	0.0005	0.0005	0.0007	117	0.0004	0.0004	0.0005	82
Molybdenum, dissolved	mg/L	0.0002	0.0002	0.0004	56	0.0005	0.0005	0.0006	103	0.0001	0.0001	0.0002	81	0.0005	0.0005	0.0007	108	0.0004	0.0004	0.0005	74
Nickel, total	mg/L	0.0007	0.0005	0.0015	56	0.0004	0.0003	0.0010	117	0.0005	0.0003	0.0017	93	0.0004	0.0003	0.0010	117	0.0005	0.0003	0.0013	82
Nickel, dissolved	mg/L	0.0006	0.0005	0.0011	56	0.0003	0.0003	0.0006	103	0.0003	0.0003	0.0005	81	0.0002	0.0003	0.0003	108	0.0006	0.0003	0.0007	76
Phosphorus, total	mg/L	0.009	0.004	0.040	37	0.006	0.003	0.018	100	0.010	0.004	0.040	81	0.011	0.006	0.048	144	0.012	0.005	0.040	91
Orthophosphate, dissolved	mg/L	0.001	0.001	0.002	44	0.001	0.001	0.004	83	0.001	0.001	0.004	69	0.002	0.002	0.003	124	0.002	0.001	0.004	76
Potassium, total	mg/L	0.44	0.37	0.80	56	0.45	0.38	1.00	116	0.34	0.23	1.00	90	0.38	0.30	1.00	116	0.38	0.32	0.68	79
Potassium, dissolved	mg/L	0.44	0.37	0.83	56	0.37	0.36	0.47	103	0.20	0.19	0.30	81	0.28	0.28	0.35	108	0.35	0.32	0.52	74
Selenium, total	mg/L	0.00005	0.00005	0.00010	56	0.00010	0.00008	0.00020	117	0.00007	0.00005	0.00020	93	0.00009	0.00008	0.00020	117	0.00005	0.00003	0.00020	82
Selenium, dissolved	mg/L	0.00005	0.00005	0.00011	56	0.00008	0.00008	0.00012	103	0.00004	0.00003	0.00007	81	0.00007	0.00007	0.00010	108	0.00003	0.00003	0.00005	74
Silica, dissolved	mg/L	n.a.'	n.a.'	n.a.'	0	5.5	5.6	6.2	13	7.2	7.0	8.0	12	6.2	6.7	8.6	18	n.a.'	n.a.'	n.a.'	0
Sodium, total	mg/L	8.1	8.3	14.0	56	2.6	2.5	4.8	116	3.5	3.6	5.1	90	1.6	1.0	2.8	116	1.2	1.0	2.5	79
Sodium, dissolved	mg/L	8.1	8.6	14.0	56	2.7	2.5	4.9	103	3.5	3.6	5.4	81	1.6	1.0	2.8	108	1.2	1.0	2.4	76
Strontium, total	mg/L	0.2	0.2	0.2	56	0.1	0.1	0.1	117	0.1	0.1	0.1	93	0.1	0.1	0.1	117	0.0	0.0	0.1	82
Strontium, dissolved	mg/L	0.2	0.2	0.2	56	0.1	0.1	0.1	103	0.1	0.1	0.2	81	0.1	0.1	0.1	108	0.0	0.0	0.1	74
Silver, total	mg/L	0.00001	0.00001	0.00002	56	0.00001	0.00001	0.00002	117	0.00001	0.00001	0.00002	93	0.00001	0.00001	0.00002	117	0.00001	0.00001	0.00002	82
Silver, dissolved	mg/L	0.00001	0.00001	0.00001	56	0.00001	0.00001	0.00001	103	0.00001	0.00001	0.00001	81	0.00001	0.00001	0.00001	108	0.00001	0.00001	0.00001	74
Tin, total	mg/L	0.00007	0.00005	0.00010	56	0.00005	0.00005	0.00010	117	0.00005	0.00005	0.00010	93	0.00005	0.00005	0.00007	117	0.00023	0.00005	0.00010	82
Tin, dissolved	mg/L	0.00008	0.00005	0.00010	56	0.00010	0.00005	0.00010	103	0.00005	0.00005	0.00010	81	0.00005	0.00005	0.00005	108	0.00006	0.00005	0.00010	74
Thallium, total	mg/L	0.00001	0.00001	0.00001	56	0.00000	0.00001	0.00001	117	0.00000	0.00001	0.00001	93	0.00000	0.00001	0.00001	117	0.00001	0.00001	0.00001	82
Thallium, dissolved	mg/L	0.00001	0.00001	0.00001	56	0.00001	0.00001	0.00001	103	0.00000	0.00001	0.00001	81	0.00000	0.00001	0.00001	108	0.00001	0.00001	0.00001	74
Uranium, total	mg/L	0.00012	0.00010	0.00026	56	0.00007	0.00006	0.00014	117	0.00013	0.00012	0.00026	93	0.00006	0.00006	0.00009	117	0.00004	0.00004	0.00008	82
Uranium, dissolved	mg/L	0.00011	0.00010	0.00026	56	0.00007	0.00006	0.00014	103	0.00013	0.00011	0.00026	81	0.00005	0.00005	0.00008	108	0.00003	0.00003	0.00005	74
Vanadium, total	mg/L	0.0009	0.0006	0.0029	56	0.0006	0.0003	0.0017	117	0.0012	0.0009	0.0037	93	0.0009	0.0006	0.0033	117	0.0011	0.0005	0.0050	82
Vanadium, dissolved	mg/L	0.0005	0.0005	0.0011	55	0.0003	0.0003	0.0005	103	0.0007	0.0007	0.0010	81	0.0003	0.0003	0.0005	108	0.0004	0.0003	0.0006	74
Zinc, total	mg/L	0.0026	0.0030	0.0048	56	0.0031	0.0015	0.0052	117	0.0017	0.0015	0.0054	93	0.0023	0.0015	0.0067	117	0.0023	0.0015	0.0050	82
Zinc, dissolved	mg/L	0.0012	0.0010	0.0023	56	0.0012	0.0013	0.0021	103	0.0010	0.0010	0.0015	81	0.0011	0.0015	0.0015	108	0.0011	0.0008	0.0023	76

Source: https://srk.sharepoint.com/sites/NA1CT027.003/Internal/100_Data_Analysis/2023%20Updates/SurfaceWQ_BaselineData_rev14_cc_CCM_20250514.xlsx?web=1

Parameter	Units	Overburden Water Quality				Bedrock Water Quality				Groundwater - Combined			
		Average	P50	P95	Count	Average	P50	P95	Count	Average	P50	P95	Count
Chloride	mg/L	1.5	0.52	3.3	48	4.2	2.5	10	69	3.1	2.5	10	120
Fluoride	mg/L	0.17	0.13	0.35	41	1.7	1.5	5.1	61	1.1	0.5	5.0	100
Ammonia, total	mg-N/L	0.15	0.025	0.61	44	0.32	0.32	0.69	69	0.25	0.22	0.68	110
Nitrate	mg-N/L	0.04	0.005	0.17	41	0.07	0.025	0.16	58	0.058	0.025	0.170	99
Nitrite	mg-N/L	0.0016	0.001	0.005	41	0.0072	0.005	0.02	58	0.005	0.005	0.020	99
Nitrogen, total	mg/L	1.3	0.54	5.9	40	0.81	0.38	2.2	64	1.000	0.410	5.000	100
Sulfate	mg/L	18	11	42	48	24	6	75	69	21	9	67	120
Aluminum, total	mg/L	6.2	0.64	26	47	1.3	0.24	6.2	69	3.3	0.3	9.6	120
Aluminum, dissolved	mg/L	0.032	0.005	0.034	44	0.033	0.0086	0.1	69	0.033	0.005	0.091	110
Antimony, total	mg/L	0.00053	0.0005	0.00071	40	0.00049	0.0005	0.0005	61	0.00051	0.00050	0.00053	100
Antimony, dissolved	mg/L	0.00052	0.0005	0.00054	37	0.022	0.0005	0.00097	61	0.014	0.001	0.00072	98
Arsenic, total	mg/L	0.01	0.002	0.02	47	0.0042	0.001	0.0058	69	0.007	0.001	0.012	120
Arsenic, dissolved	mg/L	0.0034	0.00081	0.011	44	0.0011	0.0006	0.002	69	0.002	0.001	0.010	110
Barium, total	mg/L	0.29	0.13	0.86	47	1.6	0.4	4.1	68	1	0.24	3.8	120
Barium, dissolved	mg/L	0.12	0.093	0.25	45	0.85	0.33	3.6	69	0.56	0.14	3.5	110
Beryllium, total	mg/L	0.00099	0.0001	0.005	47	0.00089	0.00015	0.005	69	0.00093	0.0001	0.0050	120
Beryllium, dissolved	mg/L	0.00034	0.0001	0.0002	44	0.00079	0.0001	0.005	69	0.00062	0.00010	0.00500	110
Boron, total	mg/L	0.091	0.10	0.10	47	0.21	0.18	0.38	69	0.16	0.13	0.35	120
Boron, dissolved	mg/L	0.084	0.10	0.10	44	0.19	0.16	0.34	69	0.15	0.11	0.33	110
Cadmium, total	mg/L	0.00036	0.000056	0.00075	47	0.00029	0.000042	0.0026	69	0.00032	0.00005	0.00230	120
Cadmium, dissolved	mg/L	0.00012	0.000021	0.00027	45	0.00022	0.000012	0.0016	69	0.00018	0.000015	0.00087	110
Calcium, total	mg/L	63	55	130	47	16	16	36	68	36	25	91	120
Calcium, dissolved	mg/L	51	50	86	46	16	14	35	68	30	22	85	110
Chromium, total	mg/L	0.0065	0.001	0.033	47	0.0034	0.001	0.01	69	0.0046	0.0010	0.0150	120
Chromium, dissolved	mg/L	0.0015	0.001	0.001	44	0.0011	0.001	0.002	69	0.0013	0.0010	0.0020	110
Cobalt, total	mg/L	0.0082	0.00044	0.017	47	0.32	0.0005	0.0043	69	0.19	0.00048	0.01200	120
Cobalt, dissolved	mg/L	0.0009	0.0003	0.0041	44	0.00057	0.0003	0.0026	69	0.0007	0.00030	0.00300	110
Copper, total	mg/L	0.018	0.0016	0.025	47	0.0049	0.0018	0.014	69	0.01	0.002	0.023	120
Copper, dissolved	mg/L	0.0016	0.001	0.005	45	0.0019	0.001	0.0039	69	0.002	0.001	0.005	110
Iron, total	mg/L	17	0.5	20	47	1.4	0.53	3.9	69	7.6	0.51	17	120
Iron, dissolved	mg/L	0.043	0.03	0.099	44	0.2	0.065	0.59	69	0.14	0.05	0.55	110
Lead, total	mg/L	0.014	0.00062	0.046	47	0.0029	0.00085	0.02	69	0.0073	0.00074	0.02	120
Lead, dissolved	mg/L	0.0021	0.0005	0.00093	44	0.0014	0.0005	0.001	69	0.002	0.001	0.001	110
Lithium, dissolved	mg/L	0.0048	0.0028	0.0067	45	0.054	0.05	0.1	66	0.034	0.018	0.099	110
Lithium, total	mg/L	0.011	0.0041	0.05	47	0.07	0.051	0.11	66	0.046	0.020	0.11	110
Magnesium, total	mg/L	26	19	57	47	3.3	2.1	8.6	68	12	6	53	120
Magnesium, dissolved	mg/L	21	14	51	46	3	1.9	8.6	68	10	5.5	48	110
Manganese, total	mg/L	0.61	0.12	3.6	47	0.079	0.036	0.23	69	0.300	0.058	0.910	120
Manganese, dissolved	mg/L	0.13	0.052	0.57	45	0.061	0.017	0.25	69	0.089	0.022	0.300	110
Mercury, total	mg/L	0.0011	0.000005	0.00017	47	0.034	0.000011	0.03	69	0.021	0.000008	0.000	120
Mercury, dissolved	mg/L	0.0012	0.000005	0.00018	44	0.0029	0.000005	0.03	69	0.002	0.000005	0.000	110
Molybdenum, total	mg/L	0.0049	0.0014	0.014	47	0.0054	0.001	0.015	69	0.0052	0.0010	0.0140	120
Molybdenum, dissolved	mg/L	0.0053	0.001	0.015	45	0.0044	0.001	0.015	69	0.0047	0.0010	0.0150	110
Nickel, total	mg/L	0.0083	0.001	0.045	47	0.0036	0.0012	0.0084	69	0.0055	0.0011	0.0200	120
Nickel, dissolved	mg/L	0.0027	0.001	0.017	44	0.0021	0.001	0.005	69	0.0023	0.0010	0.0050	110
Phosphorus, total	mg/L	0.66	0.044	1.1	47	0.051	0.039	0.11	69	0.30	0.04	0.92	120
Phosphorus, dissolved	mg/L	0.18	0.012	0.89	40	0.023	0.016	0.06	61	0.08	0.01	0.79	100
Potassium, total	mg/L	2.6	2	3.6	47	2.3	2	3.8	68	2.4	2.0	3.8	120
Potassium, dissolved	mg/L	1.8	2	2	44	2.2	2	3.5	68	2.1	2.0	3.2	110
Selenium, total	mg/L	0.00037	0.0002	0.00099	47	0.00065	0.0001	0.001	69	0.0005	0.00012	0.0010	120
Selenium, dissolved	mg/L	0.00032	0.0002	0.00096	45	0.00026	0.00014	0.001	69	0.0003	0.00017	0.0010	110
Silica, dissolved	mg/L	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	n.a.	n.a.	n.a.	n.a.
Sodium, total	mg/L	44	20	110	47	350	310	750	68	220	190	730	120
Sodium, dissolved	mg/L	46	20	110	45	350	320	720	68	230	180	710	110
Silver, total	mg/L	0.00016	0.00002	0.00087	47	0.023	0.00002	0.0016	69	0.014	0.00002	0.0011	120
Silver, dissolved	mg/L	0.0001	0.00002	0.00027	44	0.059	0.00002	0.0001	68	0.036	0.00002	0.000	110
Thallium, dissolved	mg/L	0.00019	0.0002	0.0002	37	0.0002	0.0002	0.0002	58	0.0002	0.0002	0.000	95
Thallium, total	mg/L	0.000036	0.00001	0.0002	40	0.000047	0.00002	0.0002	58	0.000043	0.000014	0.000	98
Tin, total	mg/L	0.0015	0.0005	0.005	38	0.00073	0.0005	0.0013	51	0.0011	0.0005	0.0042	89
Tin, dissolved	mg/L	0.001	0.0005	0.0049	36	0.00061	0.0005	0.00053	51	0.0008	0.0005	0.0026	87
Titanium, dissolved	mg/L	0.012	0.01	0.024	44	0.013	0.01	0.05	66	0.0130	0.0100	0.0500	110
Titanium, total	mg/L	0.038	0.014	0.12	47	0.02	0.01	0.05	66	0.0270	0.0100	0.0650	110
Uranium, total	mg/L	0.0033	0.0018	0.0083	47	0.023	0.0004	0.0069	69	0.0150	0.0010	0.0080	120
Uranium, dissolved	mg/L	0.0017	0.0011	0.0032	45	0.023	0.0004	0.0071	69	0.0140	0.00068	0.0067	110
Vanadium, total	mg/L	0.016	0.0023	0.041	47	0.0055	0.001	0.03	69	0.010	0.002	0.030	120
Vanadium, dissolved	mg/L	0.0027	0.001	0.005	45	0.0039	0.00053	0.03	69	0.003	0.001	0.030	110
Zinc, total	mg/L	0.051	0.005	0.11	47	0.016	0.0073	0.05	69	0.03	0.006	0.081	120
Zinc, dissolved	mg/L	0.011	0.005	0.012	44	0.0067	0.005	0.011	69	0.008	0.005	0.012	110

Source: Z:\01_SITES\Telkwa Coal\!020_Site-Wide_Data\Groundwater\GW_Quality\GWQuality_Summary_Stats_rev08_smh.xlsx

Appendix E Geochemical Source Term Analysis

(1) SRK Consulting (Canada) Inc. 2024b. Updated Water Quality Model Source Terms. Prepared for Telkwa Mining Limited. Project Number CAPR002933. June 2024.
(2) M.A. O'Kane Consultants Inc. 2024. Tenas project - Suboxic Evaluation of Non-Acid Generating Mine Rock Report. prepared for Telkwa Mining Limited. August 2024

FINAL

Updated Water Quality Model Source Terms

Tenas Project, British Columbia, Canada

Telkwa Mining Ltd.



SRK Consulting (Canada) Inc. ▪ CAPR002933 ▪ June 2024

srk consulting

FINAL

Updated Water Quality Model Source Terms

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Useful Definitions

This list contains definitions of symbols, units, abbreviations, and terminology that may be unfamiliar to the reader.

EMA	Environmental Management Act
EMP	East Management Pond
EOM	End of Mining
FS	Feasibility Study
HCT	Humidity cell testing
MA	Mines Act
Non-PAG	Non-potentially acid generating
NMP	North Management Pond
PAG	Potentially acid generating
TML	Telkwa Mining Limited
TSS	Total suspended solids

1 Introduction

Telkwa Mining Ltd (TML) submitted an Environmental Assessment Certificate (EAC), application for the Tenas Project, located at the Telkwa Property, near the town of Telkwa, British Columbia in May of 2022. In support of the EA application, SRK Consulting (Canada) Inc. (SRK) developed geochemical source terms (SRK 2022a) that formed the basis for evaluating changes to water quality in downstream receptors. The source terms were based on humidity cell testing (HCT) results. In parallel to the geochemical characterization testing program that was used to support the EAC application, TML initiated a field barrel testing program in late 2019. Release rates from the barrel testing program were compared to the scaled results that formed the basis of the source terms that were developed to support the EAC application. The outcomes indicated that the scaled HCT release rates were underestimated for some constituents while overestimated for others. Updated source terms were developed using the barrel release rates to reflect release rates more accurately under field conditions.

This report describes the conceptual models, methods and assumptions used to derive the site water quality model source term inputs based on the field barrel testing results. The site wide water quality model development and results are described in SRK (2024a).

2 Project Background

2.1 Geological Setting

2.1.1 Bedrock Geology

The Tenas Project is located within the northeast/southwest trending Skeena Arch, which separates Jurassic-age sedimentary rocks of the Bowser Basin in the north from the Jurassic to Cretaceous-age sedimentary rocks of the Nechako Basin to the south. The coal-bearing sedimentary rock sequence of the Project is associated with the Lower Cretaceous age Skeena Group, and unconformably overlies the Jurassic-age Hazelton volcanic group, which will be below the proposed pit limit. A simplified stratigraphic column of the Project's deposit is presented in Figure 2-1.

Jurassic Hazelton Volcanic Group

The volcanic rocks include andesite, trachyte, and basalt with associated tuffs and breccias.

Lower Cretaceous Skeena Group

The Lower Cretaceous Skeena Group includes marine and continental sediments interbedded with coal seams, often correlated over long lateral distances. It is subdivided into four units (Units I through IV) and a unit of undivided sediments overlying the four units (Figure 2-1).

The economic coal seams in the Tenas area are located within Coal Zone 1 of Unit I and include two seams: C seam and 1 seam (upper and lower). Coal Zones 2 through 10, located in Unit III (Figure 2-1), are absent from the Tenas area. Units I through IV are summarized below.

- The Unit I consists of more than 100 m of fine to coarse-grained cross-bedded sandstone, conglomerate, siltstone, mudstone, and coal (coal zone 1). Overall, Unit I fines upward, from primarily conglomerate and sandstone to almost entirely carbonaceous mudstone, seatearth and coal (1A to 1G). The conglomerate and sandstone were deposited in braided channels and bars, and mudstone accumulated in floodplains. Thin coal seams formed in poorly drained, peat-forming backswamps, and seatearths formed under leaching conditions in less submerged areas. With denudation of the volcanic source area, braid plains were abandoned and extensive low-energy, peat-forming swamps were established, resulting in the formation of thick coal seams in the upper part of the Unit.
- The Unit II separates coal zone 1 and coal zone 2. It consists of up to 140 m of primarily monotonous silty mudstone, occasionally interbedded with beds of chert-rich, micaceous, bioturbated or cross-bedded sandstone. The sediments were deposited in a deltaic/shallow marine environment following a regional marine transgression. The mudstone accumulated in bays, and the sandstones in distributary channels and mouthbars. Locally, thin discontinuous peat beds formed in salt marshes.
- Unit III comprises about 90 m of chert-rich, micaceous sandstone, siltstone, and mudstone, and up to nine coal zones (coal zones 2 through 10). The sandstone and mudstone were deposited and biogenically reworked in a tidal flat environment; siltstone accumulated in a restricted, nearshore marine environment. Peat accumulated in freshwater coastal marshes which periodically prograded over tidal flats.

- Unit IV consists of approximately 150 m of a laterally extensive, bright green, chert-rich, chloritic sandstone or siltstone bed at the base, overlain by massive grey silty mudstone like that of Unit II. The basal sandstone is a transgressive lag deposit, and silty mudstone, the predominant lithofacies, was deposited in a quiet, nearshore, shallow marine environment.

Intrusions

Tertiary and Cretaceous-age porphyritic dykes and sills commonly intrude this sequence, the most notable of which includes a Tertiary granodiorite intrusion located on the north side of the Telkwa River. These intrusions are not present in the Tenas area.

Geological Structures

The sedimentary sequence in the Tenas area is folded into a syncline in which the gently (typically 10 to 20°) northeast-dipping western limb of the syncline subcrops on the western side of the pit area, while the moderately (40 to 45°) southwest-dipping eastern limb subcrops on the eastern side of the pit. Faulting is generally near-vertical, and can be subdivided into two main groups, one which strikes approximately northwest/southeast and the other which strikes approximately northeast/southwest. A few east/west striking faults have also been interpreted.

The Goathorn area is located within an outlier of the Lower Cretaceous Skeena Group. The structural geology is somewhat more complex than the Tenas area and is characterized by a complex series of sub-parallel north-south trending reverse faults, and to a lesser extent east-west, trending normal faults.

Northeast striking faults are related to emplacement of the Bulkley intrusions in the Late Cretaceous.

2.1.2 Surficial Geology

The surficial geology in the Project area consists primarily of two types of deposits, glacial clay- or silt-rich till, and sand and glaciofluvial sand and gravel outwash. At upper elevations and south of the proposed pit, the terrain is mapped as having bedrock outcrops to a limited extent or thin mantles of clay- and silt-rich tills deposits, between 3 m and 10 m thick. North of the proposed pit and towards Tenas Creek and Goathorn Creek, drillholes report thin mantles of clay- and silt-rich tills deposits, between 3 m and 10 m thick underlain by a thick sand and gravel outwash deposit that can exceed 100 m.

Other types of deposits are present locally. Patches of glaciolacustrine deposits are scattered throughout the morainal landscape in low ridges and in depressions; the sediments comprise bedded and laminated mud, and minor sand and gravel (Clague 1984). Recent fluvial deposits form the narrow floodplains of Goathorn Creek and Tenas Creek, which are 40 m to 80 m deep incised into the subdued morainal landscape, and the wide floodplains of the Telkwa and Bulkley Rivers. The fluvial deposits range from extremely coarse, poorly sorted gravel on steep alluvial fans to moderately to well-sorted sand and mud on low-gradient floodplains (Clague 1984).

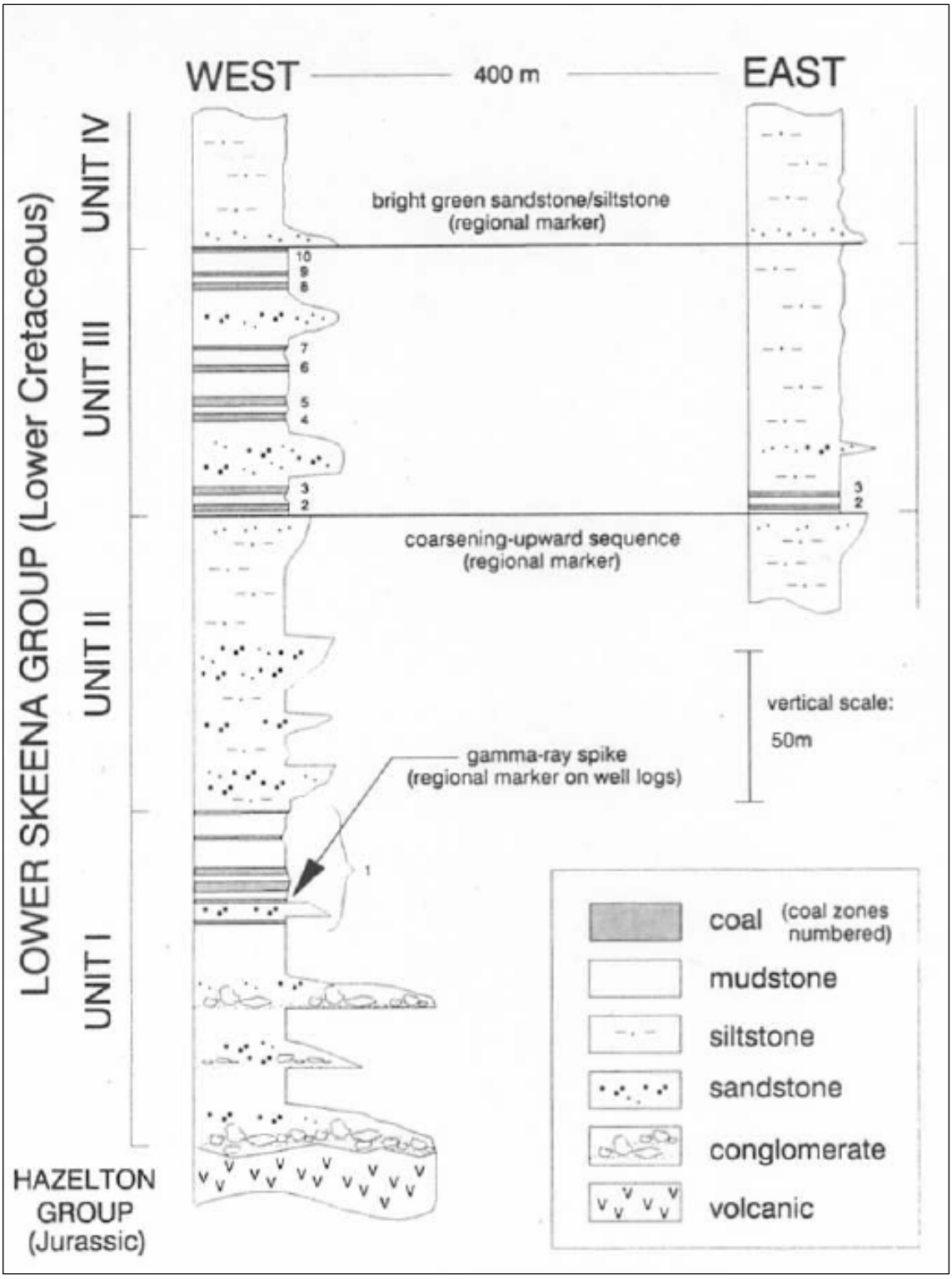


Figure 2-1. Stratigraphic Sequence of Lower Cretaceous Skeena Group Sediments.

Source: Telkwa Coal Ltd.

2.1.3 Material Zone Designations

Geochemical properties are stratigraphically constrained in coal deposits versus lithologically constrained. For example, the deposition environment of the Tenas Deposit includes marine and deltaic sedimentary sequences and rocks formed in these two different environments will be compositionally different. The deposit was demarcated into stratigraphic zones of sedimentary sequences between the mineable coal seams. The stratigraphic zones were further divided into additional zones if they had different distinct geochemical properties (e.g., Zone 1 and Zone 1a) or grouped if geochemical properties were similar between zones identified between coal seams (e.g., Zone 2 and Zone 3). The stratigraphic zones and classification of PAG and non-PAG based on an NPR of 2.0 identified for the Project are presented in Figure 2-2.

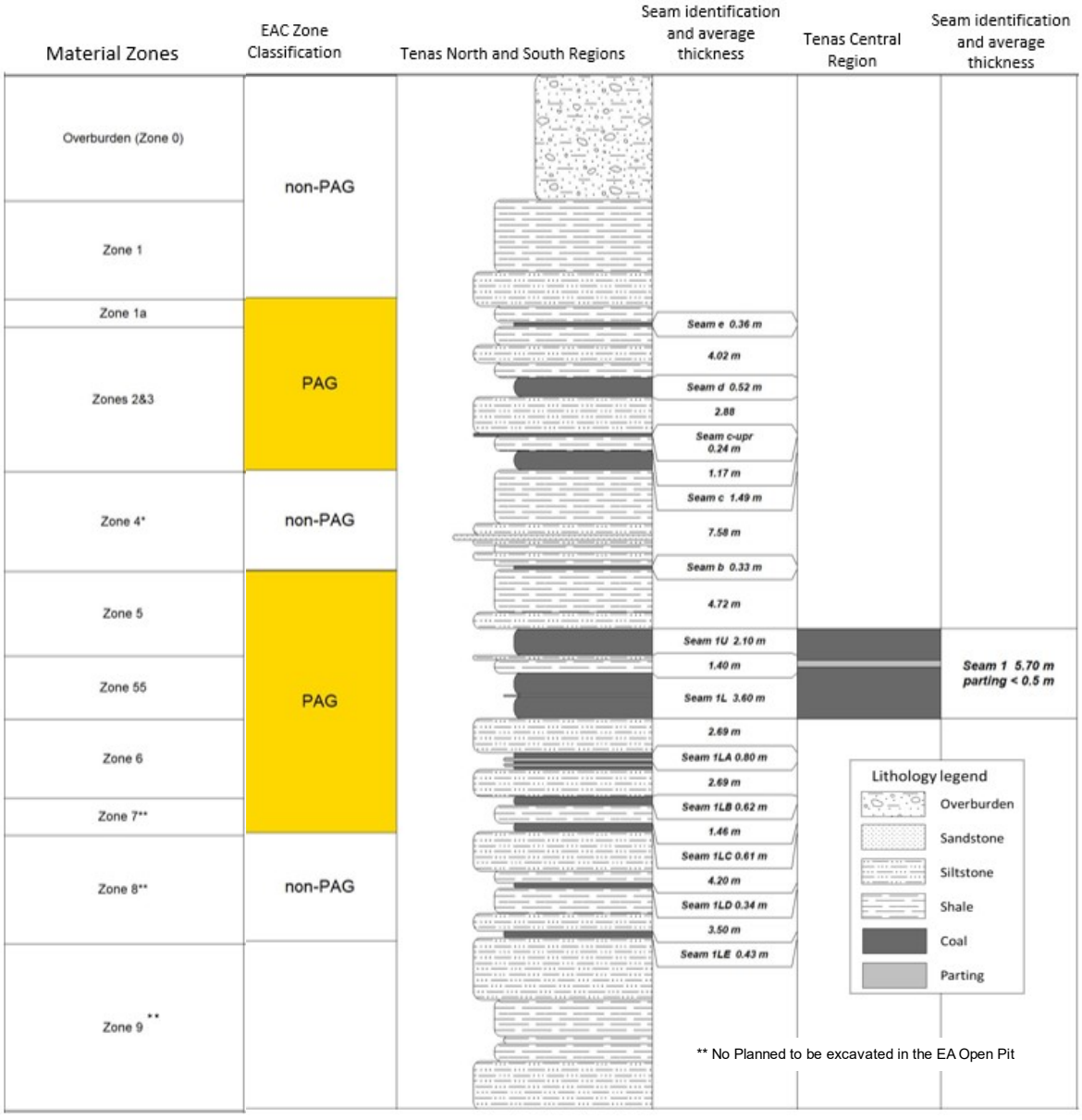


Figure 2-2. Tenas Deposit Stratigraphic Zones

2.2 Geochemical Characterization Study

Two geochemical studies have been completed to characterize the acid generating and metal leaching potential of the Tenas deposit:

- Norecol Dames and Moore (1999). Draft Report. Assessment of ARD Potential and Water Quality Predictions. Telkwa Coal Project.
- SRK (2022b). Telkwa Coal – Tenas Project Supplemental Geochemical Characterization.

The Norecol Dames and Moore (1999) study included the collection and analysis of over 700 samples. An additional 173 samples were collected as part of the supplemental geochemical characterization study (SRK 2022b). The supplemental samples were used to confirm the results of the 1999 study and correlate the test results to more up-to-date testing methods. For example, samples collected as part of the Norecol Dames and Moore (1999) study were analyzed for total sulfur only and neutralization potential was determined using the Sobek-NP (1978) method. Results from both studies were combined to form a robust geochemical characterization that is reported in SRK (2022b). The reader is referred to SRK (2022b) for additional detail on the geochemical characterization program including sample selection, collection, testing and results.

The outcomes of these studies indicated that a large volume of the rock to be mined from the Tenas deposit is potentially acid generating (PAG) and that acid generating potential is stratigraphically constrained in zones generally separated by coal seams. The geochemical properties of the deposit were therefore described based on mineable stratigraphical zones. The geochemical testing results indicate that all zones contain some PAG rock; however, there are units that are predominantly PAG versus non-PAG. Based on the site-specific neutralization potential ratio of 2.0 (NPR) and the average bulk geochemical properties, the following zones were characterized as PAG and non-PAG:

- Non-PAG: Zone 1, 4 and 8;
- PAG: Zones 1a 2/3, 5, 55, 6 and 7.

The geochemical characterization results also indicate that coarse and fine processed rock are PAG and overburden samples tested are non-PAG, including construction materials.

2.3 Summary of Mine Material Management Plan

Mining of the Tenas deposit will produce mine rock and processed rock materials. Previous geochemical testing (Norecol Dames & Moore 1999) indicates that the coarse and fine processed rock and a component of the mine rock will be PAG, and management will be required. Management of mine rock and coarse and fine processed rock are summarized in the following sections.

2.3.1 Management of PAG Rock

In advance of, and during mining, TML proposes to progressively construct Management Ponds with a combination of excavation and embankments with buttresses (Figure 2-3). The purpose of the management ponds is to store PAG and processed rock in saturated conditions preventing sulfide oxidation, limiting acidic drainage from occurring. Three management ponds will be constructed including the North, West and East Management Ponds. The North Management pond will be constructed first and is located north of the West Management Pond and is external to the open pit. The East Management is constructed next and is south of the NMP and external of the open pit. The last management pond, which is the West Management Pond which is constructed from a combination of excavation for the open pit for the North Phase and construction of an embankment external to the open pit.

PAG rock will first be placed in North Management Pond. PAG rock will be progressively placed in lifts and flooded as each lift is completed so that exposure of rock to atmospheric oxygen is minimized. TCL is proposing to place PAG rock including processed rock underwater before it becomes acid generating.

Once the storage capacity of the pond has been reached, storage will begin in the East Management pond and then the West Management Pond. The three management ponds will be independent of one another allowing different water levels and PAG material levels in each of the ponds as conditions require. The Management Ponds will be maintained with at least a two-metre water cover once PAG material disposition has been completed.

2.3.2 Management of non-PAG Rock and Overburden

Non-PAG rock will be used to progressively backfill the open pit during operations and for constructing portions of the embankments and buttresses for the Management Ponds and Control Ponds. Some non-PAG rock will also be used to cap PAG material in the management ponds once the PAG material has reached its design elevation. Non-PAG rock will be placed in lifts into water, keeping the water level at least 1 metre above PAG rock and at or below the non-PAG placement platform. A 1.5 metre thickness was selected for non-PAG as this is below the expected change in water levels during the Post-closure phase so that this material is never above water.

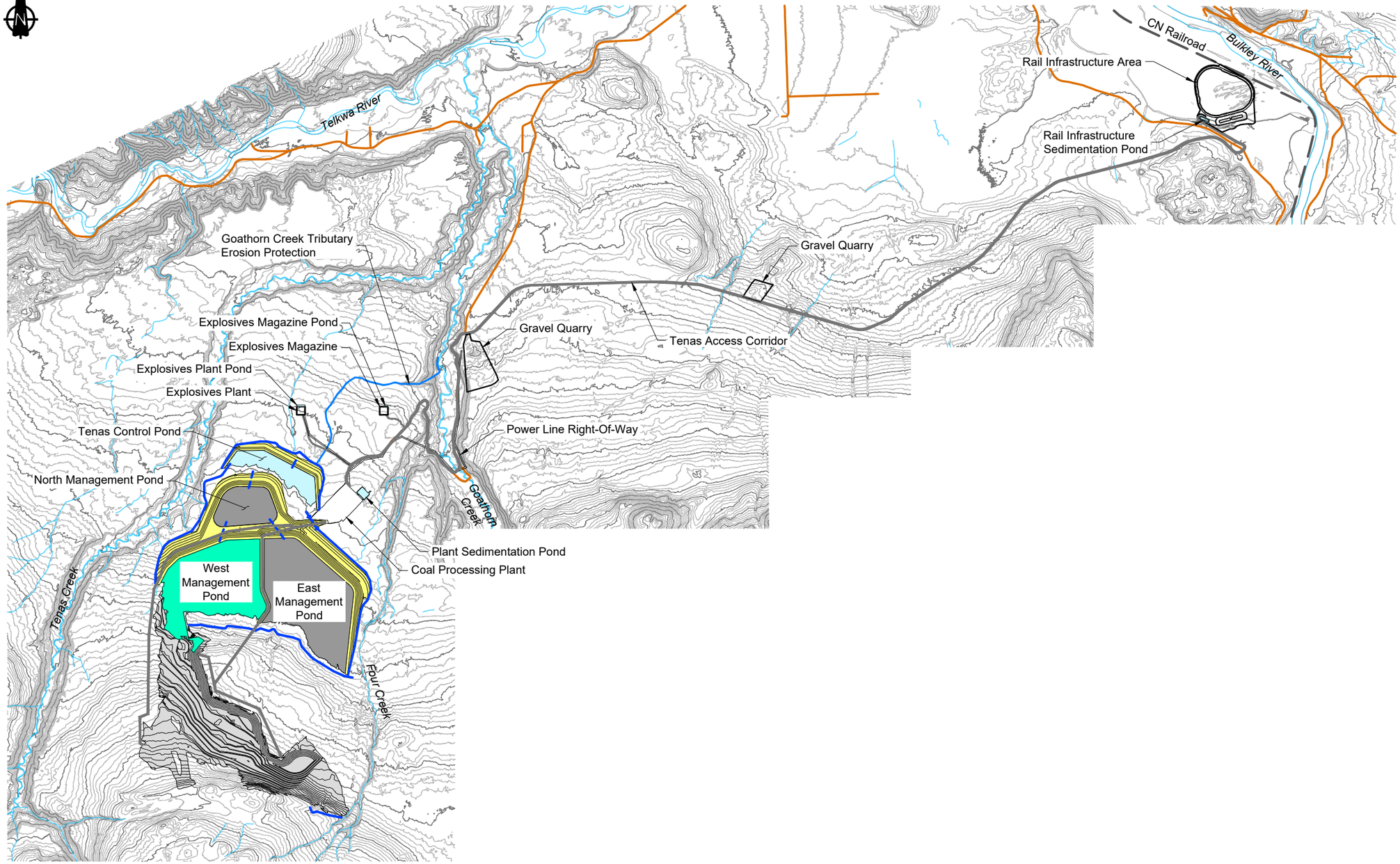
Overburden will be stored in the buttresses during operation and used as a cover material over non-PAG rock placed in the management ponds.

2.3.3 Management of Processed Rock

Coarse and fine processed rock materials are expected to be PAG and will also be placed in the Management Ponds with the PAG rock (Figure 2-3).

2.3.4 Open Pit Walls

Most of the open pit will be backfilled during the Operation phase. However, a small portion of the hanging wall will exist at post-closure. Meteoric water contacting the open pit walls will report to the end pit lakes, with one of them draining northwards by gravity and mix with Management Pond water prior to discharging into the surrounding environment while the other one discharges to Four Creek once its water quality meets regulatory requirements. Until this time, this end pit lake also drains toward the north.



LEGEND

- Water Management Feature
- Spillway
- Existing Watercourse
- Existing Road
- Proposed Road
- Dams and Buttresses
- Sedimentation Pond
- Active Management Pond
- Backfill / NAG Pile
- Covered Inactive Management Pond

NOTES

1. Contours shown at 5.0m intervals.
2. All dimensions shown in meters unless otherwise stated.
3. Pile designs by SRK Consulting Ltd.

REFERENCE

NAD83 UTM Zone 9.

0m 500 1000 1500 2000

srk consulting

TELKWA MINING LIMITED

SRK JOB NO.:	CAPR002933
FILE NAME:	1CT027.003 Overview.dwg

Tenas Project

Geochemical Source Terms

Mine Site Facilities

DATE:	APPROVED:	FIGURE:
2024/05/1	MH	2-3

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3 Conceptual Model

3.1 Unsaturated Mine Rock & Processed Rock

Pyrite (FeS_2) is the main sulfide mineral in PAG rock and processed rock at the Project (SRK 2022b). Under natural conditions, pyrite is stable in bedrock where it is isolated from atmospheric oxygen. However, following blasting and excavation of the bedrock, pyrite in the rock mined will be exposed to atmospheric oxygen prior to being placed in the management ponds and will begin to oxidize producing sulfate, ferrous iron, and acidity (Rxn1).

$$FeS_{2\,(s)} + \frac{7}{2}O_{2\,(g)} + H_2O_{\,(l)} \leftrightarrow Fe^{2+}{}_{(aq)} + 2SO_4{}^{2-}{}_{(aq)} + 2H^+{}_{(aq)} \text{ (Rxn 1)}$$

Under oxidizing conditions, ferrous iron liberated during sulfide oxidation will subsequently oxidize to ferric iron in neutral pH producing additional acidity according to the following reaction:

$$Fe^{2+}{}_{(aq)} + \frac{1}{4}O_{2\,(g)} + 2\frac{1}{2}H_2O_{\,(l)} \leftrightarrow Fe(OH)_{3\,(s)} + 2H^+{}_{(aq)} \text{ (Rxn 2)}$$

Although oxidation of mine rock and processed rock for the Project will release acidity, acidic conditions are not predicted to occur immediately since these materials also contain carbonate minerals that will neutralize the acid according to the following reactions:

$$CaCO_{3(s)} + H^+{}_{(aq)} \leftrightarrow HCO_3{}^-{}_{(aq)} + Ca^{2+}{}_{(aq)} \text{ (Rxn 3)}$$

$$CaCO_{3(s)} + 2H^+{}_{(aq)} \leftrightarrow H_2CO_{3(aq)} + Ca^{2+}{}_{(aq)} \text{ (Rxn 4)}$$

Depletion calculations (SRK 2022b) indicate that the lag times to acid generation are on the order of years (>5 years based on the average bulk rock properties). The lag time to acid generation prediction based on HCTs was confirmed by the barrel testing results. Barrel 6, which is a composite sample of rock from Zones 6 and 7, became acid generating in October 2023, four years after the barrel program was initiated. SRK (2022b) indicated that these zones were non-PAG based on their average bulk geochemical properties. However, the weighted barrel 6's NPR (0.5) was more closely aligned with the minimum and P5 NPR observed for these zones (see Table 4 in SRK (2022b)). The lag times to the onset of acid generation based on the Zone 6 and 7 minimum NPRs ranged from 3 to 5 years.

TML proposes to place PAG rock identified by verification testing and processed rock in the management ponds under saturated conditions within an average of six months after blasting but no more than 12 months. Theoretically, this will limit sulfide oxidation (i.e., oxygen becomes a limited reactant in reaction 1 limiting oxidation of the PAG rock and coarse and fine processed rock precluding acidic conditions at the Project. However, any oxidation products that are produced prior to placement of PAG rock and processed rock underwater will be flushed and dissolve in water stored in the management ponds.

At closure TML will cap saturated PAG rock and coarse and fine processed rock in the management ponds with non-PAG rock. The non-PAG rock will be below the active water level in the management ponds and will be saturated. Any oxidation products that have accumulated on non-PAG rock surfaces will also be flushed when the rock is placed in the management pond.

3.2 Unsaturated Non-PAG Rock

Non-PAG rock that is not used in the management pond cover will be used to backfill the open pit and used in portions of the embankments and buttresses with approximately 50% remaining unsaturated in

post-closure. Under these conditions, the rock will continually oxidize according to Reaction 1 (see Section 3.1) producing oxidation products that will be dissolved in meteoric water contacting the rock. However, non-PAG rock contains more neutralization potential than acid generating potential and the sulfide is predicted to be consumed prior to the neutralization potential (SRK 2022b) and acidic drainage from exposed non-PAG rock will not occur. The non-PAG rock will provide a continuous source of element load under neutral conditions.

3.3 Overburden

Overburden that is stripped during mining will be mixed with unsaturated waste rock for use in the buttresses and open pit backfill. Overburden has been characterized as having low sulfur content (SRK 2022b) and is classified as non-PAG. The small amount of sulfide in the overburden will oxidize according to Reaction 1 producing oxidation products that will be solubilized by incident precipitation. Like unsaturated waste rock, the overburden will provide a continuous source of element load that is soluble under neutral conditions.

3.4 Open Pit Wall Rock Runoff

Mining of the Tenas Project will result in open pit walls that are exposed to atmospheric oxygen until they are progressively covered with non-PAG rock and/or overburden during the Operation phase with any remaining uncovered open pit walls being covered in the Decommissioning and Reclamation phase. Sulfides that are present in the open pit wall rock will oxidize according to reaction 1 (Section 3.1) producing sulfate, acidity, ferrous iron, and release of trace chalcophile elements. Soluble oxidation products will be flushed from exposed open pit wall surfaces in meteoric water contacting the wall rock.

The open pit will be progressively backfilled with non-PAG rock and/or overburden during operations reducing the exposure of open pit wall to atmospheric oxygen. Oxidation of open pit wall rock that is covered with backfill will be reduced by limiting oxygen ingress.

At closure, two end pit lakes will form in the backfilled open pit. A footwall will exist above the end pit lakes composed mainly of Zone 6 sedimentary rock. Based on the site-specific NPR criterion (2.0), this unit PAG; however, as discussed in Section 2.3.4, the majority of the exposed pit walls will be covered. The end pit lake will be a mixture of wall rock runoff, direct precipitation and runoff from non-PAG backfill.

The pit lake will drain by gravity and mix with the Management Pond before being discharged during closure.

3.5 Processed Coal Stockpile Runoff

Processed coal will be temporarily stored at the Rail Infrastructure area in two stockpiles prior to being transported from the site to Ridley terminals. While the processed coal is stored, it will oxidize but long-term oxidation is not a concern since processed coal will only be stored for short durations prior to being loaded into rail cars. Soluble load from the processed coal stockpiles will be collected in the Rail Infrastructure Sedimentation Pond to allow suspended solids to settle.

4 Source Term Derivation Methods

Consistent with SRK (2022b), source terms using the barrel testing results were developed in two ways: concentrations and load flushing rates. Unsaturated mine rock, overburden and wall rock runoff source terms were expressed as concentrations. Concentrations were estimated by scaling barrel testing results and mixing estimated annual loads in predicted annual volumes of water and evaluating if the predicted concentrations would be limited by secondary mineral precipitation. PAG rock, coarse and fine processed rock and some non-PAG rock will be stored permanently underwater in the management ponds. Solute produced through oxidative weathering once these materials have been exposed will be flushed from rock surfaces when they are placed in the management ponds. The source term for these materials is therefore represented by a flushing term in milligrams per bank cubic metre (mg/bcm) of rock, also estimated using scaled barrel testing results.

Processed rock (e.g., coal and rejects) barrels were not constructed since there was insufficient material available. Source terms for coal and rejects have therefore not been updated. The reader is referred to SRK (2022a) for the coal and reject source terms. The particulate concentrations source term has also not been updated since it is independent of kinetic testing release rates (i.e., it was derived based solid-phase static testing results) and is not included in this report. The reader is referred to SRK (2022a) for details on the derivation methods and results of these source terms.

The following subsections provide the inputs and assumptions for each of the source terms based on the barrel testing results.

4.1 Mine Rock Solute Release Rates

A key input into the source term calculations is the mine rock solute release rates. Barrels were constructed from rock representative of each rock zone and the barrel release rates were used to represent the release rates from individual rock zones. Composite samples for each barrel were prepared from excess sample stored at Bureau Veritas Laboratories in Burnaby, British Columbia. Sample, varying in mass from one to 110 kg were selected for use in the barrels until a minimum mass of 200 kg was achieved. Zones with insufficient sample mass to achieve 200 kg (e.g., Zone 4 PAG and Zone 4 non-PAG) were supplemented with sample from other zones with similar geochemical properties (SRK 2024b).

Leachate sampling from the barrels has been conducted intermittently since October 2019 until present. The source terms only consider samples collected until November 2023. Seven to nine samples have been collected from each barrel during this period. The monitoring results from these sampling events was used to estimate barrel release rates according to the following formula:

$$L_j = C_j * \frac{V}{m} / t \qquad \text{(EQ 1)}$$

Where:

L_j is the load of parameter j expressed in mg/kg/week

C_j is the concentration of parameter j in the leachate sample in mg/L

V is the volume of the sample in L

m is the total mass in the barrel in kg

t is the time between sample events in weeks

The average release rate calculated from each sampling event was used in the source term calculations. As noted in Section 3.1, Barrel 6 began to produce acidic leachate in October 2023. Release rates from this sampling event were not included in the average barrel release rate calculations since the conceptual model for the Project is rock will be managed to minimize acid generation and release rates under acidic conditions are not expected to occur.

As noted above, the barrels were constructed of crushed drill core. This results in the barrel samples having a higher reactive surface area in comparison to rock that will be blasted and used in the pit backfill or construction of the buttresses. Scaling factors were applied to the barrel release rates to account for this difference. Details of the scaling factors that were used are discussed in the following subsections.

4.2 Unsaturated Mine Rock and Overburden

4.2.1 Base Case Source Term

Unsaturated non-PAG rock and overburden will be used as backfill in the open pit as well as in construction of the management pond buttresses. The backfill will become partially saturated as the open pit floods at closure. Unsaturated portions of the backfill will continue to oxidize and produce soluble load that will be mobilized in meteoric water interacting with the mine rock.

Annual unsaturated mine rock concentrations were estimated as follows:

$$C_{j=\frac{L_{j,annual}}{Q_{annual}}} \quad \text{(Eq 2)}$$

Where: C_j is the concentration of constituent j

$L_{j,annual}$ is the annual load of constituent j released from exposed mine rock and/or overburden

Q_{annual} is the annual average flow contacting exposed mine rock and overburden

Source term concentrations using Equation 2 were estimated for the following timeframes:

- Pit Backfill
  - End of East Management Pond (EMP)
  - End of Mining (EOM)
- Buttresses
  - End of North Management Pond (NMP)
  - End of EMP
  - End of West Management Pond (WMP)

These periods were selected to evaluate changes to water quality throughout the life of mine (LOM) at key stages of the mine development. In the source term calculations, mine rock and overburden present in the above timeframes was assumed to be unsaturated and produce soluble load. In reality, a portion of the waste rock will become inundated as the pit is progressively backfilled. This assumption results in a conservative estimate of the pit backfill and buttress drainage water quality.

The mine plan indicates that the buttresses will be constructed using overburden and mine rock sourced from Zones 1 and 4. Table 4-1 provides a summary of the cumulative mine rock and overburden volumes and tonnages associated with each of the model timeframes. Mine rock tonnages were estimated using an assumed density of 2.55 grams per bank cubic centimetre (g/bcc) and a density of 2.0 g/bcc was assumed to estimate overburden tonnages (TML 2024, pers. comm.). The respective barrel release rates were prorated in proportions estimated based on the volumes provided in Table 4-1 to estimate the unit solute release rates for the backfill and buttresses at each of the model timeframes. This rate was multiplied by the total mass at each timeframe to estimate the annual load produced.

As noted in Section 4.1, scaling factors were applied to the barrel release rates to account for testing and operational field differences. A generic scaling factor of 0.2, based on SRK's experience at other coal mines in British Columbia, was applied to account for grain size differences between the barrel tests and mine rock that will be produced during operations. Channelization and temperature scaling factors, which were applied to the HCT release rates (SRK 2022b), were not applied to the barrel release rates. Due to the size of the tests, the barrels will have a higher degree of flushing in comparison to rock stored in the backfill and in the buttresses and additional channelization is expected to occur under operational conditions. It is difficult to quantify the degree of flushing in the barrels and a channelization factor was conservatively not included in the barrel release rate estimates.

The barrels only contain 200 kg of material and will therefore be more susceptible to temperature variations in comparison to the rock and overburden used in the backfill and buttresses which will exhibit internal heating from sulfide oxidation. However, the average temperature of the water samples collected from the barrel tests was approximately 10°C. It is assumed a similar internal temperature will occur in the mine rock backfill and buttresses from oxidation of sulfide minerals and carbonaceous rock and release rates were therefore not corrected for temperature differences.

Table 4-1. Summary of Unsaturated Mine Rock & Overburden Quantities

Facility	Cumulative Volume (bcm)			Cumulative Tonnage (Mt)		
	Mine Rock		Overburden	Mine Rock		Overburden
	Zone 1	Zone 2		Zone 1	Zone 2	
Backfill						
End of EMP	279,370	812,529	500,000	0.7	2.7	1.0
EOM	13,194,743	6,667,067	8,727,775	34	17	17
Buttresses						
End of NMP	706,410	---	2,302,531	1.8	---	4.6
End of EMP	2,043,701	---	5,753,394	5.2	---	12
End of WMP	3,621,260	---	10,666,841	9.2	---	21

Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 500 Source Term Updates/01_Source_term_updates/[Telkwa_backfill_buttress_volume_summary_CAPR002933_mkh_r0.xlsx

The annual scaled release rate was divided by the annual average volume of water contacting unsaturated mine rock (SRK 2024a) using Equation 2 to estimate the annual average constituent concentrations in drainage from unsaturated mine rock and overburden. Predicted water qualities were entered into the publicly available speciation and mass transfer code PHREEQC v.3 (Parkhurst and Appelo 1999), developed by the United States Geological Survey (USGS), to evaluate mineral and gas phases that were supersaturated in solution. The mineral and gas phases included in the model are presented in Table 4-2. Supersaturated mineral phases were allowed to precipitate from solution and

sorption to ferrihydrite was also considered using the default values of Dzombak and Morel (1990). Sorption to ferrihydrite will limit parameters that form oxyanions (e.g., arsenic) and other ligands from remaining in solution.

Table 4-2. Model Equilibrium Phases

Mineral	Empirical Formula	Mineral	Empirical Formula	Mineral	Empirical Formula
Carbon Dioxide	CO_2 (g)	Chalcanthite	$CuSO_4 \cdot 5H_2O$	Calcium Molybdenum Oxide	$CaMoO_4$
Gibbsite	$Al(OH)_3$	Ferrihydrite	$Fe(OH)_3$	Nickel Hydroxide	$Ni(OH)_2$
Otavite	$CdCO_3$	Melanterite	$FeSO_4 \cdot 7H_2O$	Zinc Hydroxide	$Zn(OH)_2$
Brochantite	$Cu_4SO_4(OH)_6$	Anglesite	$PbSO_4$	Smithsonite	$ZnCO_3$
Copper Hydroxide	$Cu(OH)_2$	Birnessite	$MnO_2 \cdot nH_2O$	Goslarite	$ZnSO_4 \cdot 7H_2O$
Malachite	$Cu_2(CO_3)(OH)_2$	Manganite	MnO(OH)	Gypsum	$CaSO_4 \cdot 2H_2O$
Azurite	$Cu_3(CO_3)_2(OH)_2$	Lead Molybdenum Oxide	$PbMoO_4$		

4.2.2 High Case Source Term

To account for variability in the source term inputs, a high case source term was developed. The high case source term was estimated by increasing sulfate concentrations to concentrations that are in equilibrium with gypsum (i.e., sulfate concentrations are assumed to be saturated in solution) under the assumed pH and redox conditions. Equilibrium with gypsum was achieved by incrementally adding anhydrite ($CaSO_4$) to the predicted base case solution (Section 4.2.1) until sulfate concentrations reached steady state. Concentrations of other elements were scaled up in the high source term by preserving the metal sulphate ratios (M/SO_4) in the base case source term. A key assumption in this approach is that elements in the solution are chalcophile which could result in an overprediction of non-chalcophile elements. Mineral saturation was evaluated by equilibrating the high case unsaturated mine rock water quality with the same mineral phases (Table 4-2) as the base case solution.

4.3 Saturated Mine Rock

4.3.1 PAG Rock Flushing Source Term

PAG rock produced during mining of the Tenas deposit will be permanently stored in saturated conditions in the management ponds. Placement of PAG rock in the management ponds will result in flushing of oxidation products accumulating on the surfaces of the PAG following exposure during mining. A unit annual flushing rate, in kilograms per tonne of rock (kg/tonne), was estimated by proportioning scaled barrel solute release rates (Section 4.1) in the relative proportion of each zone to be mined in each year (Table 4-3). The same grain size factor used to estimate loadings from unsaturated waste rock (Section 4.2.1) was applied to estimate the mass flushed from PAG rock.

A key input to the PAG rock flushing source term is the exposure time prior to placement in the management ponds. TCL proposes to have PAG rock including processed rock placed in the management ponds within an average of six months which was used when developing the PAG rock flushing source term. Like the unsaturated mine rock source term, a high case was also developed where PAG mine rock was assumed to be exposed for 12 months.

Table 4-3. Annual PAG Rock Volumes and Relative Proportions

Year	Mine Rock Volume (bcm)								Mine Rock Proportion						
	Zone 1a	Zone 2	Zone 3	Zone 4 (PAG)	Zone 5	Zone 55	Zone 6	Total	Zone 1A	Zone 2	Zone 3	Zone 4 (PAG)	Zone 5	Zone 55	Zone 6
-0.5	---	---	---	77,481	120,526	129,135	---	327,142	---	---	---	0.24	0.37	0.39	---
0	---	101,036	116,673	276,461	270,055	271,264	178,523	1,214,012	---	0.083	0.096	0.23	0.22	0.22	0.15
1	---	179,056	229,804	620,602	320,738	99,933	99,320	1,549,453	---	0.12	0.15	0.4	0.21	0.064	0.064
2	21,889	285,673	321,699	472,335	345,853	151,588	112,489	1,711,526	0.013	0.17	0.19	0.28	0.2	0.089	0.066
3	27,407	155,626	308,582	663,762	353,038	165,727	94,900	1,769,042	0.015	0.088	0.17	0.38	0.2	0.094	0.054
4	130,618	312,373	397,354	613,605	290,367	160,116	75,573	1,980,006	0.066	0.16	0.2	0.31	0.15	0.081	0.038
5	68,844	381,138	593,269	214,295	250,877	182,880	79,710	1,771,013	0.039	0.22	0.33	0.12	0.14	0.1	0.045
6	52,353	327,938	705,510	---	321,128	178,341	175,380	1,760,650	0.03	0.19	0.4	---	0.18	0.1	0.10
7	18,042	198,457	378,872	---	378,932	89,907	66,893	1,131,103	0.016	0.18	0.33	---	0.34	0.079	0.059
8	37,018	388,733	629,396	---	439,200	71,890	151,249	1,717,486	0.022	0.23	0.37	---	0.26	0.042	0.088
9	55,727	316,821	466,150	---	428,117	74,035	97,842	1,438,692	0.039	0.22	0.32	---	0.3	0.051	0.068
10	98,303	381,613	547,361	238,780	386,869	55,623	148,670	1,857,219	0.053	0.21	0.29	0.13	0.21	0.03	0.08
11	76,587	223,829	298,043	569,289	532,297	16,062	116,153	1,832,260	0.042	0.12	0.16	0.31	0.29	0.0088	0.063
12	308,172	257,049	167,938	---	264,424	29,924	119,692	1,147,199	0.27	0.22	0.15	---	0.23	0.026	0.1
13	146,459	198,589	397,430	---	523,609	---	61,069	1,327,156	0.11	0.15	0.3	---	0.39	---	0.046
14	325,128	307,724	365,342	---	495,915	---	95,471	1,589,580	0.2	0.19	0.23	---	0.31	---	0.06
15	201,789	146,756	226,844	---	481,190	---	102,576	1,159,155	0.17	0.13	0.2	---	0.42	---	0.088
16	377,112	302,140	282,975	---	186,028	36,948	55,034	1,240,237	0.3	0.24	0.23	---	0.15	0.03	0.044
17	162,336	261,355	238,266	419,874	434,193	49,875	136,393	1,702,292	0.095	0.15	0.14	0.25	0.26	0.029	0.08
18	55,193	165,578	202,373	386,347	183,975	143,569	69,979	1,207,014	0.046	0.14	0.17	0.32	0.15	0.12	0.058
19	33,669	271,177	390,325	437,687	185,176	101,005	55,193	1,474,232	0.023	0.18	0.26	0.3	0.13	0.069	0.037
20	---	---	---	495,776	188,053	102,575	135,720	922,124	---	---	---	0.54	0.2	0.11	0.15
Total	2,196,646	5,162,661	7,264,206	5,486,294	7,380,560	2,110,397	2,227,829	31,828,593	0.07	0.16	0.23	0.17	0.23	0.07	0.07

Source: P:\01_SITES\Telkwa Coal\1CT027.007_2021 Geochemistry Support\Task 500 - Source Term Memo\Tenas_source_term_rpt_tables_1ct027.007_MKH_r1.xlsx

4.3.2 Non-PAG Rock Flushing Source Term

As PAG material reaches its designed elevation, non-PAG rock will then be placed in lifts above the saturated PAG. Once this lift is completed, overburden is then placed in a maximum of a 3 metre lift to form dry land reclamation. Surface soils will then be placed in a lift thickness of approximately 30 centimetres. The non-PAG rock will be placed in aqueous conditions and the majority of the overburden will be unsaturated. Oxidation products that have accumulated on the non-PAG mine rock following exposure during mining will be flushed from the surfaces as the rock is placed in the management pond.

TML proposes to use non-PAG rock source from Zone 1 in the management pond cover. A unit flushing rate, in kg/tonne, was estimated by scaling the Zone 1 average barrel release rates results to account for differences between testing and operational field conditions. The same scaling factor used to estimate the PAG rock flushing term was applied (i.e., grain size factor). Flushing rates were estimated for six- and 12-month exposure periods.

4.3.3 Flooded non-PAG Rock Backfill

Approximately 50% of the non-PAG rock in the backfill will become flooded in Post-closure. Mass that accumulates in the backfill will be flushed during flooding. As discussed in Section 4.2.1, unsaturated mine rock is not assumed to have a channelization factor and is assumed to have a high leaching efficiency since there is uncertainty in quantifying the degree of channelization in the barrel tests. This provides a conservative estimate of the drainage quality from unsaturated materials, but no mass accumulation will occur using this approach. Therefore, flushing of submerged mass is not accounted for in the source terms.

The water balance model (SRK 2021) indicates there is no hydraulic connection of water stored in the flooded backfill to the management ponds. However, a small volume of the flooded backfill water will report to the groundwater system. Water balancing modelling indicates that the water losses from the flooded backfill represent less than one percent (i.e., 0.4%) of the total flow to the groundwater system. As noted above, there is a high degree of uncertainty in estimating the residual load that will be flushed from the flooded backfill and since the flow is effectively negligible to other flows, a source term was not developed for the flooded non-PAG rock backfill.

4.4 Wall Rock Runoff

Exposed wall rock surfaces will produce oxidative load that will be flushed by meteoric water. An annual pit wall drainage water quality was estimated using equation 2; however, in this instance $L_{j,annual}$ is the annual load of constituent j released from exposed wall rock surfaces and Q_{annual} is the annual average flow contacting the exposed wall rock. TML proposes to progressively backfill the open pit during operations. This will continually change the areas of rock exposed in the pit walls. To evaluate changes to the wall rock runoff composition, source terms were developed for the following time periods, which correspond to backfilling of different areas and volumes placed in the open pit:

- End of placement of PAG rock in the North Management Pond (NMP)
- End of placement of PAG rock in the East Management Pond (EMP)
- End of the Operation Phase (EOM)

The reactive mass of each stratigraphic zone in the open pit walls was estimated by multiplying the exposed surface area of each of the zones in the open pit walls by an assumed depth of fractured rock for each of the above time periods. Surface areas for each time period are provided in Table 4-4. The fractured rock depth was assumed to be two metres for blasted areas and five centimetres for free dig areas and the floor of the pit. A density of 2.55 g/cc was assumed to estimate the reactive mass exposed in the pit walls.

The average release rates from each barrel were prorated in relative proportions calculated based on the exposed surface areas (Table 4-4) to estimate the unit solute release rates for the backfill. As discussed in Section 4.1, barrels tests are not available for processed rock. The approach described in SRK (2022a) was used to represent loadings from exposed coal seams. This rate was multiplied by the total reactive mass in the open pit walls to estimate the annual load produced. The annual load was scaled to field conditions using the grain size differences. Since HCT release rates were used to represent release rates from exposed coal seams, a temperature factor was applied to coal (SRK 2022a). It was assumed that the entire fractured rock zone in the open pit walls would be flushed, and a channelization factor was not included.

The annual scaled release rate was divided by the annual average volume of water contacting wall rock runoff (SRK 2022) to estimate drainage concentrations using equation 2. The annual volume for each time period is presented in Table 4-5. Mineral solubility was evaluated and phases that were identified to be supersaturated in solution were allowed to precipitate or off-gas (for gas phases). Mineral phases that were considered are provided in Table 4-2. Sorption to ferrihydrite was also included when this mineral phase precipitated.

Like the unsaturated mine rock source term, a high case wall rock source term was estimated by forcing the predicted solutions to gypsum saturation through incremental anhydrite addition in PHREEQC. Element sulfate ratios in the base case source term were assumed when calculating concentrations of other constituents. The scaled-up solution was subsequently equilibrated with the mineral phases presented in Table 4-2 and sorption to ferrihydrite was permitted when this mineral phase precipitated.

During operations it is assumed that the pit backfill will be fully oxygenated. Therefore, the wall rock that is below the backfill will also be reactive. A load from the backfilled pit walls was also estimated using the same assumptions as exposed wall rock. The annual load originating from covered walls at the end of EMP and EOM was added to unsaturated mine rock load (Section 4.2). The load was estimated by prorating the scaled barrel loads (and HCT for exposed coal seams) in proportions calculated based on the backfilled pit wall surface areas (Table 4-6).

Table 4-4. Exposed Open Pit Wall Surface Areas (m^2)

Layer	Type	End of NMP	End of EMP	EOM
Zone 1	Blasted Wall	34,151	92,219	15,722
Zone 1a	Blasted Wall	---	3,711	---
Zone 2	Blasted Wall	6,392	22,123	---
Zone 3	Blasted Wall	5,780	33,356	---
Zone 4	Blasted Wall	10,798	47,774	---
Zone 5	Blasted Wall	8,489	25,854	---
Zone 6	Free Dug Wall	356,326	627,457	---
Overburden	Free Dug Wall	81,128	239,685	27,065
Seam C	Free Dug Wall	554	3,197	---
Seam 1U	Free Dug Wall	841	4,412	---
Zone 55	Free Dug Wall	2,697	11,130	---
Seam 1L	Free Dug Wall	1,200	6,944	---

Note: Areas presented in m^2

Table 4-5. Annual Wall Rock Runoff Volumes

Time Period	Volume (m^3/year)
End of NMP	302,720
End of EMP	514,842
EOM	116,847

Table 4-6. Backfilled Open Pit Wall Surface Areas (m^2)

Layer	Type	End of EMP	EOM
Zone 1	Blasted Wall	---	93,749
Zone 1a	Blasted Wall	---	13,191
Zone 2	Blasted Wall	4	9,111
Zone 3	Blasted Wall	54	8,074
Zone 4	Blasted Wall	967	12,457
Zone 5	Blasted Wall	1,088	4,654
Zone 6	Blasted Wall	---	10,331
Zone 7	Blasted Wall	---	36,728
Zone 6	Free Dug Wall	320,672	1,686,406
Overburden	Free Dug Wall	12,000	164,165
Seam C	Free Dug Wall	93	2,515
Seam 1U	Free Dug Wall	233	1,557
Zone 55	Free Dug Wall	1,041	449
Seam 1L	Free Dug Wall	280	3,201
Seam 1	Free Dug Wall	---	1,426

Note: Areas presented in m^2

5 Source Terms

The following sections present the Tenas Project source terms. The source terms do not represent discharge water quality and how the mine rock flushing source terms influence site drainage water quality cannot be quantified until they are carried forward into the site wide water and load balance. Therefore, limited interpretation of the source terms is included in the following sections. Detailed interpretations of the site wide water and load balance model results using these source terms are included in SRK (2024a).

5.1 Unsaturated Mine Rock & Overburden

5.1.1 Pit Backfill Source Term Water Quality

The base case and high case pit backfill source terms for end of EMP and EOM are provided in Table 5-1. The charge imbalance for the base case and high case solutions were less than 10%. This is considered acceptable for a modelled solution that have average inputs from multiple sampling rounds and charge imbalances were not corrected. The pH of solutions is alkaline (8.2 to 8.5) and all modelled constituent concentrations are higher in the high case in comparison to the base case source terms since gypsum was not predicted to be supersaturated in the base case source term and the scaling method (i.e., preserving element/sulfate ratios; see Section 4.2.2) results in constituent concentrations being higher in the high case solutions. Predicted constituent concentrations are higher at the EOM in comparison to the end of EMP source terms because of increased reactive mass in the pit backfill (Table 4-1).

Table 5-1. Pit Backfill Source Term Water Quality

Parameter	Units	Non-PAG Backfill - End of EMP		Non-PAG Backfill - End of EOM	
		Typical	High	Typical	High
Conventional					
pH	s.u.	8.2	8.4	8.3	8.5
% Error	%	-0.3	-0.3	-0.2	-0.2
Alkalinity	mg $CaCO_3$/L	1904	3398	2953	4468
Major Ions					
Calcium	mg/L	53	95	79	119
Magnesium	mg/L	32	57	48	72
Potassium	mg/L	13	23	20	31
Sodium	mg/L	1614	2881	2505	3790
Chloride	mg/L	24	43	37	56
Sulfate	mg/L	1803	3218	2772	4193
Dissolved Elements					
Aluminum	mg/L	0.0045	0.0072	0.0064	0.0089
Antimony	mg/L	0.0029	0.0052	0.0045	0.0069
Arsenic	mg/L	0.0043	0.0078	0.0067	0.01
Barium	mg/L	0.045	0.08	0.069	0.1
Boron	mg/L	0.45	0.8	0.7	1.1
Cadmium	mg/L	0.000095	0.00017	0.00014	0.00021
Chromium	mg/L	0.0018	0.0033	0.0029	0.0043
Cobalt	mg/L	0.015	0.026	0.02	0.03
Copper	mg/L	0.016	0.029	0.025	0.037
Iron	mg/L	0.00012	0.0001	0.00011	0.0001
Lead	mg/L	0.0048	0.0085	0.0074	0.011
Lithium	mg/L	0.14	0.24	0.21	0.32
Manganese	mg/L	0.11	0.19	0.12	0.18
Mercury	mg/L	0.00001	0.000018	0.000016	0.000023
Phosphorus	mg/L	0.026	0.046	0.04	0.06
Molybdenum	mg/L	0.17	0.3	0.26	0.39
Nickel	mg/L	0.029	0.051	0.04	0.061
Selenium	mg/L	0.089	0.16	0.14	0.21
Silica	mg/L	4.6	8.3	7.1	11
Silver	mg/L	0.000074	0.00013	0.00011	0.00017
Strontium	mg/L	0.83	1.5	1.3	1.9
Tin	mg/L	0.00078	0.0014	0.0012	0.0018
Thallium	mg/L	0.000078	0.00014	0.00012	0.00018
Uranium	mg/L	0.019	0.034	0.029	0.044
Vanadium	mg/L	0.004	0.0072	0.0062	0.0095
Zinc	mg/L	0.032	0.058	0.046	0.07

Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 500 Source Term Updates/01_Source_term_updates/02_Input_files/[TelkwaSourceTerms_Barrel_Loads_Sc2_CAPR002933_mkh_r4.xlsx

5.1.2 Dam/Buttress Source Term Water Quality

The base case and high case dam/buttress source term water quality for end of NMP, end of EMP and end of WMP are provided in Table 5-2. The charge imbalance for the base case and high case solutions were less than 10%. This is considered acceptable for a modelled solution mixing average inputs from multiple HCTs and charge imbalances were not corrected. The pH of solutions is alkaline ranging from 7.6 to 8.3.

The trends in predicted concentrations are like the pit backfill water quality. For example, the modelled constituent concentrations are higher in the high case in comparison to the base case source terms since gypsum was not predicted to be supersaturated in the base case scenario. Constituent concentrations are predicted to increase throughout the LOM because of the reactive mass increasing (Table 4-1).

Table 5-2. Dam/Buttress Source Term Water Quality

Parameter	Units	Dam/Buttress Infiltration - End of NMP		Dam/Buttress Infiltration - End of EMP		Dam/Buttress Infiltration - End of WMP	
		Typical	High	Typical	High	Typical	High
Conventional							
pH	s.u.	7.6	8.2	7.8	8.2	8.0	8.3
% Error	%	-1.5	-1.5	-1.3	-1.4	-1.4	-1.4
Alkalinity	mg $CaCO_3$/L	448	1848	761	2167	1074	2458
Major Ions							
Calcium	mg/L	33	134	50	141	71	163
Magnesium	mg/L	17	69	26	73	37	84
Potassium	mg/L	3.6	15	5.9	17	8.3	19
Sodium	mg/L	334	1380	577	1643	812	1859
Chloride	mg/L	6.5	27	11	31	15	35
Sulfate	mg/L	432	1784	725	2065	1026	2348
Dissolved Elements							
Aluminum	mg/L	0.0017	0.0044	0.0023	0.005	0.0029	0.0055
Antimony	mg/L	0.00064	0.0026	0.0011	0.0031	0.0015	0.0035
Arsenic	mg/L	0.00092	0.0038	0.0015	0.0043	0.0021	0.0049
Barium	mg/L	0.017	0.072	0.028	0.079	0.039	0.09
Boron	mg/L	0.099	0.41	0.17	0.48	0.24	0.55
Cadmium	mg/L	0.000021	0.000089	0.000036	0.0001	0.000051	0.00012
Chromium	mg/L	0.00045	0.0019	0.00076	0.0022	0.0011	0.0025
Cobalt	mg/L	0.0025	0.01	0.0043	0.012	0.0061	0.014
Copper	mg/L	0.01	0.043	0.016	0.046	0.023	0.053
Iron	mg/L	0.00032	0.00012	0.00021	0.00012	0.00017	0.00011
Lead	mg/L	0.001	0.0043	0.0018	0.0051	0.0025	0.0058
Lithium	mg/L	0.028	0.11	0.048	0.14	0.067	0.15
Manganese	mg/L	0.034	0.14	0.052	0.15	0.074	0.17
Mercury	mg/L	0.0000031	0.000013	0.000005	0.000014	0.0000071	0.000016
Phosphorus	mg/L	0.014	0.056	0.021	0.059	0.03	0.069
Molybdenum	mg/L	0.034	0.14	0.058	0.16	0.082	0.19
Nickel	mg/L	0.0055	0.023	0.0093	0.027	0.013	0.03
Selenium	mg/L	0.028	0.12	0.045	0.13	0.065	0.15
Silica	mg/L	2.3	9.6	3.6	10	5.2	12
Silver	mg/L	0.000018	0.000073	0.00003	0.000085	0.000042	0.000096
Strontium	mg/L	0.27	1.1	0.43	1.2	0.61	1.4
Tin	mg/L	0.00019	0.00077	0.00032	0.0009	0.00045	0.001
Thallium	mg/L	0.000018	0.000073	0.00003	0.000085	0.000042	0.000096
Uranium	mg/L	0.0049	0.02	0.0082	0.023	0.012	0.026
Vanadium	mg/L	0.00088	0.0036	0.0015	0.0042	0.0021	0.0048
Zinc	mg/L	0.009	0.037	0.015	0.042	0.021	0.047

Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 500 Source Term Updates/01_Source_term_updates/02_Input_files/[TelkwaSourceTerms_Barrel_Loads_Sc2_CAPR002933_mkh_r4.xlsx

5.2 Saturated Mine Rock

Saturated rock flushing terms are presented in kg/tonne. The influence of flushing of rock as it is placed in the management ponds cannot be quantified until it is carried forward into the water and load balance. Annual PAG rock flushing rates for the six- and 12-month exposure periods are provided in Table 5-3 and Table 5-4, respectively. The non-PAG rock flushing source terms are provided in Table 5-5, respectively.

Table 5-3. PAG Rock Annual Flushing Source Term – Six Month Average Exposure

Parameter	Units	-0.5	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Conventional																							
Alkalinity	kg CaCO3/tonne	0.005	0.005	0.008	0.006	0.008	0.006	0.003	0.001	0.001	0.001	0.001	0.003	0.006	0.001	0.001	0.001	0.001	0.001	0.005	0.007	0.006	0.011
Major Ions																							
Calcium	kg/tonne	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Magnesium	kg/tonne	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0009	0.001	0.00
Potassium	kg/tonne	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Sodium	kg/tonne	0.009	0.0087	0.01	0.009	0.01	0.011	0.008	0.007	0.007	0.007	0.007	0.009	0.011	0.015	0.01	0.013	0.012	0.015	0.0116	0.01082	0.01	0.012
Chloride	kg/tonne	0.00012	0.00012	0.00014	0.00013	0.00014	0.00014	0.00011	0.0001	0.0001	0.0001	0.0001	0.00012	0.00014	0.00014	0.00011	0.00013	0.00012	0.00014	0.00014	0.00014	0.00013	0.00016
Sulfate	kg/tonne	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.03	0.03	0.03	0.04	0.02	0.021	0.02	0.02
Elements																							
Aluminum	kg/tonne	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.00000	0.00000	0.0000	0.00000	0.00000	0.00000	0.000001	0.00000	0.00000	0.00000	0.0000001	0.00000	0.0000008	0.000001	0.000001	0.000002
Antimony	kg/tonne	9.9E-09	0.00000001	1.3E-08	1.1E-08	1.3E-08	1.2E-08	0.00000001	0.0000000	0.0000000	3.7E-09	4.1E-09	7.4E-09	1.2E-08	7.6E-09	5.3E-09	6.7E-09	6.3E-09	8.1E-09	1.1E-08	0.00000001	1.1E-08	1.7E-08
Arsenic	kg/tonne	1.0E-08	0.00000001	0.00000001	1.1E-08	1.3E-08	1.2E-08	0.00000001	0.0000000	0.0000000	3.9E-09	4.2E-09	7.5E-09	1.2E-08	7.7E-09	5.4E-09	6.8E-09	6.5E-09	8.2E-09	1.1E-08	1.2E-08	0.00000001	0.00000002
Barium	kg/tonne	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.000000	0.00000	0.00000	0.0000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.0000001	0.00000	0.0000001	0.00000
Boron	kg/tonne	0.000002	0.000001	0.000002	0.000002	0.000002	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000002	0.000002	0.000002	0.000003
Cadmium	kg/tonne	4.3E-10	8.9E-10	7.0E-10	0.0000000	0.0000000	6.2E-10	5.3E-10	0.0000000	5.0E-10	5.9E-10	0.0000000	6.5E-10	0.0000000	0.0000000	0.0000000	6.3E-10	0.0000000	0.0000000	7.4E-10	6.7E-10	5.8E-10	0.0000000
Chromium	kg/tonne	8.8E-09	8.5E-09	1.1E-08	9.2E-09	1.0E-08	0.00000001	0.00000001	0.00000001	0.00000001	5.9E-09	6.2E-09	8.0E-09	1.0E-08	9.8E-09	7.4E-09	8.8E-09	8.4E-09	1.0E-08	1.0E-08	1.0E-08	9.6E-09	1.2E-08
Cobalt	kg/tonne	0.00000	0.0000005	0.00000	0.00000	0.00000	0.00000	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.00000	0.000001	0.000001	0.000001	0.000001	0.00000	0.0000005	0.0000004	0.00000	0.00000
Copper	kg/tonne	0.00000003	0.00000002	0.00000004	0.00000003	0.00000004	0.00000003	0.00000002	0.00000001	0.00000001	0.00000001	0.00000001	0.00000002	0.00000003	0.00000002	0.00000001	0.00000001	0.00000001	0.00000002	2.9E-08	0.00000003	0.00000003	0.00000005
Iron	kg/tonne	0.000001	0.000001	0.000002	0.000002	0.000002	0.000002	0.000001	0.00000	0.00000	0.00000	0.00000	0.000001	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000002	0.0000019	0.000002	0.000003
Lead	kg/tonne	1.3E-08	1.3E-08	2.1E-08	1.5E-08	2.0E-08	1.7E-08	8.0E-09	2.1E-09	2.1E-09	2.1E-09	2.2E-09	8.4E-09	1.7E-08	4.0E-09	2.8E-09	3.5E-09	3.3E-09	4.3E-09	1.4E-08	1.8E-08	1.6E-08	2.8E-08
Lithium	kg/tonne	0.0000011	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.0000011	0.000001	0.000001	0.000001
Manganese	kg/tonne	0.0000	0.00001	0.000	0.000	0.000	0.000	0.000	0.000	0.00001	0.000	0.000	0.00001	0.000	0.000	0.000	0.00001	0.000	0.000	0.00001	0.00000518	0.000	0.000
Mercury	kg/tonne	4.2E-11	3.8E-11	4.5E-11	3.9E-11	4.4E-11	4.0E-11	3.0E-11	2.4E-11	2.5E-11	2.4E-11	2.5E-11	3.0E-11	4.1E-11	2.6E-11	2.6E-11	2.6E-11	2.7E-11	2.5E-11	3.8E-11	4.1E-11	3.8E-11	5.3E-11
Phosphorus	kg/tonne	0.000000	0.000000	0.0000001	0.000000	0.0000001	0.0000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0000001	0.0000001	0.000000	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001
Molybdenum	kg/tonne	0.00000043	0.0000004	0.00000067	0.00000047	0.00000063	0.00000055	0.00000023	0.00000004	0.00000004	0.00000003	0.00000004	0.00000025	0.00000054	0.00000013	0.00000007	0.00000011	9.9E-08	1.4E-07	4.6E-07	0.0000006	0.00000051	0.00000089
Nickel	kg/tonne	0.00000	0.000001	0.000001	0.0000	0.0000	0.0000	0.0000	0.0000	0.000001	0.0000	0.0000	0.000001	0.0000	0.0000	0.0000	0.000001	0.0000	0.0000	0.000001	0.00000054	0.000001	0.0000
Selenium	kg/tonne	0.00000046	0.0000004	0.00000044	0.00000043	0.00000049	0.00000066	0.00000044	0.00000035	0.00000032	0.00000032	0.00000041	0.00000051	0.00000057	0.00000138	0.00000073	0.00000112	0.00000101	0.00000151	0.00000077	0.0000006	0.00000046	0.00000053
Silica	kg/tonne	0.00001	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002
Silver	kg/tonne	4.9E-10	4.4E-10	5.0E-10	4.7E-10	5.1E-10	5.6E-10	4.4E-10	3.8E-10	3.8E-10	3.7E-10	4.0E-10	4.7E-10	5.3E-10	7.6E-10	5.2E-10	6.6E-10	6.3E-10	8.1E-10	5.9E-10	5.4E-10	4.8E-10	5.6E-10
Strontium	kg/tonne	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001	0.00001	0.00001
Tin	kg/tonne	0.0000000	0.0000000	0.00000001	0.0000000	0.00000001	0.00000001	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.0000000	0.00000001
Thallium	kg/tonne	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Uranium	kg/tonne	0.00000006	0.00000005	0.00000008	6.5E-08	8.3E-08	0.00000008	0.00000004	0.00000002	0.00000002	0.00000002	0.00000002	4.8E-08	7.7E-08	7.1E-08	4.0E-08	5.9E-08	5.3E-08	7.9E-08	7.7E-08	0.00000008	7.0E-08	0.00000011
Vanadium	kg/tonne	0.00000002	0.00000002	0.00000002	0.00000002	0.00000003	0.00000003	0.00000002	0.00000002	0.00000002	0.00000002	0.00000002	0.00000002	0.00000003	0.00000004	0.00000003	0.00000003	0.00000003	0.00000004	2.9E-08	0.00000003	2.4E-08	0.00000003
Zinc	kg/tonne	0.00000	0.0000007	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.0000006	0.000001	0.000001

Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 500 Source Term Updates/01_Source_term_updates/02_Input_files/[TelkwaSourceTerms_Barrel_Loads_Sc2_CAPR002933_mkh_r4.xlsx

Table 5-4. PAG Rock Annual Flushing Source Term – 12 Month Average Exposure

Parameter	Units	-0.5	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Conventional																							
Alkalinity	kg $CaCO_3$/tonne	0.011	0.01	0.016	0.012	0.015	0.013	0.006	0.001	0.001	0.001	0.001	0.006	0.013	0.002	0.002	0.002	0.002	0.002	0.011	0.013	0.012	0.021
Major Ions																							
Calcium	kg/tonne	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Magnesium	kg/tonne	0.001	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.003	0.003	0.003	0.002	0.003	0.002	0.0018	0.002	0.001
Potassium	kg/tonne	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Sodium	kg/tonne	0.019	0.0174	0.02	0.019	0.021	0.023	0.017	0.014	0.013	0.013	0.015	0.018	0.021	0.029	0.019	0.025	0.024	0.031	0.0233	0.02164	0.019	0.024
Chloride	kg/tonne	0.00024	0.00024	0.00029	0.00026	0.00029	0.00029	0.00023	0.0002	0.00019	0.00019	0.0002	0.00024	0.00028	0.00027	0.00022	0.00025	0.00024	0.00028	0.00028	0.00028	0.00027	0.00032
Sulfate	kg/tonne	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.07	0.05	0.06	0.06	0.07	0.05	0.042	0.04	0.04
Elements																							
Aluminum	kg/tonne	0.000002	0.000002	0.000003	0.000002	0.000002	0.000002	0.000001	0.00000	0.0000	0.00000	0.00000	0.000001	0.000002	0.00000	0.00000	0.00000	0.0000001	0.00000	0.0000017	0.000002	0.000002	0.000004
Antimony	kg/tonne	2.0E-08	0.00000002	2.7E-08	2.1E-08	2.6E-08	2.4E-08	0.00000001	0.00000001	0.00000001	7.5E-09	8.1E-09	1.5E-08	2.4E-08	1.5E-08	1.1E-08	1.3E-08	1.3E-08	1.6E-08	2.2E-08	0.00000002	2.2E-08	3.4E-08
Arsenic	kg/tonne	2.0E-08	0.00000002	0.00000003	2.1E-08	2.6E-08	2.4E-08	0.00000001	0.00000001	0.00000001	7.7E-09	8.4E-09	1.5E-08	2.4E-08	1.5E-08	1.1E-08	1.4E-08	1.3E-08	1.6E-08	2.2E-08	2.4E-08	0.00000002	0.00000003
Barium	kg/tonne	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000001	0.00000	0.00000	0.0000003	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000002	0.00000	0.0000002	0.00000
Boron	kg/tonne	0.000003	0.000003	0.000004	0.000003	0.000004	0.000004	0.000002	0.000001	0.000001	0.000001	0.000001	0.000002	0.000004	0.000002	0.000002	0.000002	0.000002	0.000002	0.000003	0.000004	0.000003	0.000005
Cadmium	kg/tonne	8.7E-10	1.8E-09	1.4E-09	0.0000000	0.0000000	1.2E-09	1.1E-09	0.0000000	1.0E-09	1.2E-09	0.0000000	1.3E-09	0.0000000	0.0000000	0.0000000	1.3E-09	0.0000000	0.0000000	1.5E-09	1.3E-09	1.2E-09	0.0000000
Chromium	kg/tonne	1.8E-08	1.7E-08	2.1E-08	1.8E-08	2.1E-08	0.00000002	0.00000002	0.00000001	0.00000001	1.2E-08	1.2E-08	1.6E-08	2.0E-08	2.0E-08	1.5E-08	1.8E-08	1.7E-08	2.1E-08	2.0E-08	2.1E-08	1.9E-08	2.5E-08
Cobalt	kg/tonne	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.0000009	0.0000009	0.000001	0.000001
Copper	kg/tonne	0.00000005	0.00000005	0.00000007	0.00000006	0.00000007	0.00000006	0.00000004	0.00000002	0.00000002	0.00000002	0.00000002	0.00000004	0.00000006	0.00000003	0.00000002	0.00000003	0.00000003	0.00000003	5.7E-08	0.00000006	0.00000006	0.00000009
Iron	kg/tonne	0.000003	0.000003	0.000004	0.000003	0.000004	0.000004	0.000002	0.000001	0.000001	0.000001	0.000001	0.000002	0.000004	0.000002	0.000001	0.000001	0.000001	0.000002	0.000003	0.0000037	0.000003	0.000006
Lead	kg/tonne	2.7E-08	2.6E-08	4.2E-08	3.0E-08	4.0E-08	3.4E-08	1.6E-08	4.2E-09	4.1E-09	4.1E-09	4.4E-09	1.7E-08	3.4E-08	8.1E-09	5.6E-09	7.1E-09	6.7E-09	8.6E-09	2.9E-08	3.5E-08	3.2E-08	5.5E-08
Lithium	kg/tonne	0.0000022	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.0000023	0.000002	0.000002	0.000002
Manganese	kg/tonne	0.00001	0.00001	0.000	0.000	0.000	0.000	0.000	0.000	0.00001	0.000	0.000	0.00001	0.000	0.000	0.000	0.00001	0.000	0.000	0.00001	0.00001037	0.000	0.000
Mercury	kg/tonne	8.4E-11	7.7E-11	9.0E-11	7.7E-11	8.8E-11	8.0E-11	6.0E-11	4.8E-11	5.0E-11	4.8E-11	4.9E-11	6.1E-11	8.2E-11	5.3E-11	5.2E-11	5.2E-11	5.4E-11	5.1E-11	7.6E-11	8.2E-11	7.7E-11	1.1E-10
Phosphorus	kg/tonne	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000002	0.0000001	0.0000001	0.0000001	0.0000002	0.0000001	0.0000001	0.0000001	0.0000001
Molybdenum	kg/tonne	0.00000086	0.0000008	0.00000134	0.00000095	0.00000127	0.00000109	0.00000047	0.00000007	0.00000008	0.00000007	0.00000009	0.0000005	0.00000108	0.00000026	0.00000015	0.00000021	2.0E-07	2.8E-07	9.2E-07	0.0000011	0.00000101	0.00000178
Nickel	kg/tonne	0.000001	0.000001	0.000001	0.0000	0.0000	0.0000	0.0000	0.0000	0.000001	0.0000	0.0000	0.000001	0.0000	0.0000	0.0000	0.000001	0.0000	0.0000	0.000001	0.00000109	0.000001	0.0000
Selenium	kg/tonne	0.00000092	0.0000008	0.00000087	0.00000086	0.00000099	0.00000132	0.00000089	0.00000071	0.00000064	0.00000064	0.00000081	0.00000102	0.00000115	0.00000277	0.00000145	0.00000223	0.00000202	0.00000303	0.00000154	0.0000012	0.00000091	0.00000106
Silica	kg/tonne	0.00002	0.00002	0.00003	0.00002	0.00003	0.00003	0.00002	0.00001	0.00001	0.00001	0.00001	0.00002	0.00003	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00003	0.00003	0.00004
Silver	kg/tonne	9.7E-10	8.9E-10	9.9E-10	9.4E-10	1.0E-09	1.1E-09	8.9E-10	7.7E-10	7.5E-10	7.4E-10	8.1E-10	9.3E-10	1.1E-09	1.5E-09	1.0E-09	1.3E-09	1.3E-09	1.6E-09	1.2E-09	1.1E-09	9.7E-10	1.1E-09
Strontium	kg/tonne	0.00003	0.00003	0.00002	0.00002	0.00002	0.00002	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00002	0.00004	0.00003	0.00004	0.00004	0.00004	0.00003	0.00002	0.00002	0.00002
Tin	kg/tonne	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000002	0.00000001	0.00000001	0.00000001	0.00000002	0.00000001	0.00000001	0.00000001	0.00000001
Thallium	kg/tonne	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Uranium	kg/tonne	0.00000012	0.00000011	0.00000017	1.3E-07	1.7E-07	0.00000016	0.00000009	0.00000004	0.00000004	0.00000004	0.00000005	9.6E-08	1.5E-07	1.4E-07	7.9E-08	1.2E-07	1.1E-07	1.6E-07	1.5E-07	0.00000016	1.4E-07	0.00000021
Vanadium	kg/tonne	0.00000005	0.00000004	0.00000005	0.00000005	0.00000005	0.00000006	0.00000004	0.00000004	0.00000004	0.00000004	0.00000004	0.00000005	0.00000005	0.00000008	0.00000005	0.00000007	0.00000006	0.00000008	5.9E-08	0.00000005	4.8E-08	0.00000006
Zinc	kg/tonne	0.000001	0.0000014	0.000001	0.000001	0.000001	0.000001	0.000001	0.000002	0.000001	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.0000011	0.000001	0.000001

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Table 5-5. Non-PAG Rock Flushing Source Term

Parameter	Units	Six Month Exposure	Twelve Month Exposure
Conventional			
Alkalinity	kg $CaCO_3$/tonne	0.019	0.0381
Major Ions			
Calcium	kg/tonne	0.00	0.00
Magnesium	kg/tonne	0.0001	0.00
Potassium	kg/tonne	0.00012	0.00024
Sodium	kg/tonne	0.01607	0.03214
Chloride	kg/tonne	0.00022	0.00044
Sulfate	kg/tonne	0.016	0.03
Elements			
Aluminum	kg/tonne	0.0000032	0.000006
Antimony	kg/tonne	2.8E-08	5.6E-08
Arsenic	kg/tonne	2.8E-08	5.6E-08
Barium	kg/tonne	0.0000003	0.000001
Boron	kg/tonne	0.0000044	0.000009
Cadmium	kg/tonne	7.9E-10	1.6E-09
Chromium	kg/tonne	1.8E-08	3.6E-08
Cobalt	kg/tonne	0.00000011	0.00000022
Copper	kg/tonne	7.8E-08	0.00000016
Iron	kg/tonne	0.0000048	0.00001
Lead	kg/tonne	4.9E-08	9.9E-08
Lithium	kg/tonne	0.0000013	0.0000026
Manganese	kg/tonne	0.00000	0.000001
Mercury	kg/tonne	7.3E-11	1.5E-10
Phosphorus	kg/tonne	0.00000011	0.0000002
Molybdenum	kg/tonne	1.6E-06	0.00000324
Nickel	kg/tonne	0.00000024	0.0000005
Selenium	kg/tonne	0.00000069	0.0000014
Silica	kg/tonne	0.000029	0.00006
Silver	kg/tonne	7.1E-10	1.4E-09
Strontium	kg/tonne	0.000006	0.00001
Tin	kg/tonne	0.00000001	0.00000001
Thallium	kg/tonne	0.0000000	0.0000000
Uranium	kg/tonne	1.8E-07	3.7E-07
Vanadium	kg/tonne	3.6E-08	7.1E-08
Zinc	kg/tonne	0.00000024	0.0000005

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5.3 Open Pit Wall Rock Runoff

The base case and high case open pit wall rock runoff source terms for the End of NMP, End of EMP and EOM are provided in Table 5-6. The charge balance in of the wall rock source terms is less than 10%, which is considered reasonable for solutions based on averaging several release rates in the field barrel tests. The pH of solutions was alkaline (7.4 to 8.1) and maximum pit wall runoff concentrations occurred at the end of the EMP since this timeframe represents the maximum exposure of pit wall and has the highest reactive mass (Table 4-6).

Most of the constituents were higher in the high case source term in comparison to the base case. Concentrations of iron were lower in the high case source terms. Iron concentrations are low in both scenarios since it is solubility constrained through ferrihydrite ($Fe(OH)_3$) precipitation. Lower iron concentrations occur in the high case source term since these solutions are more alkaline reducing the ferrihydrite solubility (i.e., more ferrihydrite is predicted to precipitate in the high case scenario).

Table 5-6. Open Pit Wall Rock Runoff Source Terms

Parameter	Units	Open Pit Wall Runoff - End of NMP		Open Pit Wall Runoff - End of EMP		Open Pit Wall Runoff - EOM	
		Typical	High	Typical	High	Typical	High
Conventional							
pH	s.u.	7.4	7.8	7.6	7.8	7.4	8.1
% Error	%	-0.3	-0.3	0.5	0.5	-0.3	-0.3
Alkalinity	mg $CaCO_3$/L	24	837	40	718	27	1662
Major Ions							
Calcium	mg/L	2	58	4	65	0	15
Magnesium	mg/L	2	53	3	61	0	13
Potassium	mg/L	0	7	0	7	0	11
Sodium	mg/L	26.3	906.0	47	856	23	1404
Chloride	mg/L	0.4	12.7	0.7	11.8	0.3	19.2
Sulfate	mg/L	42	1442	81	1469	23	1432
Dissolved Elements							
Aluminum	mg/L	0.0013	0.0024	0.0016	0.0022	0.0014	0.0041
Antimony	mg/L	0.00004	0.00136	0.00007	0.00122	0.00004	0.00246
Arsenic	mg/L	0.00005	0.00167	0.0001	0.002	0.00	0.002
Barium	mg/L	0.0006	0.0193	0.0011	0.0198	0.0005	0.03
Boron	mg/L	0.01	0.21	0.01	0.19	0.01	0.39
Cadmium	mg/L	0.0000	0.00013	0.00001	0.00015	0.0000	0.00007
Chromium	mg/L	0.00003	0.00097	0.00005	0.00089	0.00003	0.00156
Cobalt	mg/L	0.001	0.034	0.0017	0.0306	0.0002	0.0098
Copper	mg/L	0.0001	0.0038	0.0002	0.0035	0.0001	0.0068
Iron	mg/L	0.00047	0.00021	0.00031	0.00024	0.00042	0.00013
Lead	mg/L	0.00006	0.00219	0.0001	0.0019	0.00007	0.00432
Lithium	mg/L	0.003	0.09	0.005	0.09	0.0019	0.12
Manganese	mg/L	0.01	0.43	0.022	0.4	0.0005	0.03
Mercury	mg/L	0.00000	0.000005	0.00000	0.000006	0.00000	0.000006
Phosphorus	mg/L	0.0002	0.007	0.0004	0.0074	0.0002	0.0096
Molybdenum	mg/L	0.0021	0.0725	0.0035	0.0636	0.0023	0.1413
Nickel	mg/L	0.001	0.047	0.0023	0.041	0.0003	0.021
Selenium	mg/L	0.001	0.04	0.002	0.042	0.001	0.06
Silica	mg/L	0.05	1.6	0.1	1.5	0.04	2.5
Silver	mg/L	0.0000012	0.0000425	0.0000023	0.0000411	0.000001	0.000062
Strontium	mg/L	0.02	0.79	0.05	0.82	0.01	0.52
Tin	mg/L	0.00002	0.00062	0.00004	0.00074	0.00001	0.00065
Thallium	mg/L	0.000003	0.000108	0.000008	0.000152	0.000001	0.000062
Uranium	mg/L	0.00024	0.00829	0.0004	0.0075	0.0003	0.0161
Vanadium	mg/L	0.0001	0.0022	0.0001	0.0022	0.0001	0.0031
Zinc	mg/L	0.001	0.049	0.0025	0.0448	0.0003	0.0211

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6 Summary

SRK (2022a) developed geochemical source terms by scaling HCT testing results to field conditions. A comparison to the scaled HCT and barrel testing results indicated that the release rates of some constituents are higher in the barrels in comparison to the HCT. The geochemical source terms were updated using the barrel release rates. The barrel release rates are considered more appropriate for estimating site drainage water quality because they are more representative of solute release rates under field conditions.

Barrels were constructed using mine rock sample rejects and overburden. Insufficient processed rock (e.g., coal, coarse rejects, etc.) sample precluded barrels being constructed for these materials. Base The following source terms were updated using the barrel testing results:

- Unsaturated non-PAG & overburden
  - Pits backfill
  - Dams/buttresses
- Saturated non-PAG rock
- Saturated PAG rock
- Open pit wall rock runoff

The following source terms were not updated and the SRK (2022a) source terms remain current:

- Processed rock
- Processed coal stockpile runoff
- Particulate concentrations

The above source terms will be carried forward into the site wide water and load balance to evaluate the mixed project discharge water quality. To evaluate uncertainty in the model, both the base case and high case scenarios should be evaluated.

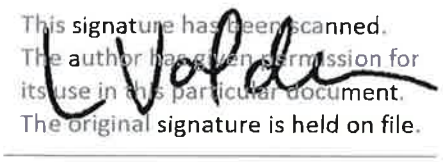
Closure

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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Tenas Project - Suboxic Evaluation of Non-Acid Generating Mine Rock

August 2, 2024



TELKWA MINING LIMITED

okane

Integrated Mine Closure and Relinquishment Solutions

Tenas Project - Suboxic Evaluation of Non-Acid Generating Mine Rock

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August 2024

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EXECUTIVE SUMMARY

Okane Consultants (Okane) are providing support to evaluate the development of suboxic conditions for the backfill of non-potentially acid generation (NAG) mine rock into the Open Pit for Telkwa Mining Limited (Telkwa) at their proposed Tenas Project in northwest British Columbia. The current scope focuses on placement of NAG mine rock. The objective of the scope was to develop geochemical source terms for the backfilled mine rock that reflect the construction and reclamation schedule, and the resulting hydrological and oxygen conditions of the backfill.

The source terms were developed using a two-dimensional oxygen model to evaluate the size, location, and timing of suboxic (low oxygen concentration) conditions within the NAG backfill. The formation of suboxic conditions limits oxidation rates of sulfide minerals and decreases the loads of constituents of interest released from sulfide oxidation to the receiving environment. The source terms will be used as inputs for the site-wide water quality model that integrates seepage and chemical loads from all mine domains to understand the overarching water quality effects of the Project on the receiving environment. All years presented herein refer to mine plan years.

Three scenarios were chosen to evaluate the development of suboxic conditions. The three scenarios were:

- Scenario #1: Poorly graded till and sandstone mine rock;
- Scenario #2: Well graded till and mine rock mix (60% siltstone, 35% mudstone, and 5% sandstone);
- Scenario #3: Well graded till and mine rock mix (60% siltstone, 35% mudstone, and 5% sandstone) with no internal cover layers.

During the covered time period for all modelled scenarios, two sequential cover surface conditions (grass cover followed by the establishment of mature forest) were used to simulate the maturing of vegetation on the cover system. These surface conditions affected how oxygen and water move into the cover material and underlying NAG backfill. For a five-year period directly after cover placement the simulation used a grass surface; following this five-year period, a forest surface was used for the remainder of the model timeframe.

GoldSim seepage modelling for the NAG backfill demonstrated a significant reduction in stabilized seepage rates between the modelled scenarios. Stabilized seepage rates for Scenarios #2 and #3 were approximately half of the stabilized rates for Scenario #1. The modelling also demonstrated that the NAG backfill will be wetted up after approximately 40 years in Scenario #1 and approximately 80 years in Scenarios #2 and #3 due to differences in material texture in the cover system. Modelling demonstrated that suboxic conditions within Scenario #1 took approximately 15 years to develop and approximately 13 years in Scenarios #2 and #3 once the cover system was placed. Depths to suboxic conditions varied between the scenarios due to differences in oxygen ingress and net percolation. Scenario #1 had a

long-term depth to suboxia of approximately 15 m while Scenarios #2 and #3 had a long-term depth to suboxia of approximately 3 m.

Estimated stored water volumes increase as mine rock is placed during construction and stabilize after approximately 15 years when construction has ended. Similar to seepage results, the stored water volumes stabilize after approximately 40 years for Scenario #1 and 70-80 years for Scenarios #2 and #3. Stored water volumes in the NAG backfill are predicted to be lower in Scenarios #2 and #3 relative to Scenario #1.

Source terms were developed for Scenarios #1, #2, and #3 using a reactive transport modelling approach. Reactive transport modelling was used to simulate the weathering of sulfide and carbonate minerals and resulting concentrations of related dissolved constituents using mechanistic kinetic weathering rates controlled by the geochemical setting of the NAG backfill. For constituents not directly controlled by sulfide oxidation and carbonate dissolution, a constant loading rate scale-up model was used to develop source terms. The geochemical models were calibrated to on-site kinetic barrel tests containing NAG mine rock and subsequently applied to the full-scale NAG backfill geometry.

The geochemical model incorporated changing cover system surface conditions by changing net percolation into the model for each time period (bare mine rock, grass coverage, and forest coverage). The effects of suboxic zones were simulated by limiting pyrite oxidation to depths where oxygen models simulated oxic conditions.

In general, concentrations for modelled parameters were similar between all scenarios. Although it was evident that less pyrite oxidation was occurring in the Scenario #2 and #3 models due to the larger suboxic zones, which resulted in lower mass release of oxidation products, decreased infiltrating water volumes (i.e., less dilution) in these scenarios resulted in similar concentrations as seen in Scenario #1. The primary benefit of the well-graded cover system scenarios is the overall decrease of released load of oxidation products (e.g., selenium and sulfate) from the NAG backfill. Scenarios #2 and #3 consistently had lower chemical loading relative to Scenario #1 resulting in approximately half the mass of oxidation products released from the NAG backfill on an annual basis. Scenarios #2 and #3 had similar chemical loading due to similar lag-times to suboxic zone development and depth to suboxic conditions. Additionally, geochemical source terms of the NAG backfill from the current model were comparable, although generally slightly lower, than source terms initially developed for the backfill (SRK, 2022a). The NAG backfill source terms from this modelling work will be integrated into the site wide load balance model to quantify the effects of the backfill on water quality around the Tenas project.

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1 INTRODUCTION

1.1 Project Description

Telkwa Mining Limited (Telkwa) are proposing to develop the Tenas Project (Project), located approximately 25 km southwest of the town of Smithers in northwest British Columbia (BC) within the Telkwa and Bulkley River watersheds. The Project consists of an open pit, backfill, external stockpiles, water management ponds, control ponds, coal processing plant, and rail infrastructure. Elevation of the Project ranges from 750 to 1,050 meters above sea level (masl), with a median elevation of 800 masl. The Project is within the Ministry of Environment and Climate Change Strategy (MECCS) Zone 8 – Nechako Plateau, close to the border with Zone 9 – Southern Hazelton Mountains (Ahmed and Jackson, 2013). The MECCS hydrological zones are areas of homogeneous hydrologic and geomorphic characteristics.

1.2 Project Objectives and Scope

Okane Consultants (Okane) is providing support to develop source terms for three scenarios of backfill NAG mine rock in lifts using bottom-up construction methodology with overburden covers within the Open Pit provided by Telkwa. The objective of the backfilled design is to limit oxygen and water ingress to minimize the release of potential contaminants of concern such as selenium and sulfate to the receiving environment.

A geochemical model that incorporated both a mechanistic reactive transport model and geochemical scale-up model was developed to simulate long-term water quality of mine rock backfilled into the Open Pit. Seepage water quality results from the geochemical model were developed as source terms to be used in the Tenas site-wide water quality model developed by SRK Consulting (SRK).

1.3 Report Organization

For convenient reference, this report has been subdivided into the following sections:

- Section 2 – Provides pertinent background information for this study;
- Section 3 – Description of modelling processes;
- Section 4 – Modelling results and discussion; and
- Section 5 – Conclusions of the modelling work.

2 BACKGROUND

Source control of contaminants of interest (COIs) is a cutting-edge practice. It demonstrates a significant commitment to minimizing water quality impacts in the region to both regulators and stakeholders. Okane has extensive experience in implementing closure strategies to mine storage facilities, ultimately limiting oxygen ingress and net percolation into the underlying waste material. This working experience has led to development of fully integrated models that link hydrology, oxygen conditions, material properties, mine rock structure and climate to develop source terms for site-wide water quality models.

Okane's experience has shown that there are solutions available to improve source control and water quality, therefore, providing the opportunity to relinquish the site at the end of the mine life versus treating water from the mine rock into perpetuity. Such solutions can include progressive reclamation and the application of oxygen-limiting cover systems which can lead to the development of suboxia within the NAG mine rock storage facilities (MRSFs) to help improve long-term seepage quality by inhibiting the oxidation of sulfide minerals within the SOZ, decreasing the release and production of metal leaching in the lower zones of the MRSF.

Currently for the Project, suboxia is defined as pore gas oxygen concentrations less than 1 vol.%, which results in a dissolved oxygen concentration in pore water of less than 1 mg/L. The NAG mine rock is a large porous mass, which during placement will have oxygen concentration in pore spaces reflecting ambient conditions, or near to ambient conditions. Oxygen within NAG mine rock pore spaces will be depleted because of sulfide (pyrite) oxidation.

2.1 Net Percolation and Oxygen Ingress Classifications

The term 'net percolation' (NP) is used throughout this memo and is defined as presented in Figure 2.1. Precipitation (PPT) that reaches the cover system surface will either be intercepted by vegetation, run off (RO), or infiltrate into the cover system. A portion of the water that infiltrates will be stored in an active zone (ΔS) where water is actively cycled within the soil profile and into the atmosphere. Water stored in the active zone can be evaporated (AE) into the overlying atmosphere or can be removed by plant transpiration (AT); the combination of evaporation and transpiration is referred to as actual evapotranspiration (AET). Water in the cover system can also potentially move laterally as interflow. Water that moves below the active zone and is no longer available to be removed from the system via AET or laterally is defined as NP. NP is infiltrating water expressed as a percentage of average annual precipitation (PPT) that will migrate beyond the active zone because of gravity overcoming the influence of evapotranspiration, resulting in flow of water into the underlying NAG mine rock and overburden cover.

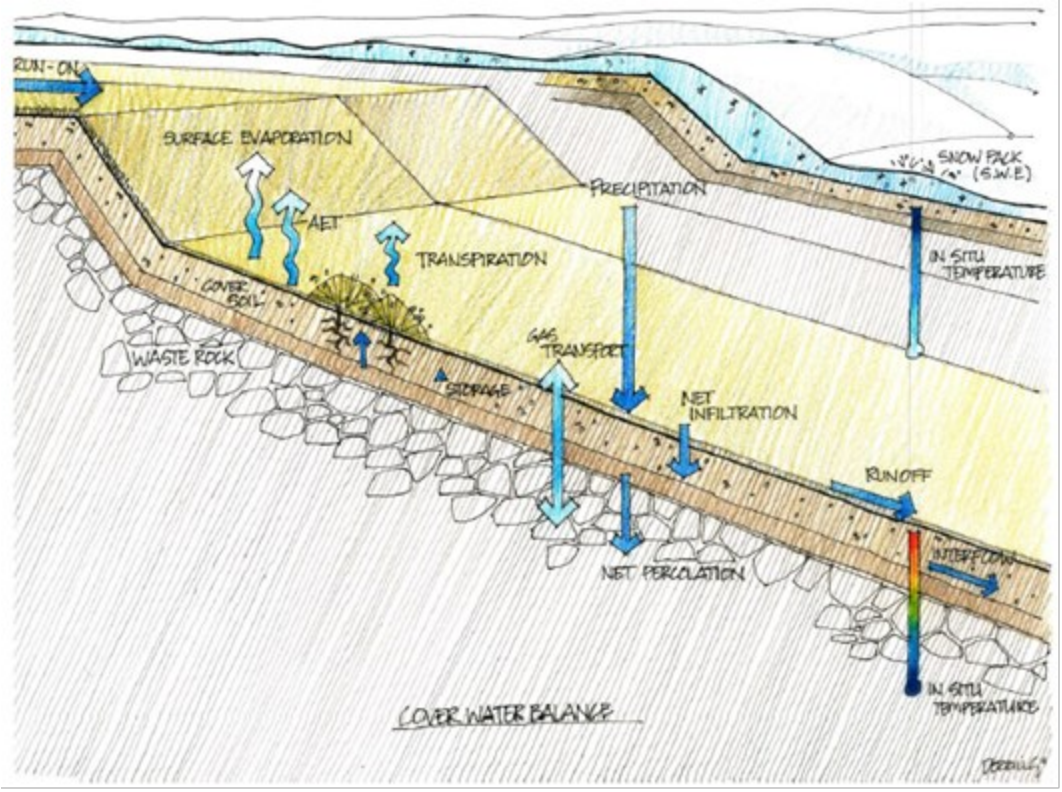


Figure 2.1: Schematic of hydraulic processes that influence performance of a cover system (from INAP, 2017)

As shown by the Project climate data described later in this report, the Project is classified as subarctic (Dfc) using the Köppen-Geiger climate classification (Peel *et al.,* 2007). Based on this classification, the range of cover system performance for the Tenas Project is presented conceptually, as defined in the Global Cover System Design Technical Guidance Document (INAP, 2017), as follows:

- "Very High" NP is greater than 50% PPT;
- "High" NP is between 25% PPT and 50% PPT;
- "Moderate" NP is between 15% PPT and 25% PPT;
- "Low" NP is between 5% PPT and 15% PPT; and
- "Very Low" NP is less than 5% PPT.

Within a single climatic regime, the same range of NP rates may be a result of the influence of differing abilities of a cover system to evapotranspirate water, and to promote runoff and interflow (i.e., lateral flow within the cover system) from the landform. Net percolation rates will also vary from year to year. For example, a high rainfall year (or, more specifically, several successive wetter than average climate

years) may result in a moderate net percolation rate for the year, even for a cover system scenario classified, on average, as having a low net percolation rate.

Cover performance with respect to oxygen (O_2) ingress can also be classified using the Global Cover System Design Technical Guidance Document (INAP, 2017) as follows:

- "Very High" O_2 ingress is greater than 100 mol/m^2/year;
- "High" O_2 ingress is between 50 and 100 mol/m^2/year;
- "Moderate" O_2 ingress is between 10 and 50 mol/m^2/year;
- "Low" O_2 ingress is between 1 and 10 mol/m^2/year; and
- "Very Low" O_2 ingress is less than 1 mol/m^2/year.

Limiting oxygen ingress is often achieved by limiting diffusion or restricting air flow by reducing pressure and/or thermal gradients. Usually, the most effective way to limit oxygen ingress is to create and sustain saturated conditions in a layer within the cover system. O_2 ingress is less challenging to limit in wetter environments where a tension-saturated layer is more easily maintained, and finer-textured material together with the tension saturated conditions will lead to reduced air permeability and therefore, advective gas transport. A similar range of performance exists for O_2 ingress as for NP where rates will vary from year to year. For example, a low rainfall year or several successive drier than average years will reduce the degree of saturation maintained within the cover system and may increase the predicted oxygen ingress rate for the year.

Limiting NP and O_2 ingress are not necessarily mutually beneficial and achieving reductions in either or both is site specific. Depending on available materials for cover system construction, limiting NP may result in less water available to maintain a saturated layer, whereas limiting O_2 ingress may require promoting additional NP. Hence, a technical assessment is required to make decisions on how best to optimize these two aspects to best take advantage of how each facet enhances performance for a particular project.

2.2 Site Specific Attributes

Assessment of the NAG backfill and cover system performance requires analysis of site attributes that constrain design alternatives to achieve the desired performance (INAP, 2017). The following site-specific attributes will be used to define performance of the NAG backfill design at Tenas:

- Climate;
- Hydrogeological setting;

- Materials;
- Vegetation; and,
- Geochemistry.

These key site attributes are described in the following sections based on background data provided by Telkwa.

2.3 Climate

The regional climate is a subarctic climate where winters are cold, averaging around -5°C during the period of November through February with temperatures potentially dropping to -30°C or colder, and summers are warm, with average temperatures greater than 20°C and highs of greater than 30°C are possible. Precipitation occurs as rain during the warmer months, accounting for 60-65% of annual precipitation. Snow accounts for 35-40% of annual precipitation with maximum accumulation of snow occurring in February-March.

The Project falls near the intersection of Dfc (subarctic climate) and Dsc (Mediterranean-influenced subarctic climate) of the Köppen-Geiger climate classification system (Peel *et al.*, 2007) where:

- D – 'continental' where average temperature of the coolest month is < -3 °C, and average temperature of the warmest month is > 10 °C;
- f – 'without dry season' where precipitation is evenly distributed throughout the year;
- s – 'dry summer' where precipitation of the driest month in summer is less than 40 mm and is also less than a third of the precipitation of the wettest month in winter; and
- c – 'cold summer' where one to three months average temperature reach >10 °C but < 22 °C.

2.4 Hydrogeological Setting

The results of historical hydrogeological investigations and *in-situ* testing are presented in Table 2.1. Surficial material is primarily sandy till to silty clay (Piteau, 1997), which is underlain by fractured sedimentary bedrock consisting of mudstones, siltstones, and sandstones (Klohn, 1985; Piteau, 1997; SRK 2018; 2019). *In-situ* hydraulic conductivity of the bedrock ranged from 6.0×10^{-6} m/s to 1.0×10^{-10} m/s.

Using the British Columbia Groundwater Wells Database, a search was completed, and 11 water wells were found in the vicinity of the mining operations. Nine domestic drinking water wells and two commercial water wells were found to be in the area N-NE of the mine site. Four of the wells are just south of the Telkwa River and west of Tenas Creek while the remaining seven (7) wells are east of Goathorn Creek. The range in finished depth of the water wells is 12 to 43 m below ground level (mbgl),

with a range of static head of 5.5 to 39 m below top of casing (btc), and an estimated yield range from 15 to 114 L/min.

Table 2.1 Record of hydrogeological investigations and *in-situ* testing.

Location and Geology	Hydrogeological Instrumentation	Groundwater Flow and Piezometric Surface	*In-Situ* Hydraulic Conductivity (K) and Linear Flow Velocity (V)
Telka Site (Klohn, 1985) Variable thicknesses of glacial till and gravel overlying sequences of sandstones, siltstones, mudstones, and coal. Bedrock dips 15-20 degrees to the east and is structurally dominated by several N-S trending reverse faults and normal faults which trend N-S and EW. Bedrock is of low permeability and contains no stratigraphically definable aquifers. The groundwater table is at or close to ground surface for much of the eastern part of the site. Breccia filled fault zones are expected to be significant conductors of groundwater.	16 piezometers installed (*none of the piezometers are still functional)	23 rural households within 3 km of the mine area obtain their domestic water supplies from groundwater, either by dug wells (2 to 6 m depth) or by drilled wells (less than 50 m depth) Domestic well records indicate that groundwater in the area is at about 12.5 m depth within a gravel layer.	Coefficient of permeability, Coal: 5×10^{-7} to 5×10^{-9} m/s Siltstone, Mudstone Sandstone: 2×10^{-7} to 1×10^{-10} m/s Recharge was estimated as 3% of annual precipitation based on the estimated groundwater flux and a value for hydraulic conductivity derived from the packer tests.
Tenas Pit (Piteau, 1997) Telkwa coal lease is underlain by coal-bearing sedimentary sequence comprising siltstone, sandstone, mudstone, and shale strata of the Lower Cretaceous age Skeena Group (Units 1-4). Economic coal seams in Unit 1 – 120 mm thick sequence of interbedded coal and sedimentary rocks. Faulting is near vertical, one group strikes ~NW/SE and other group strikes ~NE/SW. Few E/W striking faults. Surficial deposits are primarily till ranging from sandy silt to silty clay with minor gravel with range in thickness from less than 3 m to more than 10 m.	4 piezometers within coal seam #1 in 1995 5 piezometers in the major coal seams at three new locations in 1996	NE direction with horizontal hydraulic gradient of ~0.1. Flowing artesian conditions exist in all but 3 piezometers completed in coal seam #1.	K range of 2.1×10^{-8} to 6.0×10^{-6} m/s Average V is 115 m/year but does not consider local fault or fracture zones. V in the range of 10 to 250 m/year may be expected.

Location and Geology	Hydrogeological Instrumentation	Groundwater Flow and Piezometric Surface	*In-Situ* Hydraulic Conductivity (K) and Linear Flow Velocity (V)
Waste Dumps (Piteau, 1997) Waste dump sites underlain by till from 3.75 - 13.5 m thick. Thinnest till blanket is deposited directly on the bedrock surface and thickest till deposit overlies outwash sediments. East side of Tenas pit, thin 6.0 m till overlies permeable sands and gravels. Where overburden is more than 10 m thick, bedrock is overlain by high permeability sand and gravel outwash deposits. The thickest of which (106 m) is in the NW corner of the Tenas waste dump sites where a buried channel (clays, sands, and gravels) exists where the depth to bedrock exceeds 117 m. Bedrock from 4.6 - 117 m consists of either volcanic ash or interbedded sequences of siltstone and mudstone with occasional sandstone.	11 holes drilled at 9 locations	Interpreted to follow topography within surficial sediments between 0.5 - 2.0 m. Depending on location, shallow groundwater flow will either be in a northwesterly or northeasterly direction towards Tenas Creek or Four Creek. At one piezometer nest, strong downward vertical gradients indicative of groundwater recharge conditions exist between upper and lower water-bearing deposits. Due to upland topography of the waste dump sites, groundwater recharge conditions are expected to prevail.	Three single well response tests indicated K of the upper water-bearing till deposit to be in the range of 2.8×10^{-9} to 7.2×10^{-7} m/s. These values are low and thus vertical infiltration rates through this deposit would similarly be expected to be low.
Pit 3 (Piteau, 1997) Bedrock: alternating sequence of siltstone, mudstone, sandstone, and coal with sporadic volcanic tuffs throughout the sequence. Complex series of sub-parallel, N-S trending reverse faults and N-S, and to a lesser extend E-W, trending normal faults. Bedrock overlain by ~10 - 15 m of silty clay till with minor coarse fragments and sand.	5 piezometers installed at 3 locations in Pit 3. At each location, a piezometer was completed across coal seam #2 A second piezometer was installed across coal seam #4 at two locations.	Within coal units, groundwater flow is interpreted to be in a north to northwesterly direction. Horizontal hydraulic gradient of ~0.04. Depth to water ranged from 7.55 - 36.73 mbgs.	From one single well response test, K of coal seam #2 estimated at 4.3×10^{-10} m/s. From two single well response tests, K of coal seam #4 estimated at 8.5×10^{-7} m/s and 3.7×10^{-6} m/s. Average V in coal seams estimated range 20-100 m/year.
Mine rock dumps and sediment ponds (SRK, 2018)	13 sonic drillholes to depths between 9.0 m and 30.8 m upon reaching bedrock or sufficiently high soil density.	Two sonic piezometers were dry, one had water up to ground level and the last had a depth to water of ~14 m.	-

Location and Geology	Hydrogeological Instrumentation	Groundwater Flow and Piezometric Surface	*In-Situ* Hydraulic Conductivity (K) and Linear Flow Velocity (V)
	4 standpipe piezometers were installed for groundwater monitoring in 2017. 8 diamond drillholes with lengths from 70 m to 213.7 m were drilled. 3 of these drillholes had piezometers installed in them.		
Management ponds, sediment ponds, external soil/rock piles and infrastructure pad (SRK, 2019)	12 sonic drillholes were terminated at depths between 10.7 m and 67.1 m upon reaching bedrock. 12 standpipe piezometers were installed for groundwater monitoring in 2018.	The shallowest groundwater levels were approximately 14 mbgs but the piezometric table was located between 20 m and 40 m within the overburden soils.	-

2.5 Materials

Site-specific material characterization and availability are the two main elements for cover system design. Material selection and strategic placement is a key control on cover system performance and is used to provide a means for functions such as vegetation establishment, erosion control, and drainage where required in the cover system design (MEND, 2004).

Surficial deposits (overburden) within the Project Area are primarily till ranging from sandy silt to silty clay with minor gravel (and less than 5% cobbles and boulders) with a range in thickness over the Tenas Project Area from 4 m to 100 m (SRK, 2018). Recent drilling investigations (SRK, 2018; 2019) of the overburden material are in agreement with historical investigations (Klohn, 1985; Piteau, 1997) except for no sand and gravel outwash deposits in the northwest of the project site reported in Piteau (1997) being encountered in current drill holes (SRK, 2018; 2019). The till surface deposits will be excavated in the mining process and stockpiled for later use in the cover systems or direct placed from mining.

The bedrock in the Tenas Open Pit is of the early Cretaceous-aged Skeena Group and consists of alternating sequences of siltstone, mudstone, sandstone, and conglomerates with inter-bedded, bituminous coal seams (SRK, 2018). In Unit 1 a sedimentary sequence from 50 m to 120 m in thickness is interbedded with Coal Seam 1 (Seamas 1A-1F) with individual thicknesses of 1 m to 3 m (SRK, 2018). To access the inter-bedded coal layers, the bedrock will be excavated becoming mine rock to be placed in lifts and covered with the till material.

Particle size distribution (PSD) data was only available for the overburden till material and no information was available for the mine rock. The overburden material can be grouped into two categories based on the PSD data, a poorly-graded till and a well-graded till. Figure 2.2 shows the range of PSDs for each group based on the testing completed by SRK in 2019 (SRK, 2019). Following completion of sample compaction tests, four till samples were assessed for permeability, the results ranged from 1.04×10^{-7} m/s to 1.18×10^{-10} m/s (SRK, 2018).

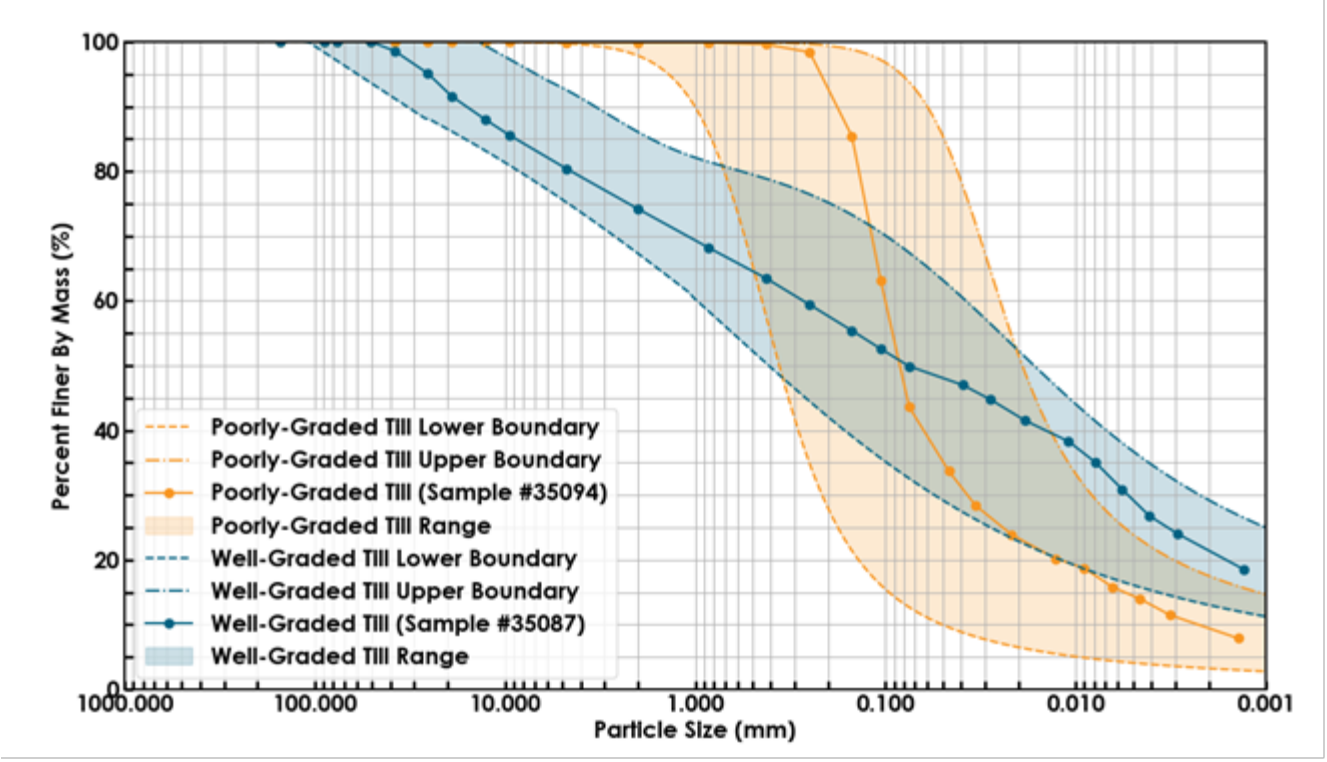


Figure 2.2: Range of PSDs for Poorly-Graded and Well-Graded Till based on SRK (2019).

(adapted from SRK, 2019)

2.6 Vegetation

The Project is located within the Sub-Boreal Spruce (SBS) zone of the biogeoclimatic zones of British Columbia. The dominant coniferous tree species in this zone include hybrid white spruce (hybrid of Engelmann spruce and white spruce), sub-alpine fir, lodgepole pine, and occasionally, black spruce and Douglas-fir (BC Ministry of Forests, 1998). Deciduous species include trembling aspen and paper birch.

2.7 Geochemistry

Non-potentially acid generating mine rock will be used as backfill into the Open Pit. Although sulfide minerals are present (and sulfide oxidation is expected), these materials contain an excess of neutralization potential (at least 2x) relative to the acid potential (AP) and are not expected to generate acidic drainage (Price, 2009). However, sulfide oxidation products will still be generated and transported through the mine rock by contact water. Concentrations of select dissolved trace metals and sulfate will be constrained by secondary mineral precipitation (e.g., gypsum and metal hydroxide phases) and adsorption to iron hydroxides that typically precipitate in circum-neutral mine waters. However, even with these solubility controls, metal loads from pyrite oxidation could still pose a risk to downstream

receptors. A conceptual model of geochemical reactions occurring along a typical flow path within the Tenas NAG mine rock is shown in Figure 2.3.

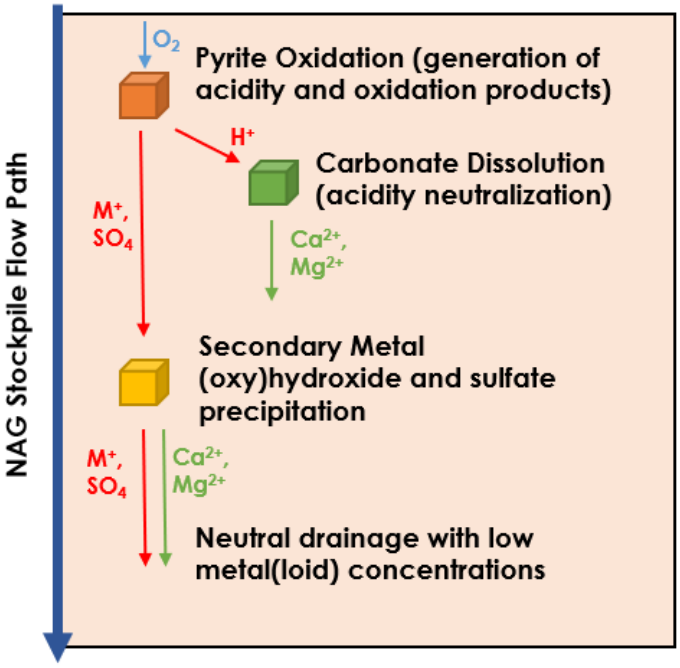


Figure 2.3: Geochemical conceptual model for Tenas NAG mine rock flow path.

Parameters that were elevated above typical crustal concentrations within the Project Area were: arsenic, phosphorus, sulfur, and selenium. Although elevated solid-phase concentrations do not necessarily imply that these species will be mobilized and result in elevated concentrations in contact water, solid-phase metals analysis was completed to flag potential contaminants of concern to evaluate in further geochemical testing.

Current geochemical characterization recommended the use of a neutralization potential ratio (NPR) > 1.60 to classify mine rock as NAG (where, NPR = neutralization potential / acid potential) during verification testing completed during the Operations phase of the Project. For planning and the EAC submission, an NPR cutoff of 2.0 was used to classify mine rock as NAG or PAG, with values > 2.0 considered NAG. This is based on a strong correlation between NP_{XRD} and modified NP following correction for iron carbonates and was developed using calcium and magnesium molar ratios in humidity cell tests (HCTs; SRK, 2022b).

Dolomite-ankerite and calcite are the most abundant carbonate minerals with lesser amounts of siderite in NAG mine rock while PAG mine rock has a higher siderite content. Dolomite-ankerite content ranged from 0.3 to 23.8 wt.% (median = 14.0 wt.%), while calcite ranged from below detection (BD) to 4.4 wt.% (median = 1.4 wt.%). Siderite content ranged from 0.2 to 12.6 wt.% (median = 2.0 wt.%). It is worth noting that siderite does not provide net neutralization to acidity generated from sulfide oxidation. This is because Fe(II) released from siderite dissolution typically oxidizes to Fe(III) which precipitates Fe(III)

hydroxide phases, releasing acidity. Therefore, the bulk of acidity neutralization in the NAG mine rock will come from the dissolution of calcite and dolomite. The primary sulfide mineral in the PAG mine rock is pyrite, which ranges from 0.3 to 2.5 wt.% (median = 0.8 wt.%).

3 DESCRIPTION OF MODELLING PROCESSES

To estimate seepage quantity and quality for the backfilled NAG mine rock in the Open Pit, Okane used the following numerical models and modelling process.

1) ***One-Dimensional (1D) Soil-Plant-Atmosphere (SPA) Models*** using components of the GeoStudio FLOW (Bentley Systems, 2022) modelling suite (namely, SEEP/W and TEMP/W) to simulate the NP rate.

2) ***Two-Dimensional (2D) Oxidation Model*** using the GeoStudio FLOW suite, including SEEP/W, TEMP/W, CTRAW/W, AIR/W, and the Gas Consumption and Exothermic Reactions Add-In Module to evaluate the size and development of suboxic conditions.

3) ***Three-Dimensional (3D) GoldSim Oxidation, Wetting-Up and Draindown Model*** to determine a range for potential seepage and oxygen consumption based on hundreds of realizations of the model, using the GoldSim Monte-Carlo formulation (GoldSim, 2021).

4) The ***Geochemical Model*** using a combination of both a *mechanistic reactive transport model* and a *scale-up geochemical model* to evaluate the evolution of water quality moving through the overburden cover and into the backfilled NAG mine rock.

The source terms from the geochemical model will be provided to SRK to be used in the site-wide water quality model to evaluate the potential effects of key mine facilities on the receiving environment. The following sections describe the numerical models in more detail.

3.1 1D Soil-Plant-Atmosphere Model with GeoStudio SEEP/W and TEMP/W

In combination, SEEP/W and TEMP/W are a 2D finite element model (which can also perform 1D simulations) that predict suction in the material profile in response to climatic forcing (such as evaporation) and lower boundary conditions (such as a water table). A key feature of the software is the ability of the model to predict actual evapotranspiration (AET) based on potential evaporation (PE) and predicted suction, as opposed to the user being required to input these surface flux boundary conditions. The AET rate from the surface material is below the potential rate during prolonged dry periods because the suction, or negative pore water pressure, in the material profile increases as the surface desiccates. In addition, SEEP/W and TEMP/W together form a fully coupled (through the vapour pressure term) heat and mass transfer model, which can predict water vapour movement and the influence of freeze/thaw on hydraulic conditions through reductions in the hydraulic conductivity. The 1D SPA models provide runoff and NP estimates, which are used as inputs in the 2D Oxidation and 3D GoldSim Oxidation, Wetting-Up, and Draindown models.

3.2 2D Oxidation Models

The 2D oxidation modelling was completed using the GeoStudio FLOW suite (SEEP/W, TEMP/W, CTRAN/W, and AIR/W) and the Gas Consumption and Exothermic Reaction Add-In to evaluate the size and development of suboxic zones within the NAG backfill. The models will account for annual material placement and provide estimates of the timing and depth to the suboxic zones, which are used in the 3D GoldSim model, as well as an estimate of cumulative oxygen (O_2) consumption with time, which is used to calibrate and validate the 3D GoldSim results.

3.3 3D GoldSim Oxidation, Wetting-Up and Draindown Model

The 3D model is a wetting-up and drain-down model developed by Okane in GoldSim to simulate the water movement in mine rock based on climate data and material properties. In the model, gravity-driven water flow depends on the NP rate and hydraulic conductivity. The hydraulic conductivity of each layer of mine rock is calculated based on the following formula with measured material properties:

$$k(h) = k_s S_e^l \left[1 - \left(S_e^{\frac{1}{m}}\right)^m\right]^2 \quad (1)$$

where S_e is the effective saturation, k_s is the saturated hydraulic conductivity (LT^{-1}), n and m are van Genuchten's equation parameters, and l is the pore-connectivity parameter. The effective saturation, S_e, within the layer is defined as:

$$S_e = \frac{\theta_w - \theta_{wr}}{\theta_s - \theta_{wr}} \quad (2)$$

where θ_w is the volumetric water content of the layer, θ_{wr} is the residual volumetric water content (L^3/L^3), and θ_s is the saturated volumetric water content (L^3/L^3). The van Genuchten equation parameter m is defined as a function of n as:

$$m = 1 - \frac{1}{n} \quad (3)$$

In the modelling process, hydraulic conductivity is calculated based on the water content of each layer of mine rock. This parameter is then used to calculate the flow rate of water between layers of mine rock. The change in water content due to the placement of new mine rock can also be simulated as part of the hydrogeology model. The Monte-Carlo formulation is used to vary the material properties for each lift of material within an anticipated range to produce a more realistic estimate of overall backfill performance.

The 3D models were extended an additional 50 years to 2150 using stochastic net percolation inputs based on the 1D water balance to ensure that steady state seepage was reached.

3.4 Geochemical Model

The evolution of water quality in the backfilled NAG mine rock was evaluated using a combination of both a mechanistic reactive transport model and a scale-up geochemical model.

The ***Mechanistic Reactive Transport Model*** was constructed with PHREEQC v.3 (Parkhurst and Appelo, 2013) and accounts for geochemical characteristics such as mineralogy, reaction kinetics, transport time, and oxygen conditions of the mine rock. This model incorporates key reactive minerals including sulfides and carbonates, chronology of the NAG mine rock placement, and cover system placement and source control implementation leading to suboxic zone development.

The ***Scale-up Geochemical Model*** was completed to estimate parameters that were not modelled using the Mechanistic Geochemical Model, and generally consist of parameters not directly influenced by sulfide oxidation or carbonate mineral dissolution. Parameter concentrations were calculated based on field barrel leachate quality and scaled-up based on the physicochemical differences between the smaller scale test conditions and expected field conditions of the NAG backfill.

3.5 Model Inputs

3.5.1 Base Case Geometry

The in-pit NAG backfill will be constructed as 120 m wide by 36 m high cells, with a 3 m cover of compacted overburden on the slope of the cell and 1 m of compacted overburden on the plateau of each cell. The cells will be built starting with the face of the slope as a 4 m by 50 m lift / road (1 in Figure 3.1). The overburden and NAG mine rock will be end dumped and compacted in 1.33 m lifts. The second lift will be a 4 m by 39 m lift (2 in Figure 3.1) on top of the first lift, followed by a third lift of 4 m by 28 m (3 in Figure 3.1). The remaining space within the cell will be end dumped as a 12 m high standard dump (4 in Figure 3.1). This process is planned to occur three times per cell, resulting in a 35 m high cell. The last step of each cell is the addition of a 1 m compacted overburden layer, completing the 36 m high cell.

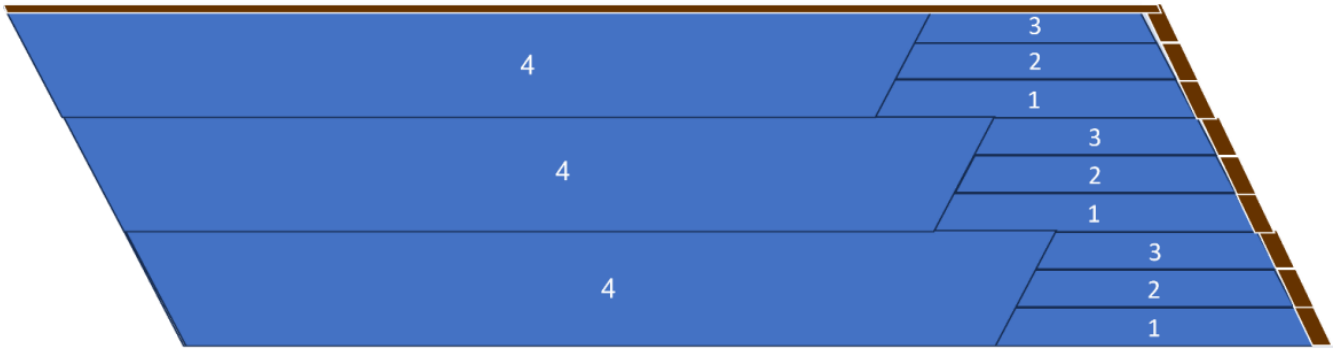


Figure 3.1: Building plan for the cells within the backfilled open pit NAG mine rock landform.

Cells will be stacked and reach an approximate height of three 36 m cells to complete the backfill within the Open Pit, as the bottom and top cells are anticipated to be half height, as shown in Figure 3.2, due to the pit bottom shape and final reclamation goals.

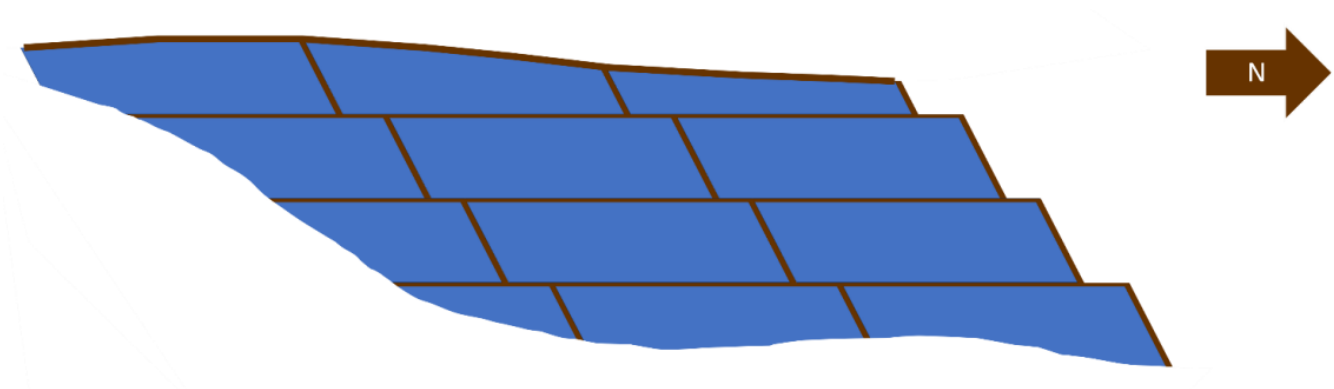


Figure 3.2: Encapsulation plan for NAG in-pit mine rock.

The final cover system on the landform will be 3 m of overburden overlain by approximately 0.3 m of surface soils (topsoil). The 1D models were constructed as 35 m of mine rock with the final cover system at the surface. These models were used to investigate the different material combinations.

A cross-section through the NAG backfill was modelled in 2D to determine the development and extent of the suboxic zone within the backfill. Figure 3.3 shows the approximate location of the cross section while Figure 3.4 shows the 2D geometry that was modelled.

An additional scenario that did not include the internal overburden layers was also modelled. This scenario assumed that the Open Pit would be backfilled following the same procedure as outlined above, but the entire 36 m cell would be composed of mine rock, with only the final cover system being composed of overburden.



Figure 3.3: Plan view of the backfill open pit NAG mine rock showing the strips and approximate location of the projected cross section.

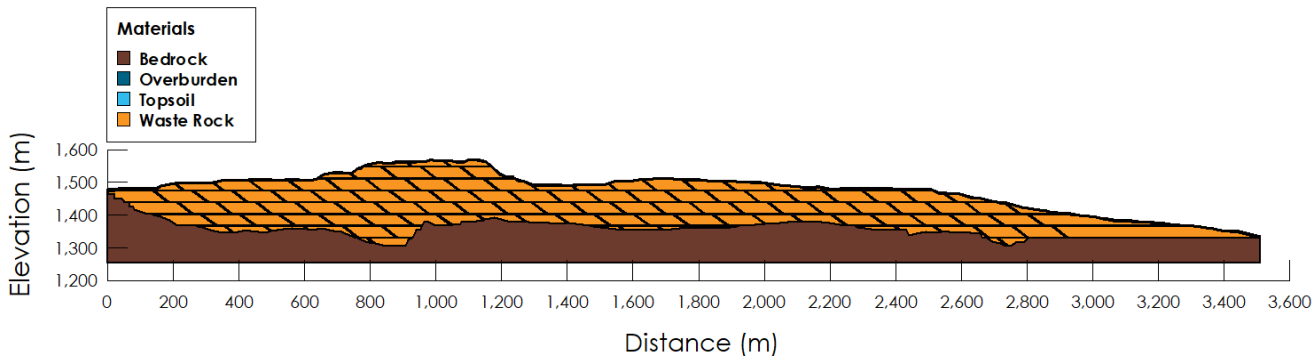


Figure 3.4: Geometry of the project 2D cross section. It should be noted that bedrock refers to bedrock of open pit, waste rock is the NAG mine rock and topsoil includes surface soils.

Within the 3D GoldSim model, the backfilled NAG mine rock was simulated by subdividing its area into 23 main strips, with each strip representing areas with similar timing of cover placement (Figure 3.3). The construction schedule for each strip was assumed based on the filling volumes and timing provided by Telkwa. The following assumptions were made regarding the placement of NAG mine rock for the GoldSim simulations:

- Construction of the NAG backfill is strip dependent, but in general, begins in Year 6 for the main strips and continues until the completion of the Operation phase in Year 21;
- Cover system placement is strip dependent and will be assumed to occur over one year (*e.g.*, cover placement that occurred in Year 8 will be assumed to occur at a uniform rate from January 1 to December 31 of Year 8). Cover system placement is assumed to occur in the year following completion of each strip due to model limitations; and
- Daily NP rate inputs will be derived separately from the 1D GeoStudio model results. In general, daily stochastic inputs will be setup for each day of the year based on the results of the GeoStudio models.

The assumed height of NAG mine rock and overburden in each strip with time, based on the volume of material placed and the surface area of the strip is shown in Figure 3.5. The surface area, total NAG mine rock and overburden volumes, and timing of cover system placement are listed in Table 3.1. For the no internal layers scenario, the internal layer volume was assumed to be NAG mine rock rather than overburden.

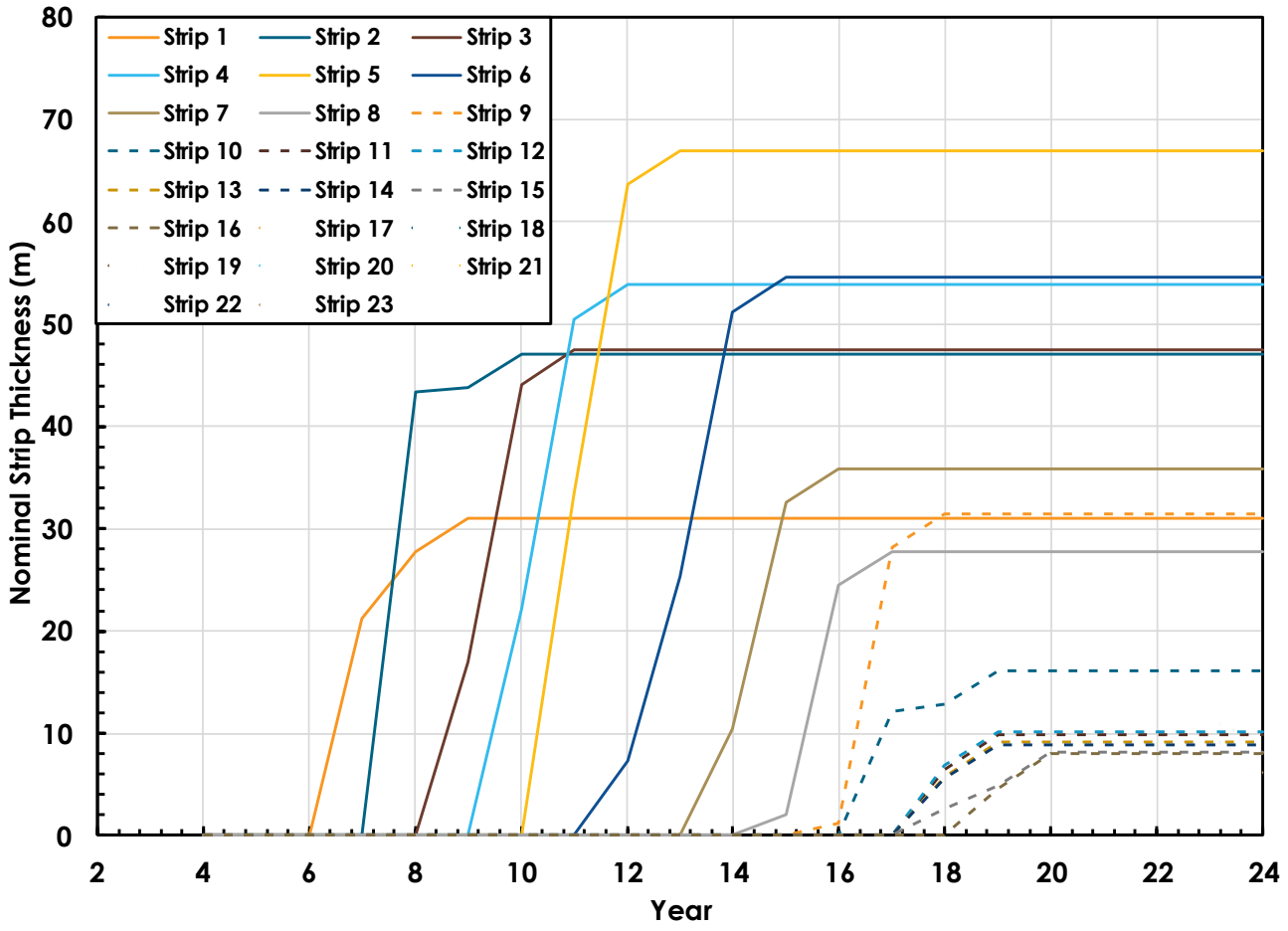


Figure 3.5: Evolution of nominal strip thickness within the GoldSim model for each strip.

Table 3.1: Surface area, volume, and nominal thickness of each strip, along with year of cover system placement.

Strip	Strip Surface Area (m^2)	Mine Rock Volume (m^3)	Internal Layers Overburden Volume (m^3)	Cover System Overburden Volume (m^3)	Total Strip Volume[1] (m^3)	Nominal Thickness (m)	Year of Cover Placement
1	41,897	1,065,383	95,548	71,661	1,232,593	31	Year 8
2	49,774	2,035,361	143,168	107,376	2,285,907	47	Year 9
3	61,199	2,529,237	171,692	128,769	2,829,695	47	Year 10
4	71,013	3,336,530	250,260	150,156	3,736,944	54	Year 11
5	78,079	4,660,016	305,995	183,597	5,149,606	67	Year 12
6	95,072	4,580,978	288,455	173,073	5,042,504	55	Year 14
7	95,482	2,895,869	209,244	156,933	3,262,049	36	Year 15
8	92,182	2,102,945	155,400	116,550	2,374,893	28	Year 16
9	61,588	1,611,409	123,760	92,820	1,827,988	31	Year 17
10	93,728	1,077,586	123,928	92,946	1,294,461	16	Year 18

Strip	Strip Surface Area (m^2)	Mine Rock Volume (m^3)	Internal Layers Overburden Volume (m^3)	Cover System Overburden Volume (m^3)	Total Strip Volume[1] (m^3)	Nominal Thickness (m)	Year of Cover Placement
11	132,059	684,134	173,334	86,667	944,138	10	Year 18
12	100,087	562,842	127,240	95,430	785,515	10	Year 18
13	105,498	486,553	126,556	94,917	708,023	9	Year 18
14	104,842	461,895	126,664	94,998	683,556	9	Year 18
15	105,081	387,746	121,744	91,308	600,798	8	Year 19
16	95,046	343,940	98,832	98,832	541,604	8	Year 19
17	91,078	368,246	96,090	96,090	560,424	8	Year 19
18	87,435	506,810	108,252	81,189	696,251	10	Year 19
19	88,006	412,599	108,160	81,120	601,876	9	Year 19
20	102,696	899,529	155,640	93,384	1,148,551	14	Year 20
21	162,765	1,054,401	184,100	110,460	1,348,963	11	Year 21
22	120,549	336,966	106,156	79,617	522,740	7	Year 21
23	324,682	755,903	157,040	235,560	1,148,505	6	Year 22
Total	*2,359,838*	*33,156,878*	*3,557,258*	*2,613,453*	*39,327,584*	-	-

1 - Includes total NAG mine rock and overburden volumes.

3.5.2 Material Properties

The hydraulic properties or functions required for modelling of overburden and NAG mine rock material are as follows:

- Water retention curve (WRC – volumetric water content versus matric suction): a continuous function relating energy and the state of water, and hence describes the water content of a material as a function of the soil suction, or negative pore-water pressure. It is central to the design of an unsaturated soil system.

- Hydraulic conductivity function (k-function – hydraulic conductivity versus matric suction): a measure of the ability of a soil or rock material to transmit water and is a maximum for saturated soil or rock materials. The saturated hydraulic conductivity (k_{sat}) and unsaturated hydraulic conductivity function are key input parameters to numerical models analyzing hydraulic performance.

For the best results, WRC and k_{sat} should be measured in the laboratory and field for each material of interest. In this case, only particle size distribution (PSD) data was available for the overburden material and no information was available for the NAG mine rock. Two PSDs for the overburden material were used as representative samples for well-graded (sample# 35087) and poorly-graded (sample# 35094) till found in the SRK 2019 field investigations (Figure 2.2).

For the overburden material the WRC (Figure 3.6) and k-function (Figure 3.7) were estimated from the PSD (both well-graded and poorly-graded) using the Fredlund and Xing (1994) pedotransfer functions in SVSOILS™ Software (Plaxis, 2022). The k_{sat} was estimated using Kozeny (1962) with PSD data as the input.

As no lab or field information was available for the NAG mine rock, three proxy materials (mudstone, siltstone, and sandstone) were provided by Okane based on field testing completed at several mine sites. A well-graded mixed material based on core logs consisting of 35% mudstone, 60% siltstone, and 5% sandstone (D. Farmer, 2024, pers. comm.) was also estimated. The WRC and k-functions for the mine rock proxy materials are found in Figure 3.6 and Figure 3.7, respectively.

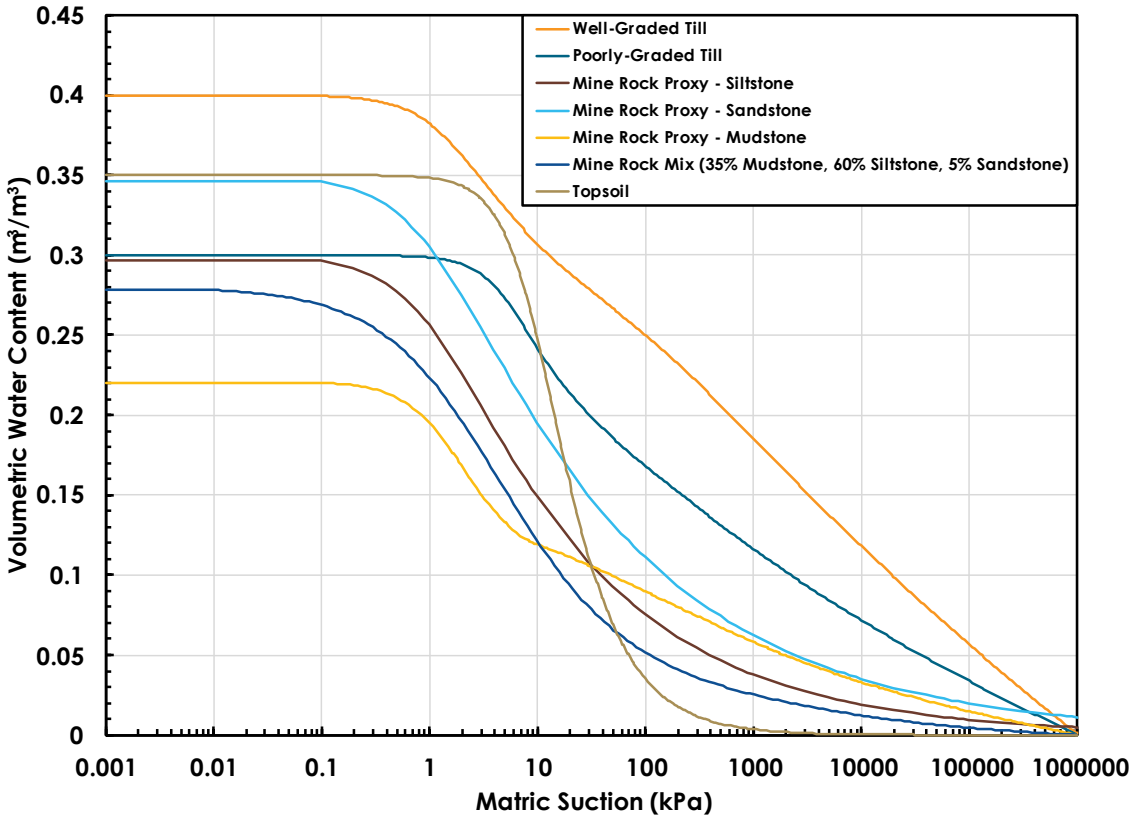


Figure 3.6: Estimated overburden (till) and proxy mine rock water retention curves.

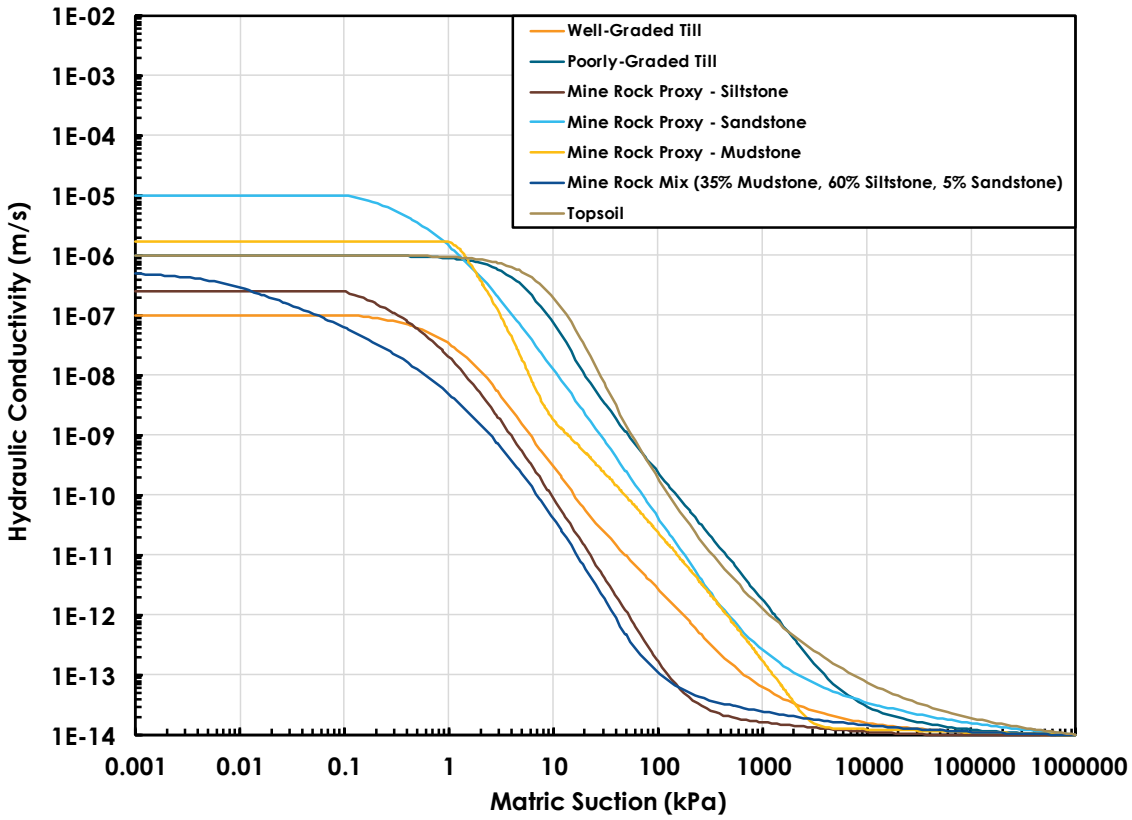


Figure 3.7: Estimated overburden (till) and proxy mine rock k-functions.

3.5.3 Climate Model Inputs

SRK (2022c) developed a project-specific synthetic historical climate database based on transposing regional datasets to the site and adjusting for orographic effects. The historical dataset spans 77 years from 1943 to 2020 and is summarized in Table 3.2.

SRK (2022c) also completed a climate change assessment for the project using the fifth version of the Coupled Model Intercomparison Project (CMIP5) and Representative Concentration Pathway (RCP) 4.5 of the Intergovernmental Panel on Climate Change (IPCC) fifth Assessment Report (AR5) (IPCC, 2014). Monthly rates of changes relative to baseline conditions (1981-2010) were calculated for temperature and precipitation based on the median values of an ensemble of 29 CMIP5 models. Projected climate change effects were evaluated for three consecutive 30-year forecast periods, defined as follows:

- Baseline period from 1981 to 2010 (CMIP5), centred on 1995;
- First forecast period from 2011 to 2040 (CMIP5), centred on 2025;
- Second forecast period from 2041 to 2070 (CMIP5), centred on 2055; and

- Third forecast period from 2071 to 2100 (CMIP5), centred on 2085.

Monthly changes relative to monthly baseline data for RCP4.5 are shown in Table 3.3 for temperature and Table 3.4 for precipitation. A long-term daily dataset (SRK, 2023a) was developed by applying the monthly changes to the average monthly values from the baseline period.

This climate change dataset was used directly as the upper boundary condition in the 1D SPA modelling through the Land-Climate Interaction (LCI) and Surface Energy Balance (SEB) boundary conditions to develop the surface water and energy balance, which was used as the upper boundary conditions in the 2D and 3D models.

Table 3.2 Monthly summary of historical climate database.

Month	Air Temperature (°C)		Precipitation[1] (mm)				Solar Radiation (W/m²)	Relative Humidity (%)	Lake Evaporation (mm)	Wind Speed (m/s)
	Maximum	Minimum	Mean	Rainfall	Snowfall	Total				
January	-5.8	-12.6	-9.2	6.1	53.9	60.0	38	83.6	0	2.0
February	-1.8	-10.4	-6.1	1.0	33.9	34.9	64	79.3	0	1.9
March	2.2	-7.5	-2.7	0.3	26.5	26.8	114	71.2	0	2.0
April	7.4	-3.1	2.1	12.5	19.6	32.2	173	63.3	60	2.2
May	12.9	0.8	6.8	41.5	8.3	49.8	220	61.3	97	2.1
June	16.5	4.7	10.7	68.7	1.2	69.9	224	65.7	108	1.9
July	19.0	6.9	13.0	57.3	0.0	57.3	224	68.8	116	1.7
August	18.6	6.4	12.5	55.2	0.1	55.3	201	72.1	99	1.5
September	13.7	3.1	8.4	63.9	3.5	67.4	134	79.5	50	1.5
October	6.5	-1.4	2.6	42.4	42.0	84.3	73	82.1	0	1.9
November	-0.8	-6.8	-3.8	5.4	67.3	72.7	40	85.9	0	1.9
December	-4.6	-11.2	-7.9	2.1	53.7	55.8	34	85.4	0	2.0
Annual	*7.0*	-2.6	*2.2*	*356.4*	*310.0*	*666.4*	*128*	*74.8*	*529*	*1.9*

(SRK, 2022c)

[1]Total precipitation was updated by SRK (SRK, 2023b) in November 2023 based on analysis against measured data at Tenas Deposit Station. Rainfall and snowfall were calculated by Okane assuming a threshold temperature of 0 °C.

Table 3.3 Monthly average temperature increase from the baseline period for RCP4.5 (in °C).

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2011-2040	1.25	1.23	1.16	1.13	1.35	1.44	1.35	1.21	1.00	0.97	1.02	0.86	1.2
2041-2070	2.89	2.16	2.42	2.30	2.60	2.51	2.45	2.39	2.11	2.07	2.26	2.48	2.4
2071-2100	3.45	2.79	3.01	3.04	3.14	3.13	3.24	2.99	2.72	2.56	2.85	2.97	3.0

Table 3.4 Monthly average precipitation variation from the baseline period for RCP4.5 (in %) (from SRK, 2022c).

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2011-2040	5%	7%	6%	0%	14%	2%	1%	-1%	5%	7%	4%	3%	+5%
2041-2070	12%	8%	14%	14%	34%	33%	-5%	0%	10%	12%	11%	12%	+12%
2071-2100	12%	11%	16%	9%	48%	23%	-23%	2%	14%	18%	16%	18%	+15%

3.5.4 Vegetation Model Inputs

Vegetation model inputs were based on the SBS bio-geoclimatic zone. Prior to reclamation, no vegetation was assumed. Once areas are reclaimed, vegetation was simulated to re-establish and grow.

To simulate the vegetation re-establishment the following assumptions were made:

- The year after cover system placement, grasses and shrubs are assumed to establish and grow.
- Grasses and shrubs are assumed to be the predominant vegetation for the first five years following cover system placement.
- Forest species are assumed to be the predominant vegetation after the grasses.

3.5.4.1 Rooting Depth and Distribution

The rooting depth and distribution was described by the work of Jackson *et al.* (1996) using the equation:

$$Y = 1 - \beta d \qquad (4)$$

where Y is the cumulative root fraction (a proportion between 0 and 1) from the soil surface to depth d (cm), and β is the fitted 'extinction coefficient', which Jackson *et al.* (1996) estimates as 0.943 for both grassland and boreal forest biomes. Hence, the same rooting depth and distribution (Figure 3.8) were used to represent both grasses and forest growth.

The maximum rooting depth is approximately 1.2 m, with 95% in the top 0.5 m of the cover system. This is like the root characteristics described in Klinka *et al.* (2000) for tree species in the region.

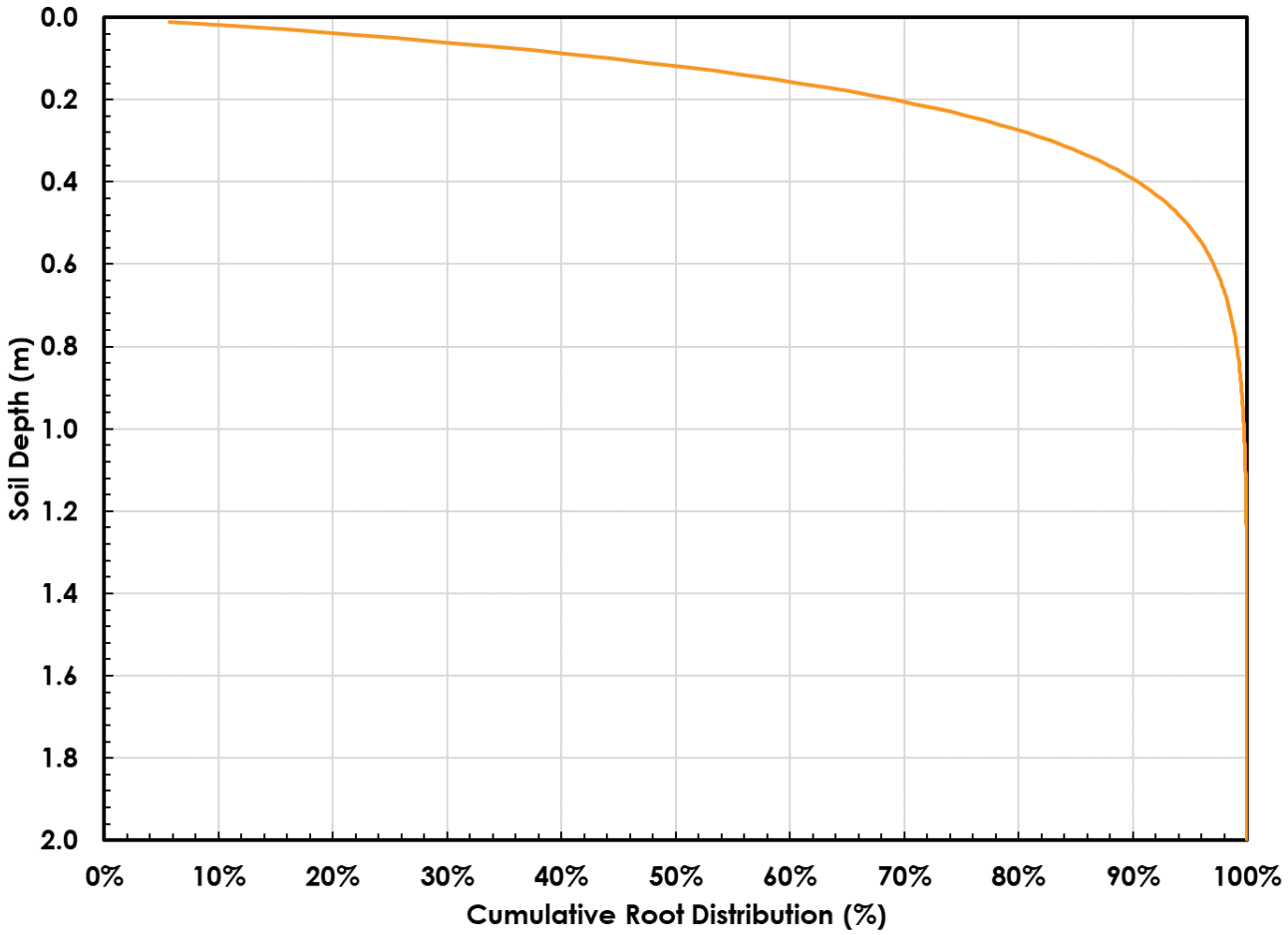


Figure 3.8: Estimated rooting depth and distribution for grasses and forest growth at Tenas Project.

3.5.4.2 Leaf Area Index and Percent Ground Cover

The Leaf Area Index (LAI) for grasses is estimated to be 1.7 with a percent ground cover of 70%. Once forest and understory species establish, LAI is estimated to increase to 2.3 with a percent ground cover of 85%. During the first seven years of vegetation, the LAI was increased annual by 0.3, starting at an LAI of 0.3, to gradually reach the mature forest vegetation LAI of 2.3.

3.5.4.3 Plant Water Limiting Function

Lack of available water and/or high evaporative demands will cause most plants to biologically react by closing stoma, reducing transpiration, and reducing metabolic reactions (Saxton, 1982). Under continued and increasing stress, the plant will reach its permanent wilting point (PWP), at which point transpiration is estimated to cease. The plant water limiting function (PWLF) defines the reduction in transpiration due to increased soil suction conditions. In general, the PWLF is defined to start to reduce at 10 kPa and stop transpiration entirely at a PWP of 1,500 kPa. This function was used to simulate grasses

growing on the cover system. Lopushinsky and Klock (1974) measured the PWLF for conifer species, which produced the PWLF (Figure 3.9). This PWLF was used to simulate forest growth.

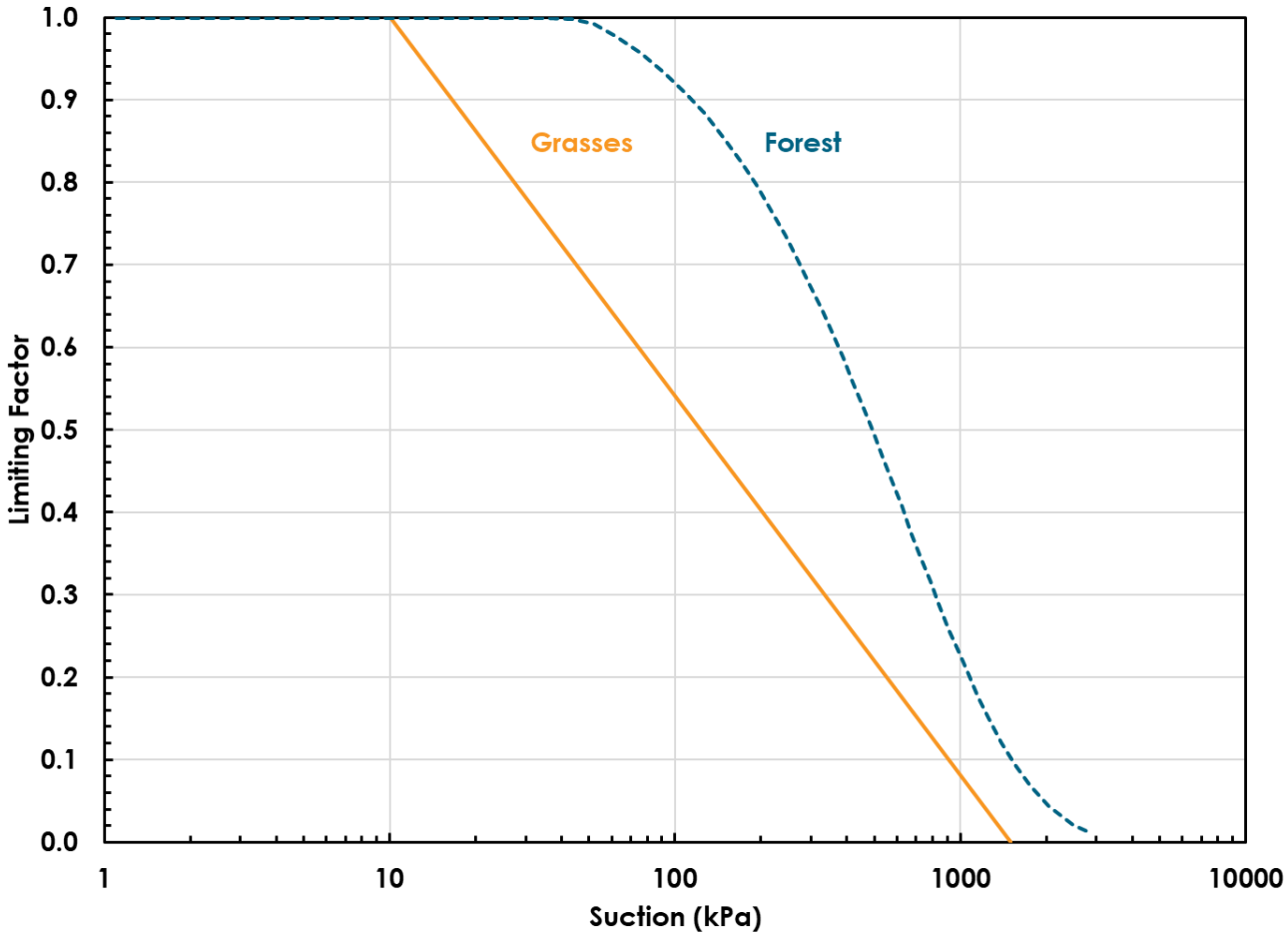


Figure 3.9: PWLFs estimated to simulate grasses and forest growth.

3.5.4.4 Growing Season

To define the growing season, the following assumptions were made:

- The growing season starts once the snowpack is completely melted and mean daily air temperature is above 5°C.
- The growing season ends once the minimum temperature after September 1 drops below 0°C.

3.5.5 Lower Boundary Conditions

The lower boundary condition was assumed to be a unit hydraulic gradient for the 1D simulations. This boundary condition assumes that the movement of water at the depth of the lower boundary is no longer influenced by atmospheric forces and is moving downwards only due to gravity.

3.5.5.1 Initial Conditions

The initial conditions for the 1D SPA model were obtained by running the models twice, using the final conditions of the first simulation as the initial conditions of the second simulation. This is done to remove the subjectivity of the ascribed initial conditions from the model results. The initial conditions of the 2D and 3D models were based on the results of the 1D SPA model.

3.5.6 Geochemical Model

Source terms for the NAG pit backfill were developed using a geochemical model based on the facility specific conceptual model. Source terms were modelled using both mechanistic reactive transport models and geochemical scale-up models. Source terms were developed for three scenarios; two cover system scenarios, a poorly graded till and sandstone mine rock scenario and a well graded till and blended mine rock (60% siltstone, 35% mudstone and 5% sandstone) with internal layers scenario and a third well graded till and blended mine rock (60% siltstone, 35% mudstone and 5% sandstone) without internal layers scenario. Source terms for the NAG pit backfill can be found in Appendix A.

3.5.6.1 Geochemical Model Methodology

Reactive transport models utilized the geochemical code PHREEQC to apply mineralogical kinetics that applicable to NAG mine rock from the Project. The purpose of the reactive transport model was to incorporate mineral kinetics, water flow, and oxygen availability to simulate the evolution of sulfide oxidation rates, metal leaching, and carbonate dissolution simultaneously over a long-term timeframe. Reaction kinetics were calibrated to NAG mine rock barrel tests that are ongoing at the Tenas site (SRK, 2022b). The geochemical scale-up model utilized NAG barrel tests from the Tenas project to calculate loading rates of parameters that are not strongly influenced by sulfide oxidation and carbonate dissolution. Source terms of these parameters were scaled up to conditions representative of the NAG backfill.

Parameters that were modelled via the reactive transport model included pH, alkalinity, SO_4, Al, Ag, As, Ca, Co, Cr, Cd, Cu, Fe, Hg, Mg, Mn, Na, Ni, Pb, Si, Sr, Sn, U, V, Zn, NO_3, NH_3, and NO_2. The mechanistic reactive transport model was developed in two phases:

- ***Phase 1*** – The reactive transport model was developed and calibrated using mineralogical data and barrel test leachate data for representative NAG mine rock.

- ***Phase 2*** – The calibrated reactive transport model for the barrel test was scaled to field conditions by adjusting for the differences in hydrology, temperature, and mass of the reactive particle size fraction (< 6.35 mm in the barrel tests) between the barrel tests and full-scale conditions.

Parameters not incorporated into the reactive transport model were estimated using a geochemical scale-up model. This model was developed by scaling up barrel test production rates by using facility- and site-specific adjustment factors to obtain representative weathering rates. Parameters incorporated in this model included Ba, B, Be, Li, K, P, Si, Sr, Ti, and Zr. Adjustment to full scale conditions was completed by applying scaling factors for reactive particle size, and water contact.

3.5.6.2 Model Development

Reactive transport models were developed for the B1 and B2 barrel tests combined and for the B7 barrel test. The B1 and B2 were combined as these barrels were constructed using the same NAG mine rock samples while the B7 barrel test used different NAG mine rock samples.

Mineralogical analyses for several samples used in the barrel tests reported a single mass for the dolomite-ankerite phase while other samples reported a unique mass for both dolomite and ankerite. Therefore, for modelling purposes it was assumed that if dolomite-ankerite was reported, 50% of this mass was dolomite and the other 50% was ankerite. The reactive mineralogy modelled in the NAG barrel tests is summarized in Table 3.5.

Table 3.5: Summary of reactive minerology in NAG mine rock barrel tests (from SRK, 2022b).

Mineral Name	Unit	B1 and B2	B7	Median NAG Mine Rock
Calcite	wt.%	2.3	0.5	1.4
Siderite	wt.%	7.3	7.8	2.0
Dolomite	wt.%	8.9	8.0	6.9
Ankerite	wt.%	7.9	3.4	0.4
Pyrite	wt.%	4.6	2.0	0.8

Metal leaching was assumed to be predominantly associated with pyrite oxidation. Therefore, metal(loid)s were added to the pyrite mineral phase in PHREEQC based on the molar ratio of respective metals to SO_4 in barrel test leachates (Table 3.6). Divalent cationic metals were assumed to substitute for Fe, while anionic metals were assumed to substitute for S in the pyrite structure. This enabled the release of metals commonly associated with pyrite to be closely coupled to the kinetics of pyrite dissolution in the model.

Table 3.6: Molar composition of pyrite phase used in the reactive transport model.

Parameter	Molar Composition
Fe	0.9999384
Ni	0.0000177
Co	0.0000051
Cu	0.0000044
Pb	0.0000014
Mn	0.000022
Zn	0.0000097
Se	0.000045
As	0.0000013
S	1.99995

Kinetic rate equations were added to the reactive transport model based on published rate law equations and reaction rate coefficients for both the oxidation of sulfide minerals and the dissolution of carbonate phases (Table 3.7). Due to limited kinetic and thermodynamic data associated with ankerite in literature it was assumed that ankerite had the same thermodynamic and kinetic properties as dolomite in the model.

The hydraulic regime of the reactive transport model of the barrel test followed leachate collection events when leachate volumes were measured. Material properties for the reactive particle size fraction (< 6.35 mm) from the water balance modelling were used and assumed a porosity of 0.35 and degree of saturation of 50%, corresponding to a volumetric water content of 0.175 m^3/m^3 in the barrels.

Table 3.7: Kinetic rate equations for minerals included in the reactive transport model.

Mineral	Rate Equation	Rate Constant, k (mol m^{-2} s^{-1})	Effective Rate Constant, k_{eff} (mol m^{-3} s^{-1})	Reference
Pyrite	$Pyrite\ Rate = k\ x \left(\frac{A}{V}\right)\ x\ [H^+]^{-0.11}\ x\ [O_2]^{0.5}\ x \left(\frac{m}{m_0}\right)^{\frac{2}{3}}$	1.1×10^{-10}	-	Williamson and Rimstidt, 1994 Xu et al., 1998
Calcite	$Calcite\ Rate = (k_1\ x\ [H^+] + k_2\ x\ [H_2CO_3])\ x \left(\frac{A}{V}\right)\ x \left(\frac{m}{m_0}\right)^{\frac{2}{3}}$	$k_1 = 10^{-0.05}$ $k_2 = 10^{-0.05}$	-	Chou et al., 1989
Dolomite	$Dolomite\ Rate = k\ x \left(\frac{A}{V}\right)\ x\ [H^+]^{0.5}\ x \left(\frac{m}{m_0}\right)^{\frac{2}{3}}$	$10^{-2.59}$	-	Chou et al., 1989
Ankerite	$Ankerite\ Rate = k\ x \left(\frac{A}{V}\right)\ x\ [H^+]^{0.5}\ x \left(\frac{m}{m_0}\right)^{\frac{2}{3}}$	$10^{-2.59}$	-	*
Siderite	$Siderite\ Rate = k_{eff}\ x \left(\frac{m}{m_0}\right)^{\frac{2}{3}}$	-	$10^{-9.52}$	Dresel, 1989

*Ankerite kinetic characteristics were assumed to be similar to dolomite.

3.5.6.3 Calibration

The reactive transport model was calibrated by adjusting mineral-specific surface areas or effective rate coefficients (Table 3.8) such that modelled barrel test results were comparable to the median leachate concentration of the barrel tests. A separate model was calibrated for the B1 and B2 barrel tests together and another model was calibrated to the B7 barrel test.

Substantial cation exchange between Na, Ca, and Mg was observed in the barrel tests. Carbonate dissolution releases Ca^{2+} and Mg^{2+} that subsequently exchange for Na^{+} from surface sites of the host rock (likely associated with clay minerals). The resulting leachate from the barrel tests is enriched in Na concentrations. In order to calibrate the reaction rate for carbonate dissolution, Ca and Mg concentrations needed to be back calculated from the Na concentrations in the leachate. It was assumed that all Na was sourced from cation exchange with Ca and Mg. The ratio of Ca/Na exchanged compared to Mg/Na exchanged was calculated based on the ratio of ion exchange coefficients of Ca-Na and Mg-Na exchange pairs (Bruggenwert and Kamphorst, 1982).

Table 3.8: Calibrated values of kinetic rate equation parameters.

Mineral	Calibrated Surface Area/Volume (dm^{-1})		Calibrated Effective Rate Coefficient (mol m^{-3} s^{-1})	
	B1 and B2	B7	B1 and B2	B7
Pyrite	-	-	$10^{-8.585}$	$10^{-8.72}$
Calcite	0.01	0.009	-	-
Dolomite	0.02	0.007	-	-
Ankerite	0.01	0.007	-	-
Siderite	-	-	$10^{-9.523}$	$10^{-9.523}$

Following the calibration of the barrel test scale reactive transport model, there was good agreement between modelled parameter concentrations and measured leachate chemistry from the mine rock barrel tests (Figure 3.10). The average of the calibrated factors for the B1/B2 and B7 models were used in the full-scale reactive transport model.

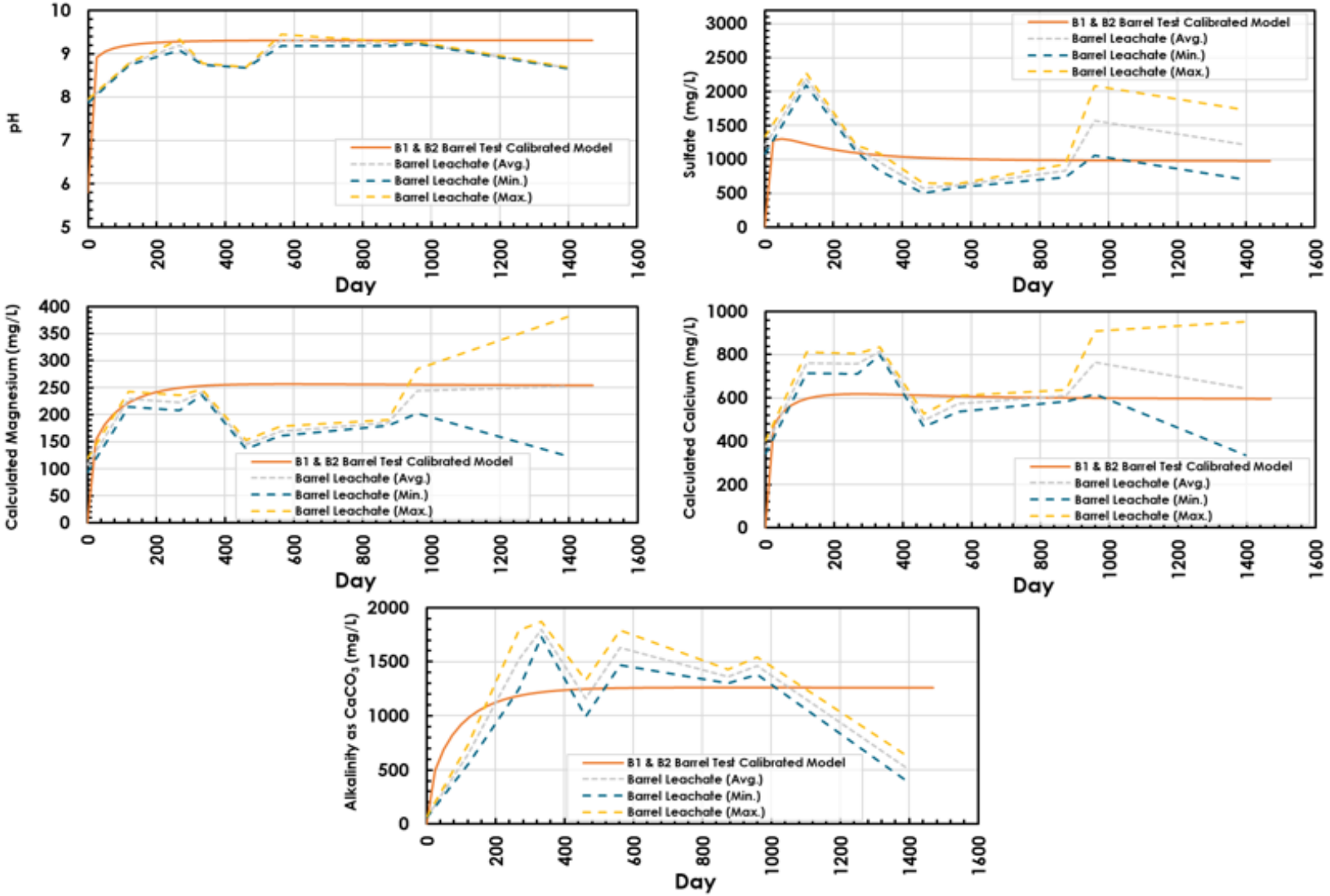


Figure 3.10: Parameter concentrations for the calibrated model versus minimum, maximum, and average B1 and B2 leachate concentrations.

3.5.6.4 Model Scale-Up

Once the geochemical model was calibrated to the field barrel tests, the reactive transport model was scaled up using the nominal height of respective strips (Table 3.1) within the NAG backfill with the final output being stockpile drainage chemistry. GeoStudio oxidation modelling provided stockpile temperature and thickness of both oxic reactive and suboxic non-reactive material. Hydraulic information such as the timing and amount of seepage for the full-scale model was provided by the GoldSim hydrological and seepage models for bare surface and covered conditions.

Temperature Adjustments

The effects of temperature on the literature values for the rate constant of each mineral modelled in the NAG backfill was adjusted using the Arrhenius equation (Equation 4; Gautelier et al., 1999). The temperature adjustment was performed on barrel tests that used an average annual air temperature of 4.9°C. The average internal NAG backfill temperature was estimated to be approximately 3°C based on the GeoStudio oxidation model, and this temperature was used to scale the reaction rates.

$$k_T = k_{25°C}\, x\, A^{\left(\frac{-Ea}{R\Delta T}\right)} \quad (5)$$

Where:

- k_T is the rate constant at temperature, T;
- $k_{25°C}$ is the rate constant at 25°C;
- A is the pre-exponential factor (2.718 s^{-1});
- E_a is the activation energy (kJ);
- R is the molar gas constant (8.314 J K^{-1} mol^{-1}); and
- ΔT is the temperature difference $\left(\frac{1}{T\ (K)} - \frac{1}{298.15\ K}\right)$

The activation energies used for the temperature correction of mineral reaction rates are summarized in Table 3.9. Only pyrite, calcite, and dolomite were adjusted for temperature, while reactivity of siderite was maintained under standard conditions due to a lack of information.

Table 3.9: Activation energies for minerals included in the reactive transport model.

Mineral	Activation Energy (kJ)	Reference
Pyrite	70	Lowson, 1982
Calcite	20.9	Sajwan and Evangelou, 1991
Dolomite	36.1	Herman and White, 1985
Siderite	-	-

3.5.6.5 Reactive Transport Model of the NAG Backfill

Infiltrating Water Chemistry

The chemical signature of the infiltrating water (or net percolation) was assumed to be equal to the water chemistry of a site-specific overburden barrel test because of the use of overburden in the cover system (Table 3.10). Initial NAG backfill porewater was assumed to be similar to the initial water chemistry sampled from the NAG barrel tests. An average from the B1/B2 and B7 tests was used in the full-scale model.

Table 3.10: Reactive transport model infiltrating water and initial NAG backfill porewater composition.

Parameter	Unit	Infiltrating Water Composition	Initial Porewater Composition
pH	-	8.2	7.9
Sulfate (Dissolved)	mg/L	118	1,205
Alkalinity (Total as $CaCO_3$)	mg/L	0.1	106
Chloride (Dissolved)	mg/L	0.25	3.83
Fluoride (Dissolved)	mg/L	0.13	-
Arsenic (Dissolved)	mg/L	0.00078	0.00012
Calcium (Dissolved)	mg/L	45.0	372
Cobalt (Dissolved)	mg/L	0.00016	0.0057
Copper (Dissolved)	mg/L	0.011	0.001
Iron (Dissolved)	mg/L	0.005	0.01
Lead (Dissolved)	mg/L	0.00014	0.0001
Magnesium (Dissolved)	mg/L	26.0	107
Manganese (Dissolved)	mg/L	0.00052	0.034
Nickel (Dissolved)	mg/L	0.00025	0.0074
Potassium (Dissolved)	mg/L	1.6	3.23
Selenium (Dissolved)	mg/L	0.00058	0.11
Sodium (Dissolved)	mg/L	19	512
Zinc (Dissolved)	mg/L	0.0005	0.0043

Parameter	Unit	Infiltrating Water Composition	Initial Porewater Composition
Nitrate (as N)	mg/L	0.44	56.8
Ammonia (Total)	mg/L	0.0088	7.18
Nitrite (as N)	mg/L	0.0039	1.31

Blasting residues from placed mine rock will leach inorganic nitrogen. Initial source terms of N species (NO_3, NO_2, and NH_4) were determined based on the powder factor (0.5 kg/m^3) and proportion of inorganic N produced based on emulsion and ammonium nitrate fuel oil (ANFO) composition (SRK, 2022a). To calculate the mass of residual N in the NAG backfill, the method by Ferguson and Leask (1988) was used and assumed the following:

- 0.9% of N from ANFO and 5.1% of N from the emulsion as available for leaching (Ferguson and Leask, 1988);
- ANFO is 75% ammonium-nitrate and emulsion comprise the remaining 25%; and
- Leachable inorganic N load from explosives will result in:
    - 87% as NO_3-N;
    - 11% as NH_4-N; and
    - 2% as NO_2-N.

Nitrogen species leaching was incorporated into the reactive transport model by using an assumed volumetric water content, the total volume of material placed, and the mass of residual N to calculate an N concentration leaching from the backfill. This methodology was used so that the hydraulic transport time simulated in the reactive transport model could also be applied to N leaching. Nitrogen species concentrations used in the model are shown in Table 3.10.

Mineralogy

The NAG backfill reactive transport models included both reactive primary minerals and secondary minerals. Reactive primary minerals were limited to pyrite, calcite, dolomite, ankerite, and siderite. Additional minerals (e.g., primary silicates) were identified in the geochemical characterization program (SRK, 2022b); however, these minerals were assumed to be kinetically insignificant during the modelled time scale due to the neutral pH of the NAG backfill.

Elevated concentrations of dissolved metals under neutral pH conditions can result in the precipitation of secondary minerals. Secondary mineral precipitation was incorporated into the final reactive transport and geochemical scale-up model results by completing equilibrium modelling on the source terms. Minerals applied in the equilibrium modelling step were generally consistent with those used in the

SRK (2022a) (Table 3.11). Surface adsorption reactions were not included in the model because it was assumed that adsorption was accounted for in the barrel test leachate chemistry, therefore, the pyrite stoichiometric composition used in the model.

Table 3.11: Model equilibrium phases.

Phase	Empirical Formula	Phase	Empirical Formula
Aluminum Hydroxysulfate	$Al_4(OH)_{10}SO_4$	Ferrihydrite	$Fe(OH)_3$
Amorphous Aluminum Hydroxide	$Al(OH)_3$	Goslarite	$ZnSO_4 \cdot 7H_2O$
Azurite	$Cu_3(CO_3)_2(OH)_2$	Gypsum	$CaSO_4 \cdot 2H_2O$
Barite	$BaSO_4$	Lead Molybdenum Oxide	$PbMoO_4$
Birnessite	$MnO_2 \cdot nH_2O$	Malachite	$Cu_2(CO_3)(OH)_2$
Brochantite	$Cu_4SO_4(OH)_6$	Manganite	MnO(OH)
Calcium Molybdenum Oxide	$CaMoO_4$	Melanterite	$FeSO_4 \cdot 7H_2O$
Calcite	$CaCO_3$	Nickel Hydroxide	$Ni(OH)_2$
Chalcanthite	$CuSO_4 \cdot 5H_2O$	Otavite	$CdCO_3$
Carbon Dioxide	$CO_{2(g)}$	Zinc Hydroxide	$Zn(OH)_2$
Copper Hydroxide	$Cu(OH)_2$		

Note: Phases in **BOLD** not included in SRK (2022a).

Flow Transport

Hydrology is an important component of the NAG reactive transport models. The NAG backfill hydrology used results from the GoldSim hydrological and seepage models (Section 3.3). The NAG backfill reactive transport models were split into 23 cells (Figure 3.3), each having different geometries and mine rock storage capacities (Table 3.1).

Material properties of the bulk mine rock in the NAG backfill were included in the full-scale geochemical model but were adjusted to account for only the reactive fraction of the mine rock (assumed to be the -6.35 mm fraction as used in the barrel tests). Flow of water was assumed to be primarily matrix-dominated. Flow calculations for the model assumed the following material properties for the finer fraction:

- Porosity – The porosity of the finer fraction of the NAG backfill was assumed to be 0.4;
- Degree of saturation – The degree of saturation of the finer fraction in NAG backfill at steady-state was 0.61 based on GoldSim modelling; and
- Proportion of reactive mine rock – The -6.35 mm size fraction typically controls the reactivity of mine rock. The NAG backfill was assumed to composed of 20% -6.35 mm particles based on existing material properties.

The adjusted reactive volumetric water content of the facility was calculated to be 0.049 based on these values and was used to determine cell-specific pore volumes in the reactive transport model.

The volume of water entering of the NAG backfill will change once the mine rock is covered. Additionally, this volume will be different based on the cover system scenario modelled. Three hydrological periods were defined in NAG backfill reactive transport models for each of the modelled scenarios, respectively:

1) ***Bare Surface*** – This period represented conditions prior to cover system placement on the cell. During this phase, mine rock is exposed to the atmosphere and infiltration rates are 273 mm/year for the poorly graded till and sandstone scenario (Scenario #1) and 143 mm/year for both the well graded till and mixed mine rock scenario (Scenario #2) and the no internal layers scenario (Scenario #3). The duration of the bare surface period is cell-specific and is dependent on the construction and reclamation schedule.

2) **Covered Grass NP** – This phase represented construction of the closure cover on a cell and occurred for a period of five years as re-vegetation occurs. Once the cover system is placed, both oxygen ingress and NP decrease. Once covered, NP decreases to 197 mm/year in the poorly graded till and sandstone scenario (Scenario #1). Due to differences in runoff between the bare surface and the grass covered surface in the well graded till and mixed mine rock scenarios (Scenarios #2 and #3) NP increased to 148 mm/year.

3) **Covered Forest NP** – This phase represents maturing of vegetation on the constructed cover system and occurred for the remaining model time following the covered grass NP period. As vegetation matures and shifts to forest dominated NP decreases. Covered forest NP was 124 mm/year for the poorly graded till and sandstone scenario (Scenario #1) and 72 mm/year for the well graded till and mixed mine rock scenarios (Scenarios #2 and #3).

Effects of Suboxic Zones

Potential establishment of suboxia within the NAG backfill is a function of limiting re-supply of oxygen from the atmosphere, either laterally across angle of repose slopes of the backfilled mine rock, or vertically across the horizontal surface of the backfilled mine rock. Limiting airflow capacity across the horizontal surfaces can also limit lateral advective gas transport, in the absence of a limitation of the presence of a limitation on airflow capacity on the sloping backfilled surface, depending on the lift height of the backfilled mine rock. Initially, oxygen concentration in the pore-space of the backfilled NAG material will be atmospheric (nominally 20.9% by volume). Sulfide material within the NAG material will consume this oxygen; however, if re-supply of oxygen is limited as discussed previously, then the availability of further sulfide oxidation will be limited, thus creating suboxic conditions within each encapsulated cell. As oxygen decreases, and the geochemical conditions shift from oxic to suboxic, additional biological reactions that are favourable in the absence of oxygen may occur; however, to provide a conservative prediction of the effect of suboxic conditions, these biological reactions were

not included in any modelling. This is a substantively conservative approach given that in suboxic conditions, and provided there is opportunity and hydraulic residence time for denitrification, it is reasonable to postulate that bio-reduction of selenium will also occur (see MEND, 2015). Once suboxic conditions are established, the reactive transport model assumes that pyrite oxidation only occurs in the oxic zone nearer to the surface, while carbonate minerals can still react throughout the entire depth of the cell as their reactivity is not dependent on oxygen availability in the NAG backfill.

Given the geometry of the NAG backfill, and the different cell volumes and placement timing, zones of suboxia will vary based on the location of the cell in the NAG backfill. Cell-specific reactive and suboxic zone thicknesses for all cells were determined from the GeoStudio Oxygen Ingress Model results (Section 4.2). The development of suboxic conditions occurred at depths of roughly 13 m below the cover system in the poorly graded till and sandstone scenario and occurred within the 3.3 m cover system in both the well graded till and mixed mine rock scenarios. In order to remain conservative and capture sulfide oxidation and subsequent reactions occurring in the mine rock mix cover system, a depth to suboxic conditions of 3 m was used in the well graded cover system scenarios. Cell-specific reactive and suboxic zone thicknesses are summarized below in Table 3.12.

Table 3.12: Cell-specific reactive and suboxic zone thicknesses.

Cell	Total Cell Height (m)*	Reactive Zone Thickness (m)		Suboxic Zone Thickness (m)	
		Poorly Graded	Well Graded	Poorly Graded Scenario	Well Graded Scenarios
1	28	13	3	15	25
2	44	13	3	31	41
3	44	13	3	31	41
4	51	13	3	38	48
5	64	13	3	51	61
6	51	13	3	38	48
7	33	13	3	20	30
8	24	13	3	11	21
9	28	13	3	15	25
10	13	13	3	-	10
11	6	6	3	-	3
12	7	7	3	-	4
13	6	6	3	-	3
14	6	6	3	-	3
15	5	5	3	-	2
16	5	5	3	-	2
17	5	5	3	-	2

Cell	Total Cell Height (m)*	Reactive Zone Thickness (m)		Suboxic Zone Thickness (m)	
		Poorly Graded	Well Graded	Poorly Graded Scenario	Well Graded Scenarios
18	7	7	3	-	4
19	6	6	3	-	3
20	10	10	3	-	7
21	8	8	3	-	5
22	4	4	3	-	1
23	3	3	3	-	-

*Not including cover system

Construction Schedule

The construction schedules of the NAG backfill will influence timing of seepage quality. Placement of the cover system will limit oxygen ingress and NP into the NAG backfill as well as the maturing of the cover system vegetation. The construction schedule of both the backfill and cover system was simplified to allow for implementation into the reactive transport model. These simplifications and assumptions were:

- All cells are built instantaneously, and the complete height of the cell was available for reaction once it was placed in the model.
- Cover system placement for the backfill is indicated by the construction schedule provided by Telkwa and detailed in Section 3.5.1.
- Once covered, there will be an instantaneous decrease in NP.
- Once forest vegetation is developed (assumed to be five years after cover construction) there will be an instantaneous decrease in NP.
- Once covered, there will be an approximately 15-year period for suboxic conditions to develop. It was assumed there will be an instantaneous shift to suboxic conditions 15 years after cover construction.

Additional NAG Backfill Reactive Transport Model Assumptions

- Mineralogy was homogeneous throughout the NAG backfill and is defined based on the NAG mine rock barrel tests compositions;
- Mine rock placement in the NAG backfill will include mine rock characterized as the average composition from the mine rock barrel tests;

- Cell-specific annual loads (mg/year) were calculated based on the reactive transport concentration outputs and total annual flow volumes for each cell respectively;
- The timing of seepage from each cell of the reactive transport model was based on wetting-up timing from the GoldSim model. A cell was assumed to be wetted-up when total annual seepage from the GoldSim model was greater or equal to 50% of the steady state total annual seepage for that cell. Prior to a cell being wetted-up, parameter concentrations were set to equal the concentration from Year 0 of the reactive transport model. Seepage rates are negligible during the time the cell is wetting up, and therefore load from the cell is also negligible;
- After an initial wetting-up phase, final concentrations for the NAG backfill were calculated using the total annual loads (mg/year) from each cell divided by the total annual seepage rate (L/year);
- Seasonality was not included in the model. A constant NP based on bare surface, covered grass surface, or covered forest surface was assumed for all cells;
- Cell-specific seepage volumes and concentrations were mixed at the base of the NAG backfill based on the modelled seepage rates from the GoldSim model;
- The performance of the cover system remains constant;
- Parameter concentrations below detection limit were assigned values of the detection limit used in the barrel test leachate chemistry reporting;
- During the bare surface period, seepage and porewater is in equilibrium with the atmosphere ($\log(pO_2) = -0.7$ and $\log(pCO_2) = -3.5$); and
- During the cover period, pore water residing in the suboxic zone is in equilibrium with O_2 concentrations of 0.1% ($\log(pO_2) = -3.0$).

3.5.6.6 Geochemical Scale-Up Model

Parameters that were not included in the reactive transport model were modelled using a geochemical scale-up model. The geochemical scale-up model functioned by:

- Developing average loading rates for parameters not included in the reactive transport models using the leachate data from the B1, B2 and B7 barrel tests; and
- Scaling-up the production rates based on material placement, hydraulic properties, and material properties.

Soluble salts can accumulate before kinetic experiments are initiated and result in rapid flushing of constituents. Potentially due to the age of the weathering experiments or variations in collected water volumes it was not entirely apparent if the B2 and B7 barrel tests had fully flushed stored soluble salts; however, loading rates from the last three samples collected were used.

Similar to the reactive transport model, loading rates derived using the barrel leachate data were scaled up based on differences between the barrel test scale and the full backfill scale. The scale up included two scaling factors: particle size and mine rock contact. Temperature scaling factors were not applied as it was assumed that the average temperature in the barrels will be comparable to the full-scale NAG backfill.

Particle Size Factor

The reactive particle sizes of the NAG backfill were assumed to be limited to the < 6.35 mm portion and assumed to be 20% of the bulk mine rock; therefore, the scaling factor for particle size was set to 0.2. This particle size scaling factor was previously used by SRK (2022a) to scale HCT loading rates to field scale.

Contact Factor

The reactivity of the mine rock will be limited to the < 6.35 mm portion; however, only a portion of the seepage will react with this portion given the likely presence of preferential flow paths. A contact factor of 0.5 was used in previous source term development (SRK, 2022a) and was deemed reasonable for the current model.

Geochemical Scale-Up Model Assumptions

The following assumptions were included in the geochemical scale-up model:

- Cell-specific annual loads (mg/year) were calculated based on the annual mass of mine rock for the cell in the given year and the loading rate of the parameter (mg/kg/year). After an initial wetting-up phase, final concentrations for the NAG backfill were calculated using the total annual loads (mg/year) for all cells divided by the total annual seepage rate (L/year);

- The wetting up period for the backfill was estimated as the period of time prior to total annual seepage volumes equalling roughly 50% of steady state annual seepage volumes (roughly 17 years). Seepage concentrations prior to wetting up were set to concentrations calculated for the first year after wetting up;

- Once a cell was fully constructed and wetted-up, the annual loads were assumed to remain constant and estimated parameter concentrations were only influenced by changes in annual seepage rates;

- The seepage of all cells mixed at the base of the NAG backfill;

- Loading rates remained constant and were not affected by changes in mineralogy or kinetic rates over time; and

- Solubility controls were applied by including the geochemical scale-up modelled parameters in the equilibrium modelling discussed in Section 3.5.6.5.

3.5.7 Nitrogen Sensitivity Scenarios

Two additional model sensitivity scenarios were simulated to assess nitrogen source terms under different blasting loss conditions. A high nitrogen source term scenario was run to simulate a scenario where nitrogen losses from blasting are greater than expected. A low nitrogen source term scenario was run to simulate decreased nitrogen losses from blasting resulting from blast hole liners used as a source mitigation.

Nitrogen source term scenarios were modelled by either increasing or decreasing the residual nitrogen available for leaching as calculated by Ferguson & Leask (1988). This in turn increased or decreased the initial pore-water concentration of nitrogen species applied in PHREEQC for the respective nitrogen scenarios (Table 3.13). All other reactive transport model inputs remained the same as in the Well-Graded with No Internal Layers models. The high nitrogen source term scenario represents an increase of 56.25% residual nitrogen. Blasthole liners are assumed to decrease nitrogen losses by 37.5% in the low nitrogen source term scenario (D. Farmer, personal communication, July 15, 2024).

Table 3.13: Initial nitrogen species concentrations in NAG backfill porewater for nitrogen source term scenarios.

Parameter	Unit	Initial Porewater Composition		
		Well-Graded No Internal Layers Scenario	High Nitrogen Scenario	Low Nitrogen Scenario
Nitrate (as N)	mg/L	65	102	41
Ammonia (Total)	mg/L	8.3	13	5.2
Nitrite (as N)	mg/L	1.5	2.4	0.94

4 MODELLING RESULTS AND DISCUSSION

4.1 Water Balance Results

A landform water balance was completed to develop simplified boundary conditions for the 2D GeoStudio oxidation modelling and the 3D GoldSim modelling. A summary of the 1D water balance for the two material combination scenarios is provided in Table 4.1. The well-graded till and mine rock mix material properties and results were also used for the no internal layers scenario.

Table 4.1: Summary of water balance results for the two material combination scenarios.

Scenario	Total Precipitation (mm)	Rainfall (% of PPT)	Snow (% of PPT)	Actual Evapotranspiration (% of PPT)	Runoff (% of PPT)	Sublimation (% of PPT)	Net Percolation (% of PPT)
PG Till and Sandstone (Bare)	649	61%	39%	32%	2%	24%	42%
PG Till and Sandstone (Grass – 5 years)	616	52%	48%	49%	0%	19%	32%
PG Till and Sandstone (Forest – 73 years)	655	61%	39%	57%	3%	21%	19%
WG Till and Mine Rock Mix (Bare)	649	61%	39%	42%	12%	24%	22%
WG Till and Mine Rock Mix (Grass – 5 years)	616	52%	48%	54%	3%	19%	24%
WG Till and Mine Rock Mix (Forest – 73 years)	655	61%	39%	59%	9%	21%	11%
Mine Rock Mix (Bare)	649	61%	39%	28%	28%	21%	22%*

PG Till – Poorly Graded Till; WG Till – Well Graded Till; PPT – Precipitation

* - Surface net infiltration into the bare Mine Rock Mix

An average year of daily net percolation rates for each time period (bare, grass, and forest) were used as inputs in the 2D GeoStudio models and stochastically in the 3D GoldSim model.

4.2 2D GeoStudio Oxidation Model Results

The predicted development of the suboxic zone within the NAG backfill mine rock within the Open Pit with time for the poorly graded till and sandstone mine rock scenario is shown in Figure 4.1. The suboxic zone development for the well graded till and mine rock mix scenario is shown in Figure 4.2, while the suboxic zone development for the scenario with no internal overburden layers is shown in Figure 4.3. The models indicate that the long-term depths to suboxia are, on average, 13 m for the poorly graded till with sandstone mine rock scenario and 3.3 m for the well graded till with the mine rock mix scenario, as well as the no internal overburden layers scenario. The suboxic zone takes approximately 15 years to form in each strip in the poorly graded till with sandstone mine rock scenario. In both the well graded till with the mine rock mix scenario and the no internal layers scenario (using well graded till and mine rock mx material properties), it took approximately 13 years for the suboxic zone to form in each strip. These results were used to estimate the development of the suboxic zone within the 3D GoldSim model.

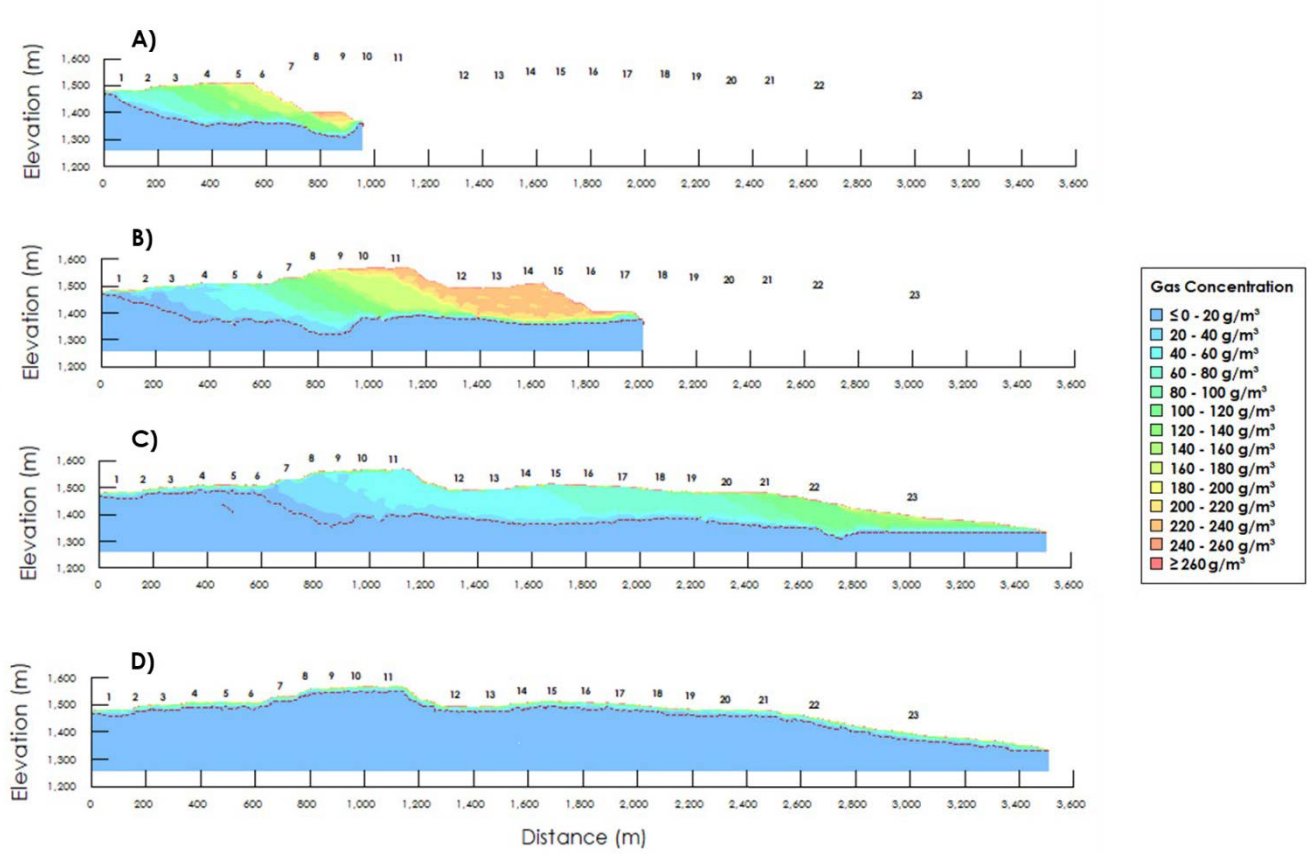


Figure 4.1: Development of suboxic zone for the poorly graded till and sandstone mine rock scenario (outlined by red dashed line in figures, which represents the zone at, or below, an O_2 concentration of 13 g/m³ or 1 vol.%) for the poorly graded till and sandstone mine rock scenario at A) Year 12; B) Year 17; C) Year 23; and d) Year 36/Long Term.

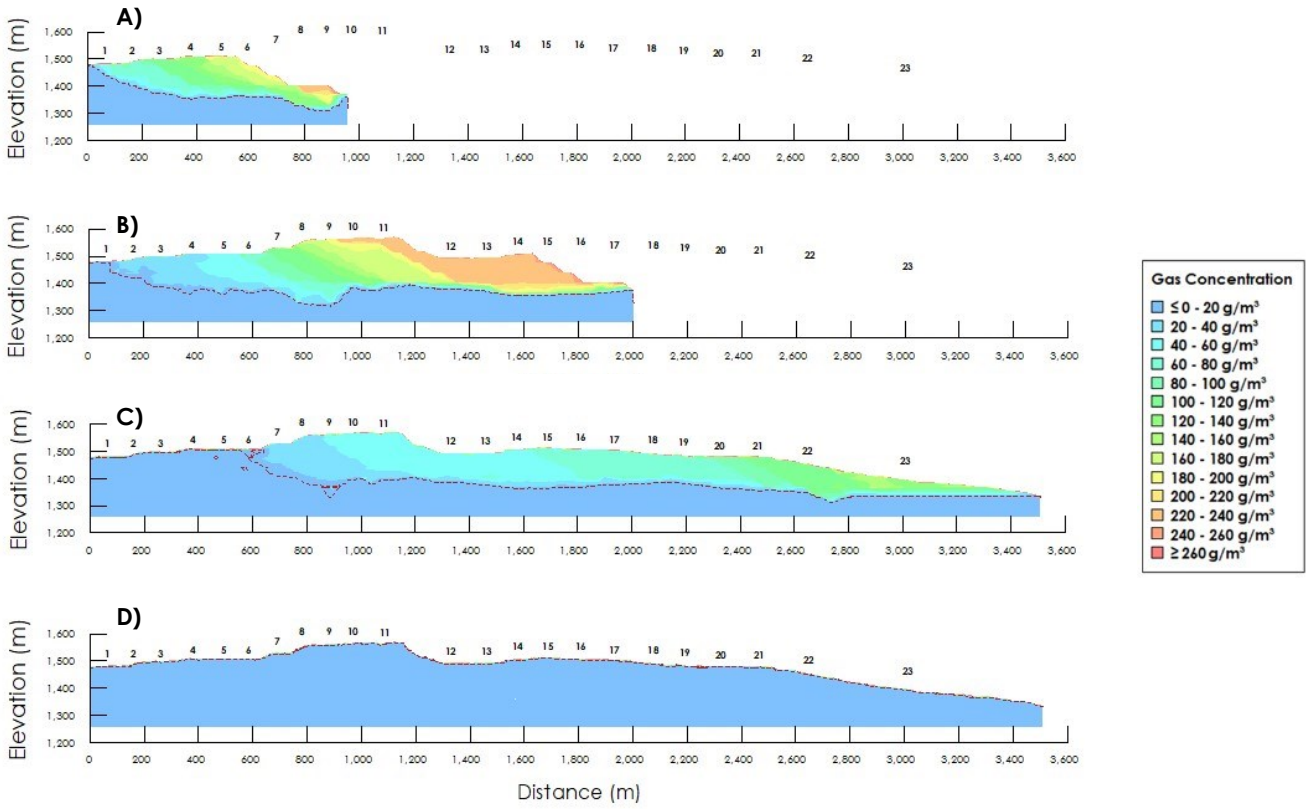


Figure 4.2: Development of suboxic zone (outlined by red dashed line in figures, which represents the zone at, or below, an O_2 concentration of 13 g/m³ or 1 vol.%) for the well graded till and mine rock mix scenario at A) Year 12; B) Year 17; C) Year 23; and d) Year 36/Long Term.

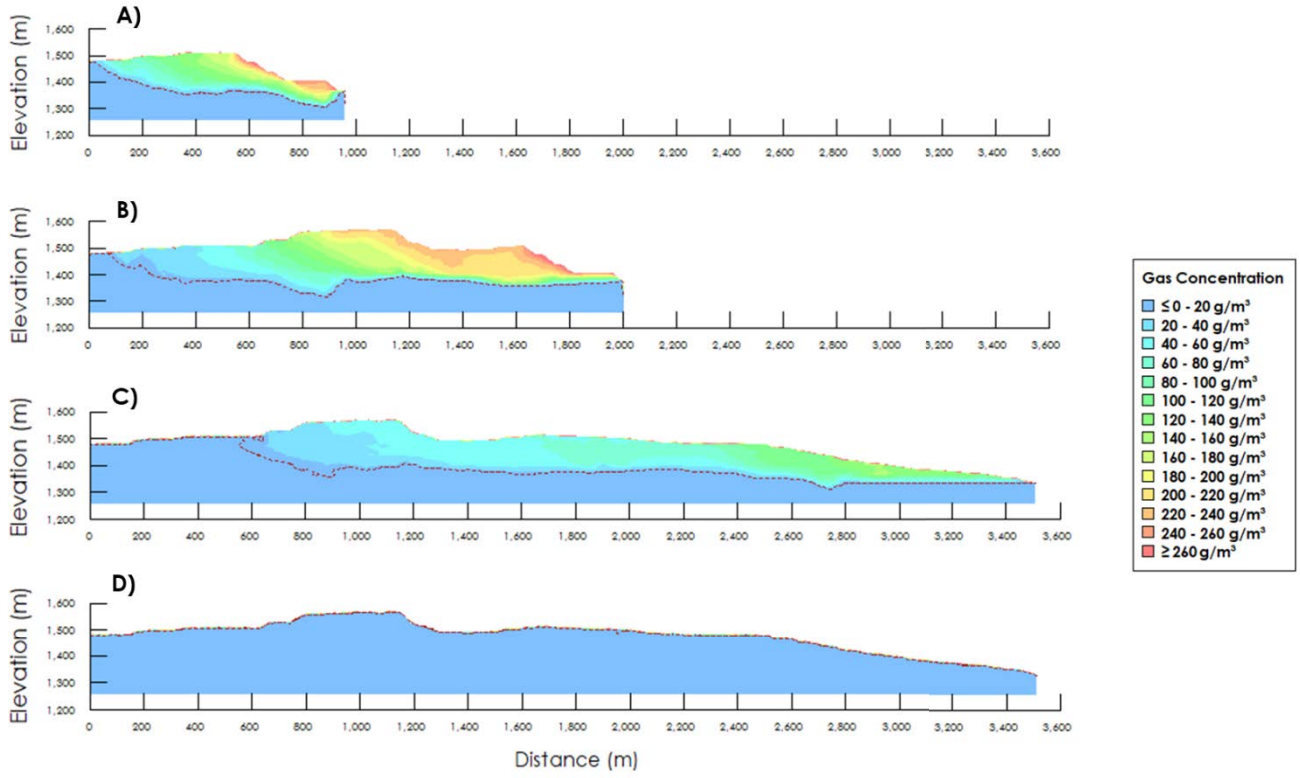


Figure 4.3: Development of suboxic zone (outlined by red dashed line in figures, which represents the zone at, or below, an O_2 concentration of 13 g/m³ or 1 vol.%) for the no internal layers scenario at A) Year 12; B) Year 17; C) Year 23; and d) Year 36/Long Term.

4.3 3D GoldSim Model Results

The 3D GoldSim model was run on calendar time with 2023 representing the first year of placement, or Year 6. The results are therefore presented in calendar time out to 2150, which represents Year 133.

4.3.1 Total Seepage

The total seepage rate of the backfilled NAG mine rock in the Open Pit was simulated in GoldSim for 100 realizations. The mean value, along with the 5th and 95th percentiles of the model results, are plotted in Figure 4.4 for all modelled scenarios. The models predicted long-term stabilized seepage rates from the covered and vegetated backfilled NAG mine rock that were between 31,000 m³/month and 36,000 m³/month for the poorly graded till and sandstone mine rock scenario, and between 14,500 m³/month and 16,000 m³/month for both the well graded till with mine rock mix scenario and the no internal layers scenario. The poorly graded till and sandstone mine rock scenario showed greater variability in monthly seepage rates due to the coarser texture of the material. Prior to cover system placement, the well graded till with mine rock mix scenario differs from the no internal layers scenario

due to the lack of overburden layers, but once the cover system is placed, the two scenarios show almost identical results.

The model results indicate that the backfilled NAG mine rock in the Open Pit will be wetted up, as indicated by the stabilization of the seepage rates, approximately 40 years following completion of construction for the poorly graded till and sandstone mine rock scenario. The finer texture of the material in both the well graded till with mine rock mix scenario and the no internal layers scenario resulted in a longer wetting up period, reaching stabilization approximately 80 years following the completion of construction.

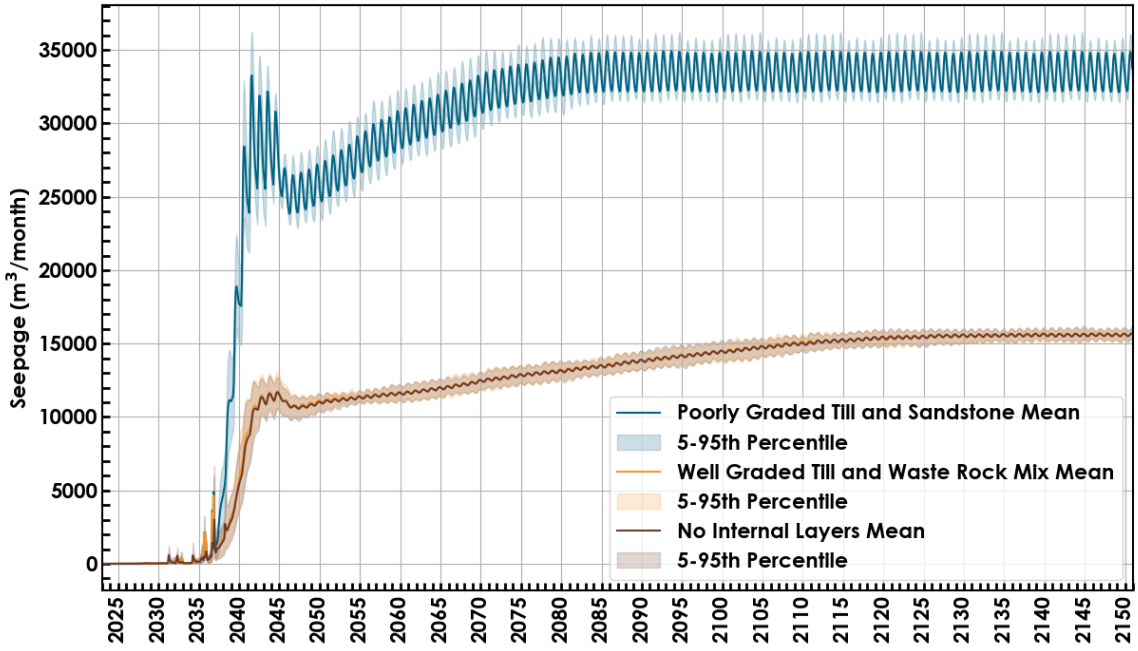


Figure 4.4: Range of seepage rates simulated by the GoldSim model for the backfilled NAG mine rock in the Open Pit for all the scenarios.

4.3.2 Total Storage

The estimated total stored water volume within the backfilled NAG mine rock for the modelled scenarios are shown in Figure 4.5. The modelled water volume increases with mine rock placement during construction before starting to stabilize once construction is complete and the cover system is placed. Similar to the seepage results, the water volume within the backfilled NAG mine rock is estimated to stabilize after approximately 40 years for the poorly graded till and sandstone mine rock scenario and approximately 70-80 years for both the well graded till with mine rock mix scenario and the no internal layers scenario. Once the stored water volume stabilized, very small variations in water volume were predicted, due to the variation in seasonal NP inputs.

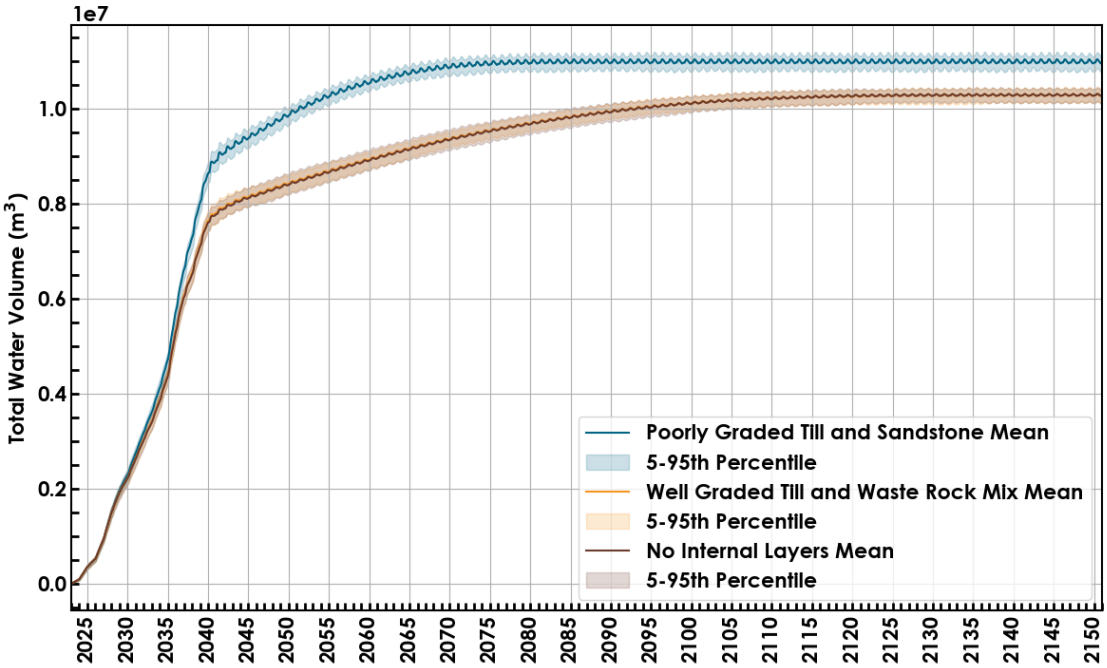


Figure 4.5: Range of total water volume within the backfilled NAG mine rock in the Open Pit simulated by the GoldSim model.

4.3.3 Oxygen Ingress

The range of oxygen ingress from the 3D GoldSim model for all modelled scenarios is presented in Figure 4.6. The well graded till with mine rock mix scenario and the no internal layers scenario both showed a higher long term average oxygen ingress despite having a shallower depth to suboxia. Due to the limitations of the GoldSim model representing each strip as a 1D column, convection is limited to density driven convection (free convection) and oxygen ingress is dominated by diffusion. In this case, with a shallower depth to suboxia, the concentration gradient across the cover system is greater, resulting in a higher diffusive oxygen ingress rate. In the poorly graded till and sandstone mine rock scenario, the depth to suboxia is greater, reducing the concentration gradient across the cover system and lowering the overall diffusive flux. When forced convection (advection) is accounted for, it is likely that the oxygen ingress rate for the poorly graded till and sandstone mine rock scenario would show higher oxygen ingress rates.

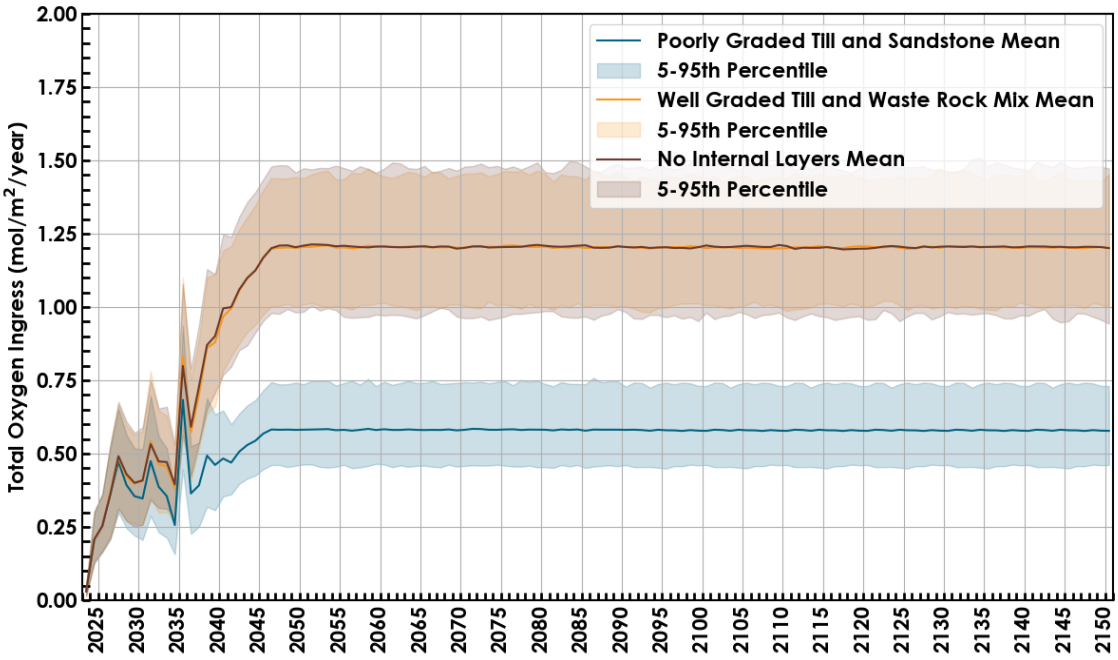


Figure 4.6: Range of oxygen ingress rates simulated by GoldSim for the backfilled NAG mine rock in the Open Pit for all modelled scenarios.

4.4 Geochemical Modelling Results

This section summarizes the results of the geochemical models of the NAG backfill cover scenarios and present a time-series of source terms for the NAG backfill during the bare surface, covered grass surface, and covered forest surface timeframes. Model results of select parameters are presented in Figure 4.7 to Figure 4.11. Tables of source terms and annual loads from the three scenarios of the NAG backfill are provided in Appendix A.

In the three modelled scenarios, the cover system construction decreases NP and limits oxygen ingress into the mine rock within the NAG backfill. Suboxic zones were established in almost half of the cells in the poorly graded till and sandstone mine rock scenario and in all but one cell in the well graded till and mine rock mix scenarios (Section 4.3.3). Sulfide oxidation only occurred in the reactive oxic zones, as a result, loading rates of oxidation products are partly controlled by the amount of suboxic mine rock in the backfill.

In general, concentrations for most modelled parameters were similar between the poorly graded till and sandstone and well graded till and mine rock mix scenarios. While the amount of suboxia increased substantially for the well graded till and mine rock mix scenarios, the volume of water infiltrating the surface of the NAG backfill decreased, resulting is less water available to dilute oxidation products from the limited reactive zone. Despite concentrations remaining similar between the three scenarios, the

annual load exiting the NAG backfill as seepage in both the well graded till and mine rock mix scenarios is roughly half the annual load exiting in the poorly graded till and sandstone scenario.

The onset of seepage from the NAG backfill occurs as cells from the model become fully wetted-up, which begins in approximately 2036. Areas of the backfill that contain smaller thicknesses of mine rock wet up faster than areas with greater thicknesses; therefore, the effects of seepage from thinner cells are observed in the model results faster than the effects from thicker cells. Thicker cells will generally produce poorer water quality than thinner cells because there is a longer pathway for water to accumulate oxidation products (ignoring the effects of suboxic zones).

After the initial wetting-up period and prior to the development of suboxic zones within the models, concentrations of parameters associated with pyrite oxidation (e.g., SO_4, Se, Cu, etc.) generally have an increasing trend. Concentrations stabilize and tend to decrease once suboxic conditions are established. After the onset of seepage, Se concentrations range between 0.03 to 0.07 mg/L, with the onset of lower concentration occurring near the end of the modelled timeframe. Concentrations of Se are trending lower near the end of the modelled timeframe for the well graded till and mine rock mix scenario. Concentrations of SO_4 and Cu are approximately 1,500 mg/L and 0.015 mg/L, respectively, near the end of the modelled timeframes for all three scenarios. Annual loads of parameters related to pyrite oxidation in the well graded till and sandstone scenarios are approximately half of the poorly graded till and mine rock mix scenario. Annual loads are generally similar between the two well graded till and waste rock mix scenarios with the largest differences observed in the last ~20 years of the modelled timeframe.

Nitrate concentrations and loads peak in the initial years that seepage occurs and are controlled by flushing of blast residues that are on the surface of the mine rock. The release of NO_3 (and subsequently NO_2 and NH_4) is spread out over many decades as the transport time is variable in different areas of the backfill depending on the cell thickness.

A slight variation in pH was observed between the modelled scenarios with the well graded till and sandstone scenarios having a slightly higher value. This is likely a result of the longer residence time of water in the suboxic zone of the carbonate-rich mine rock in the well-graded model scenario.

The NAG backfill source terms from the three modelled scenarios are summarized in Table 4.2 and represent the concentrations of parameters at the end of the modelled timeframe (year 2150). The source terms are also compared to source terms developed by SRK (2024). It should be noted that source terms developed by both SRK and Okane utilized NAG field bin data to derive source terms. Differences in source terms are attributed to the implementation of reactive transport modelling and the consideration of changes in net percolation and oxygen ingress into the NAG backfill as a result of the modelled cover systems. In general, the source terms from the current modelling work are lower than the initial SRK source terms. Due to the incorporation of wetting up in the current model, the largest differences in loading rates between both sets of models are observed in the initial 20 years of the model

time frame. Once the modelled loading rates stabilize, mass loads of constituents such as SO_4 and Se range from approximately 50 to 75% lower than the initial SRK loads (Figure 4.12).

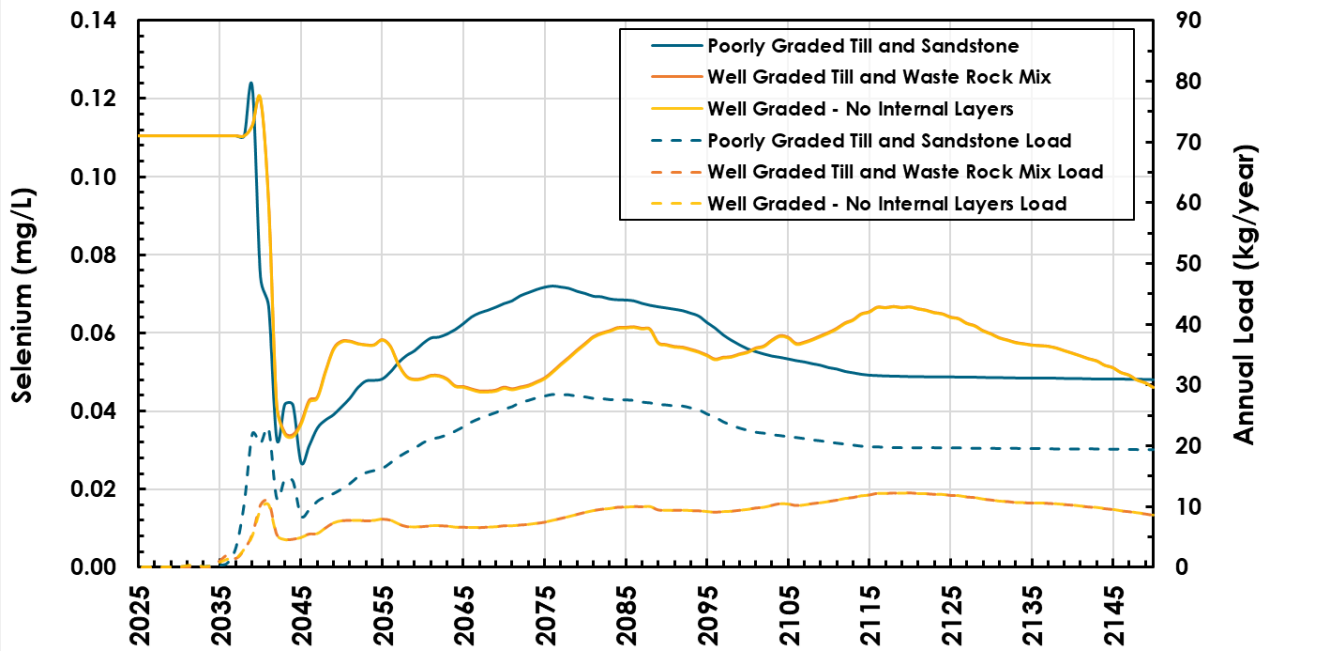


Figure 4.7: Evolution of Se concentrations and annual loads from NAG backfill seepage in the three cover system and mine rock scenarios.

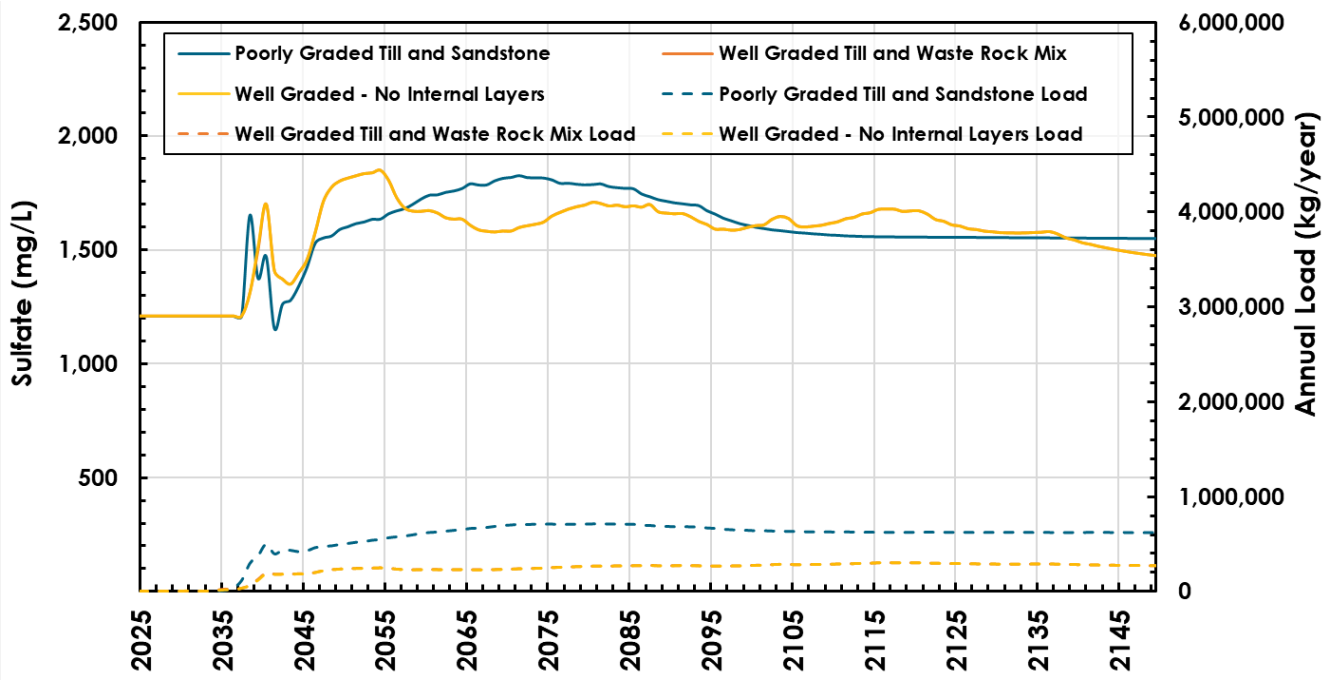


Figure 4.8: Evolution of SO_4 concentrations and annual loads from NAG backfill seepage in the three cover system and mine rock scenarios.

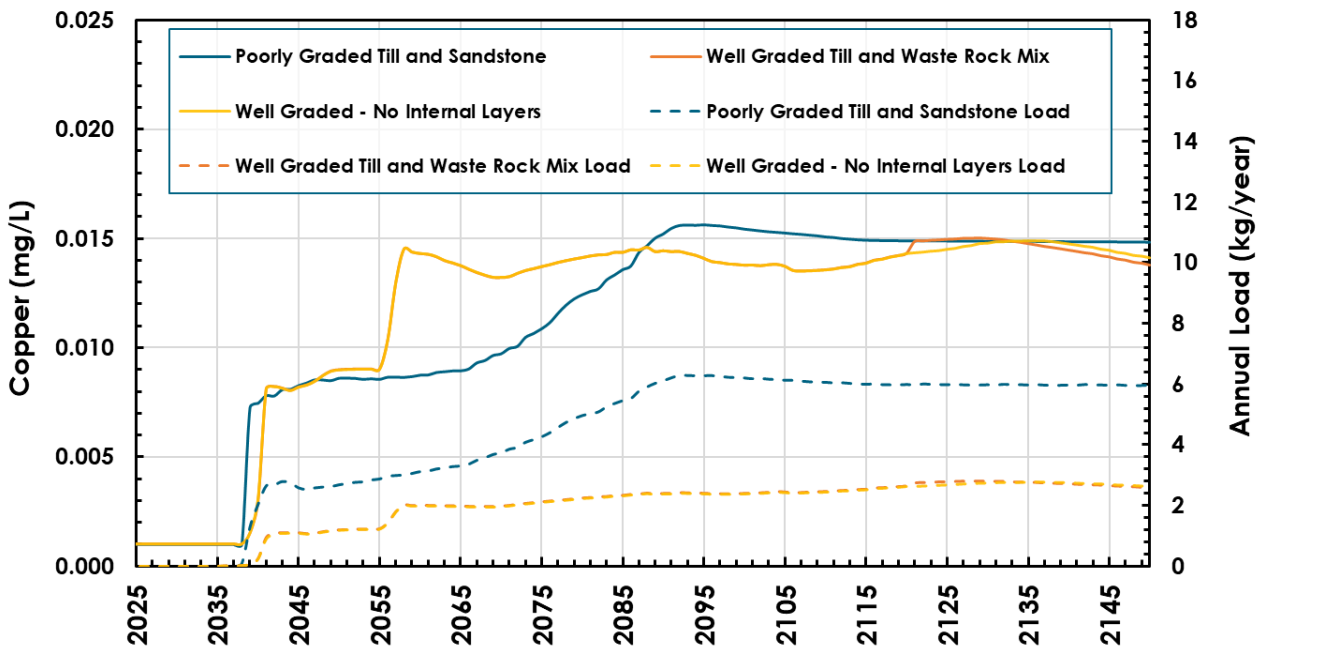


Figure 4.9: Evolution of Cu concentrations and annual loads from NAG backfill seepage in the three cover system and mine rock scenarios.

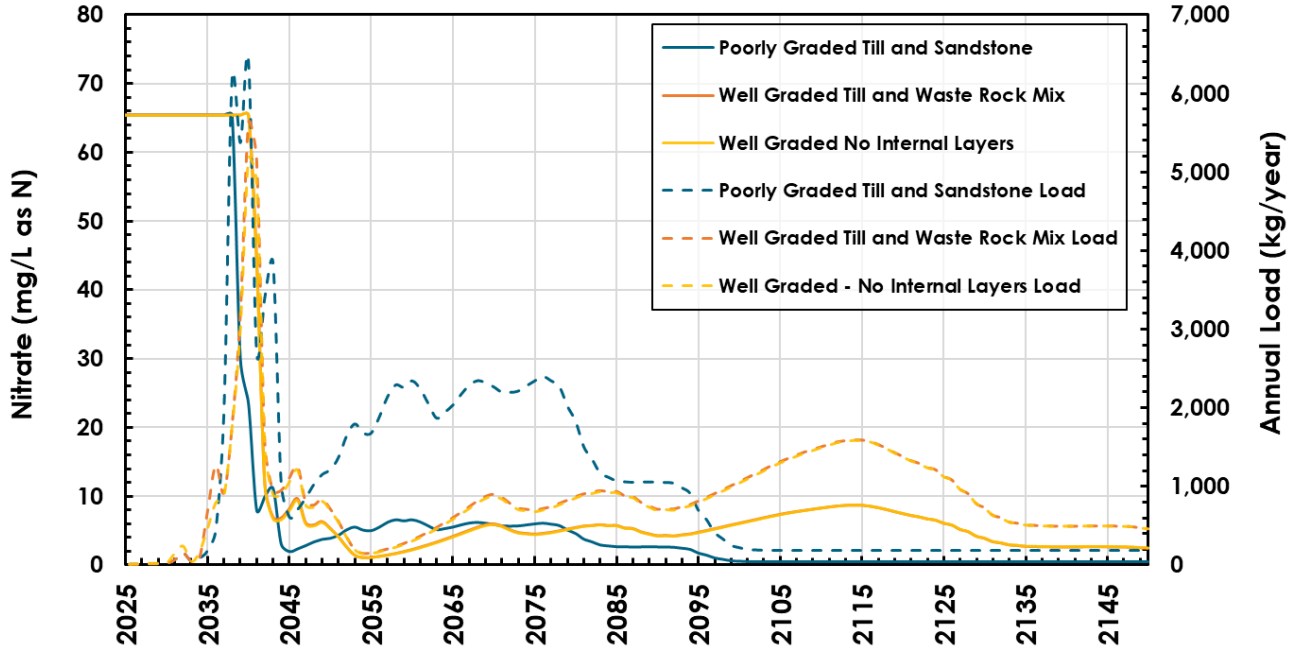


Figure 4.10: Evolution of NO_3 concentrations and annual loads from NAG backfill seepage in the three cover system and mine rock scenarios.

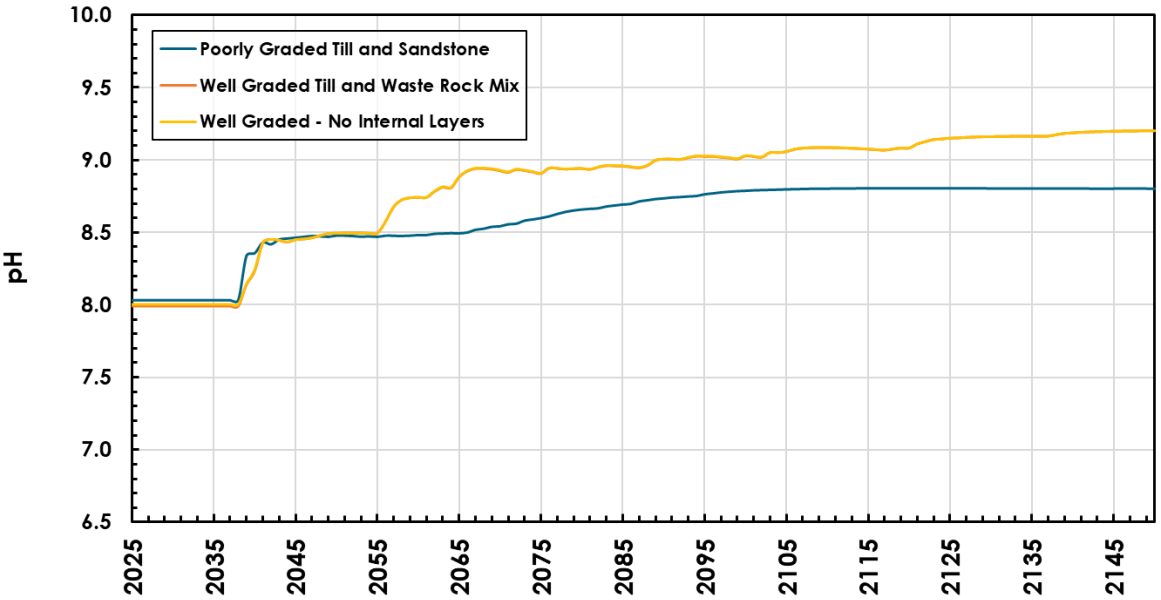


Figure 4.11: Evolution of pH from NAG backfill seepage in the three cover system and mine rock scenarios.

Table 4.2: Comparison of source terms of the NAG backfill from various model scenarios.

Parameter	Well Graded Model Source Term[1]	Well Graded with No Internal Layers Source Term[1]	Poorly Graded Model Source Term[1]	NAG Backfill – 2021-2029		NAG Backfill – 2030-2100	
				NAG Typical[2]	NAG High[2]	NAG Typical[2]	NAG High[2]
pH	9.2	9.2	8.8	8.2	8.4	8.3	8.5
Alkalinity (mg/L as $CaCO_3$)	3,445	3,445	1,947	1,904	3,398	2953	4468
Ca (mg/L)	0.85	0.85	2.6	53	95	79	119
Mg (mg/L)	84	84	54	32	57	48	72
K (mg/L)	24	24	11	13	23	20	31
Na (mg/L)	1,335	1,335	1,083	1,614	2,881	2505	3790
Cl (mg/L)	17	17	7.9	24	43	37	56
SO4 (mg/L)	1,476	1,476	1,550	1,803	3,218	2772	4193
Al (mg/L)	0.27	0.27	0.075	0.0045	0.0072	0.0064	0.0089
Sb (mg/L)	0.0026	0.0026	0.0027	0.0029	0.0052	0.0045	0.0069
As (mg/L)	0.0019	0.0019	0.002	0.0043	0.0078	0.0067	0.01
Ba (mg/L)	0.0034	0.0034	0.0026	0.045	0.08	0.069	0.1
B (mg/L)	0.78	0.78	0.36	0.45	0.8	0.7	1.1
Cd (mg/L)	0.00004	0.00005	0.00004	0.000095	0.00017	0.00014	0.00021
Cr (mg/L)	0.0005	0.0005	0.0005	0.0018	0.0033	0.0029	0.0043
Co (mg/L)	0.0039	0.0039	0.0042	0.015	0.026	0.02	0.03

Parameter	Well Graded Model Source Term[1]	Well Graded with No Internal Layers Source Term[1]	Poorly Graded Model Source Term[1]	NAG Backfill – 2021-2029		NAG Backfill – 2030-2100	
				NAG Typical[2]	NAG High[2]	NAG Typical[2]	NAG High[2]
Cu (mg/L)	0.014	0.014	0.015	0.016	0.029	0.025	0.037
Fe (mg/L)	0.05	0.05	0.05	0.00012	0.0001	0.00011	0.0001
Pb (mg/L)	0.0036	0.0036	0.004	0.0048	0.0085	0.0074	0.011
Li (mg/L)	0.43	0.43	0.2	0.14	0.24	0.21	0.32
Mn (mg/L)	0.016	0.016	0.017	0.11	0.19	0.12	0.18
Hg (mg/L)	0.000005	0.000005	0.000005	0.00001	0.000018	0.000016	0.000023
P (mg/L)	0.27	0.27	0.13	0.026	0.046	0.04	0.06
Mo (mg/L)	0.05	0.05	0.052	0.17	0.3	0.26	0.39
Ni (mg/L)	0.013	0.013	0.014	0.029	0.051	0.04	0.061
Se (mg/L)	0.046	0.046	0.048	0.089	0.16	0.14	0.21
Si (mg/L)	2.8	2.8	1.3	4.6	8.3	7.1	11
Ag (mg/L)	0.000035	0.000035	0.000037	0.000074	0.00013	0.00011	0.00017
Sr (mg/L)	1.4	1.4	0.64	0.83	1.5	1.3	1.9
Sn (mg/L)	0.0005	0.0005	0.0005	0.00078	0.0014	0.0012	0.0018
Tl (mg/L)	0.000036	0.000036	0.000037	0.000078	0.00014	0.00012	0.00018
U (mg/L)	0.016	0.016	0.017	0.019	0.034	0.029	0.044
V (mg/L)	0.005	0.005	0.005	0.004	0.0072	0.0062	0.0095
Zn (mg/L)	0.01	0.01	0.01	0.032	0.058	0.046	0.07

[1] Source term represents the parameter value at the end of the modelled timeframe (year 2150).
[2] Source term from SRK (2024).

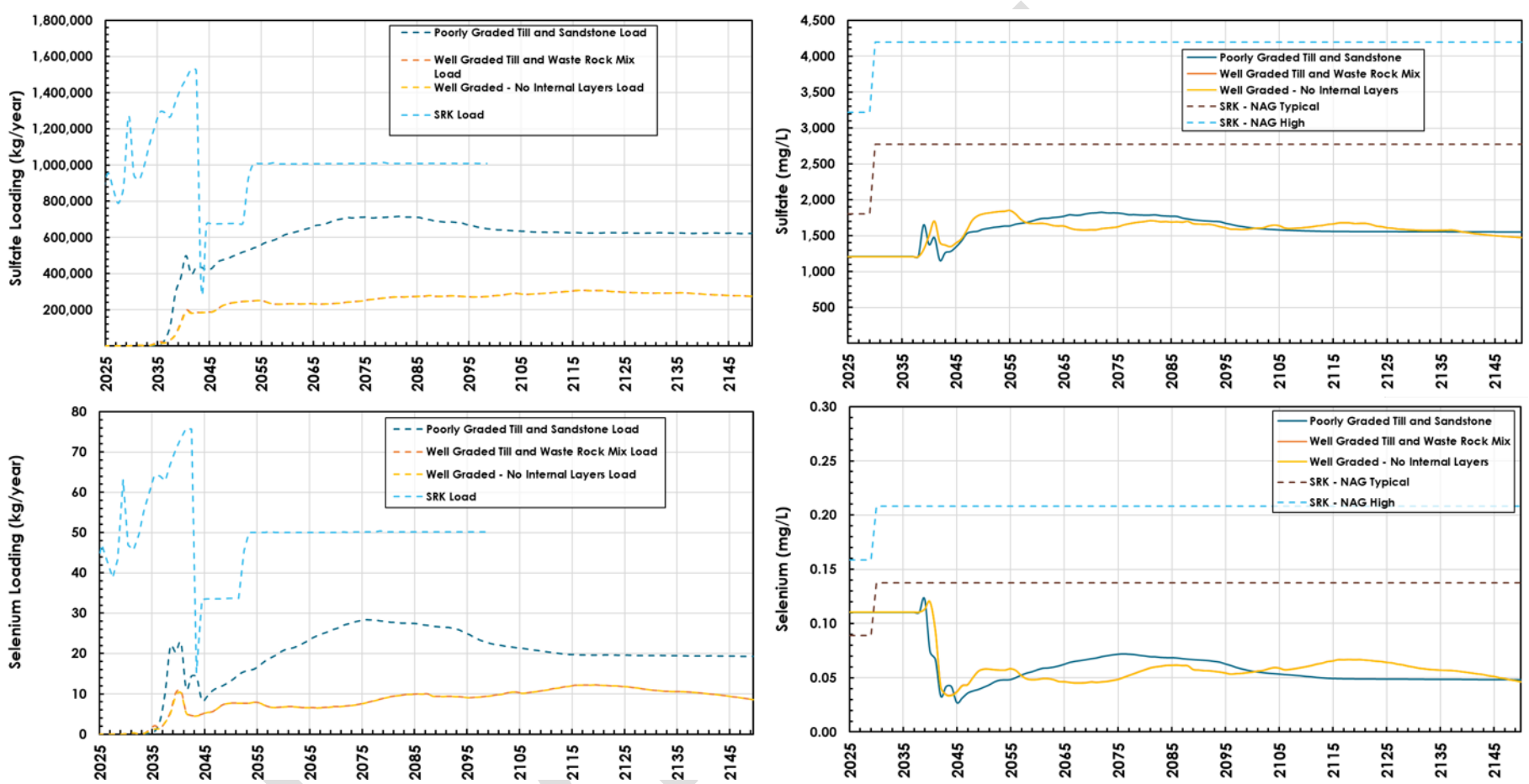


Figure 4.12: Summary of sulfate and selenium NAG backfill source terms and loading rates.

4.4.1 Nitrogen Source Term Scenarios

Nitrogen source terms decreased by 37.5% in the low nitrogen scenario and increased by 56.25% in the high nitrogen scenario throughout the first 15 years of the modelled timeframe as the initial porewater from each cell flushed out (Figure 4.13). Once individual cells began to be fully flushed, there were small variations in the percent change in nitrogen concentrations across sensitivities caused by dilution from cells that had been fully flushed of nitrogen. Overall, the differences in nitrogen source terms were similar to the 37.5% decrease or 56.25% increased applied in the respective sensitivity.

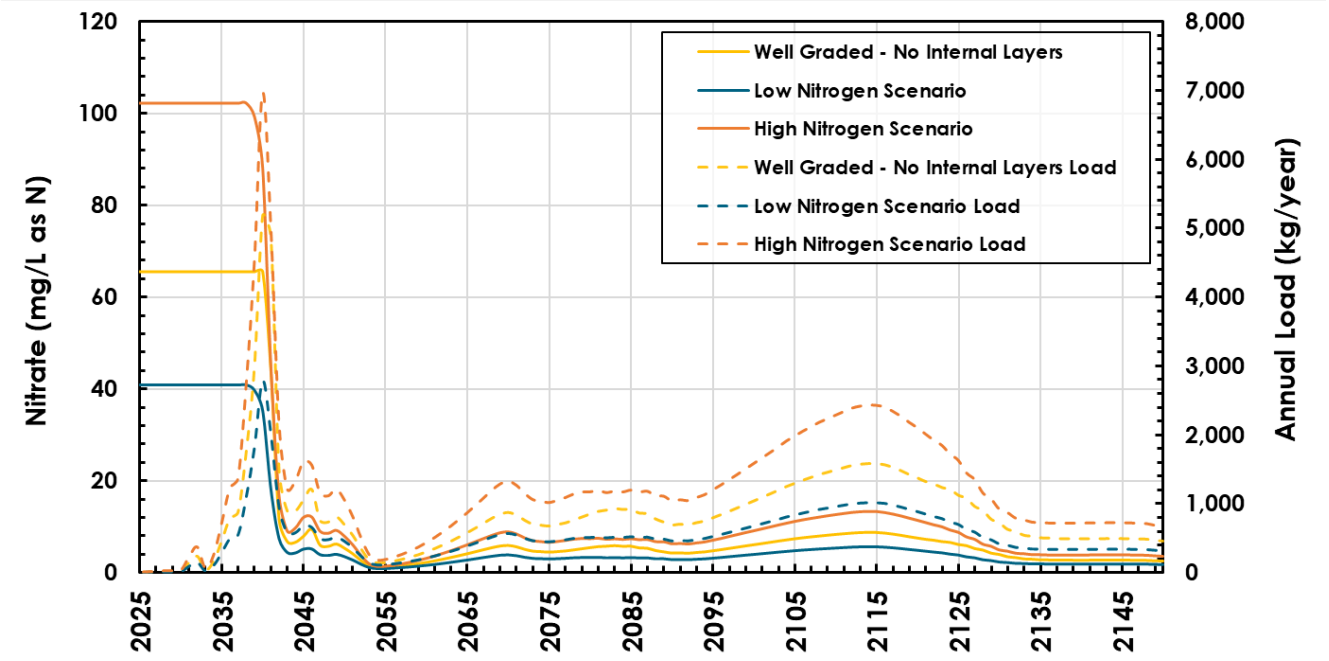


Figure 4.13: Summary of nitrate source terms and loading rates in the well graded – no internal layers scenario and two nitrogen source term scenarios.

5 CONCLUSIONS

The scope of this work was to provide Telkwa support in the development of source terms for three scenarios of backfilled NAG mine rock in lifts using bottom-up construction methodology with overburden covers. The objective of the backfilled design is to limit oxygen and water ingress to minimize the release of potential contaminants of concern such as selenium and sulfate to the receiving environment. Based on the modelling that was completed for this work, the following conclusions are made:

- GoldSim modelling indicates that the backfilled NAG mine rock in the Open Pit will be wetted up approximately 40 years following completion of construction for the poorly graded till and sandstone mine rock scenario. The well graded till with mine rock mix scenario and the no internal layers scenario will be wetted up approximately 80 years following the completion of construction due to the finer texture of material.

- Two-dimensional oxygen models indicate that the long-term depths to suboxia are, on average, 13 m for the poorly graded till and sandstone mine rock scenario and 3.3 m for the well graded till with mine rock mix scenario and the no internal layers scenario. The suboxic zone takes approximately 15 years to form in each strip modelled of the poorly graded till and sandstone mine rock once the cover system has been placed. In both the well graded till with mine rock mix scenario and the no internal layers scenario, the suboxic zone takes approximately 13 years to develop following cover system placement.

- It is likely that the oxygen ingress rate for the poorly graded till and sandstone mine rock scenario would be greater than the well graded till and mine rock mix scenarios.

- In general, concentrations in NAG backfill seepage for most modelled parameters will be similar between the three modelled scenarios.

- The decrease in oxygen ingress and infiltrating water into the NAG backfill for the well graded till and mine rock mix scenarios results in an annual chemical load (mass released per year) decrease of approximately half compared to the poorly graded till and sandstone mine rock scenario.

- As a result, mass loads of dissolved constituents such as selenium and sulfate from the NAG backfill are expected to decrease relative to initial source term and load balance models under the conditions modelled herein.

The NAG backfill source terms from this modelling work will be integrated into the site wide load balance model to quantify the effects of the backfill on water quality around the Tenas project.

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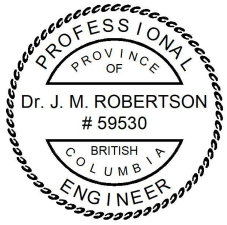
7 CLOSURE

We trust information provided is satisfactory for your requirements. Please do not hesitate to contact the undersigned for further information or questions.

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Appendix A

NAG Backfill Source Terms

Table A1. Source terms of the NAG backfill for the poorly graded cover system scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2023	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	16
2024	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	33
2025	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	57
2026	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	87
2027	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	116
2028	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	195
2029	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	221
2030	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	266
2031	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	961
2032	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	2,273
2033	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	710
2034	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	1,289
2035	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	2,755
2036	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	6,758
2037	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	30,026
2038	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	94,634
2039	8.3	1,652	609	12	0.022	0.0029	0.0015	0.0021	0.53	0.00005	21	0.0005	0.0068	0.002	0.05	0.0011	0.29	31	0.038	0.000005	0.056	0.011	0.19	17	0.12	1.9	0.00004	846	0.93	0.00004	0.0005	0.018	0.005	0.01	30	3.8	0.69	178,458
2040	8.4	1,376	625	12	0.023	0.0024	0.0014	0.0023	0.53	0.00005	18	0.0005	0.0044	0.0068	0.05	0.0013	0.29	27	0.023	0.000005	0.046	0.0085	0.19	17	0.074	1.9	0.000033	730	0.93	0.000033	0.0005	0.015	0.005	0.01	23	3.0	0.54	272,969
2041	8.4	1,472	753	9.4	0.028	0.0026	0.0015	0.0023	0.43	0.00005	13	0.0005	0.0041	0.008	0.05	0.0016	0.23	29	0.021	0.000005	0.05	0.0087	0.15	13	0.067	1.6	0.000035	806	0.75	0.000035	0.0005	0.016	0.005	0.01	8.0	1.0	0.18	338,914
2042	8.4	1,156	717	9.2	0.028	0.002	0.0013	0.0026	0.42	0.00005	13	0.0005	0.0024	0.0078	0.05	0.0015	0.23	24	0.011	0.000005	0.039	0.0061	0.15	13	0.033	1.5	0.000028	658	0.74	0.000028	0.0005	0.012	0.005	0.01	9.9	1.3	0.23	343,355
2043	8.5	1,262	782	9.2	0.03	0.0022	0.0014	0.0025	0.42	0.00005	11	0.0005	0.0029	0.0081	0.05	0.0016	0.23	26	0.014	0.000005	0.042	0.0072	0.15	13	0.042	1.5	0.00003	721	0.74	0.00003	0.0005	0.013	0.005	0.01	11	1.4	0.26	345,155
2044	8.5	1,280	797	9.3	0.03	0.0023	0.0014	0.0025	0.43	0.00005	11	0.0005	0.003	0.0082	0.05	0.0019	0.23	26	0.014	0.000005	0.043	0.0078	0.15	13	0.042	1.6	0.000031	733	0.75	0.000031	0.0005	0.014	0.005	0.01	3.0	0.38	0.07	339,203
2045	8.5	1,343	812	10	0.03	0.0024	0.0014	0.0024	0.46	0.00005	11	0.0005	0.0023	0.0083	0.05	0.0021	0.25	27	0.0094	0.000005	0.045	0.0074	0.16	15	0.027	1.7	0.000032	764	0.82	0.000032	0.0005	0.014	0.005	0.01	1.9	0.25	0.045	312,231
2046	8.5	1,424	827	11	0.031	0.0025	0.0015	0.0024	0.48	0.00005	11	0.0005	0.0026	0.0084	0.05	0.0024	0.26	29	0.011	0.000005	0.048	0.0085	0.17	15	0.031	1.8	0.000034	804	0.85	0.000034	0.0005	0.015	0.005	0.01	2.3	0.29	0.054	301,366
2047	8.5	1,529	845	10	0.031	0.0027	0.0017	0.0023	0.48	0.00005	11	0.0005	0.003	0.0085	0.05	0.0027	0.26	31	0.012	0.000005	0.051	0.0096	0.17	15	0.036	1.7	0.000037	855	0.84	0.000037	0.0005	0.016	0.005	0.01	2.8	0.36	0.065	302,616
2048	8.5	1,553	841	10	0.03	0.0027	0.0017	0.0023	0.47	0.00005	11	0.0005	0.0031	0.0085	0.05	0.0028	0.26	31	0.013	0.000005	0.052	0.01	0.17	15	0.038	1.7	0.000037	864	0.83	0.000037	0.0005	0.017	0.005	0.01	3.3	0.42	0.077	305,970
2049	8.5	1,561	834	10	0.03	0.0028	0.0017	0.0023	0.47	0.00005	11	0.0005	0.0032	0.0085	0.05	0.0028	0.26	31	0.013	0.000005	0.053	0.01	0.16	15	0.039	1.7	0.000037	866	0.83	0.000038	0.0005	0.017	0.005	0.01	3.7	0.47	0.086	308,547
2050	8.5	1,590	853	10	0.031	0.0028	0.0018	0.0022	0.46	0.00005	11	0.0005	0.0034	0.0086	0.05	0.003	0.25	32	0.014	0.000005	0.054	0.011	0.16	15	0.041	1.7	0.000038	884	0.82	0.000038	0.0005	0.017	0.005	0.01	3.9	0.49	0.089	311,965
2051	8.5	1,602	853	10	0.031	0.0028	0.0018	0.0022	0.46	0.00005	11	0.0005	0.0036	0.0086	0.05	0.0031	0.25	32	0.015	0.000005	0.054	0.011	0.16	14	0.043	1.7	0.000038	889	0.81	0.000039	0.0005	0.017	0.005	0.01	4.3	0.55	0.099	316,216
2052	8.5	1,616	848	9.9	0.03	0.0028	0.0018	0.0022	0.45	0.00005	11	0.0005	0.0038	0.0086	0.05	0.0032	0.25	32	0.016	0.000005	0.054	0.012	0.16	14	0.046	1.6	0.000039	894	0.79	0.000039	0.0005	0.017	0.005	0.01	5.1	0.65	0.12	321,547
2053	8.5	1,623	839	9.8	0.03	0.0029	0.0019	0.0022	0.45	0.00005	11	0.0005	0.0039	0.0085	0.05	0.0033	0.24	32	0.016	0.000005	0.055	0.012	0.16	14	0.048	1.6	0.000039	895	0.78	0.000039	0.0005	0.017	0.005	0.01	5.5	0.7	0.13	324,989
2054	8.5	1,635	843	9.6	0.03	0.0029	0.0019	0.0022	0.44	0.00005	11	0.0005	0.0039	0.0086	0.05	0.0034	0.24	32	0.016	0.000005	0.055	0.012	0.15	14	0.048	1.6	0.000039	901	0.77	0.000039	0.0005	0.017	0.005	0.01	5.1	0.64	0.12	331,093
2055	8.5	1,636	838	9.4	0.03	0.0029	0.0019	0.0022	0.43	0.00005	11	0.0005	0.0039	0.0085	0.05	0.0034	0.24	32	0.016	0.000005	0.055	0.012	0.15	14	0.048	1.6	0.000039	900	0.76	0.000039	0.0005	0.017	0.005	0.011	5.0	0.63	0.11	335,909
2056	8.5	1,659	855	9.3	0.03	0.0029	0.0019	0.0022	0.42	0.00005	11	0.0005	0.0041	0.0086	0.05	0.0035	0.23	33	0.017	0.000005	0.056	0.013	0.15	13	0.05	1.5	0.00004	915	0.75	0.00004	0.0005	0.018	0.005	0.01	5.5	0.7	0.13	342,067
2057	8.5	1,672	854	9.2	0.03	0.0029	0.002	0.0022	0.42	0.00005	11	0.0005	0.0042	0.0086	0.05	0.0036	0.23	33	0.018	0.000005	0.056	0.013	0.15	13	0.052	1.5	0.00004	920	0.74	0.00004	0.0005	0.018	0.005	0.01	6.2	0.78	0.14	345,301
2058	8.5	1,682	851	9.1	0.03	0.003	0.002	0.0022	0.42	0.00005	11	0.00051	0.0044	0.0086	0.05	0.0037	0.23	33	0.019	0.000005	0.057	0.014	0.15	13	0.054	1.5	0.00004	924	0.73	0.00004	0.0005	0.018	0.005	0.01	6.6	0.83	0.15	348,168
2059	8.5	1,701	857	9.0	0.03	0.003	0.002	0.0022	0.41	0.00005	11	0.00051	0.0045	0.0087	0.05	0.0038	0.23	34	0.019	0.000005	0.057	0.014	0.14	13	0.056	1.5	0.000041	934	0.72	0.000041	0.0005	0.018	0.005	0.01	6.4	0.81	0.15	352,107
2060	8.5	1,724	867	8.9	0.031	0.003	0.0021	0.0021	0.41	0.00005	11	0.00052	0.0046	0.0087	0.05	0.0039	0.22	34	0.02	0.000005	0.058	0.015	0.14	13	0.057	1.5	0.000041	947	0.72	0.000041	0.0005	0.018	0.005	0.01	6.6	0.83	0.15	356,256
2061	8.5	1,741	868	8.9	0.031	0.0031	0.0021	0.0021	0.41	0.00005	11	0.00052	0.0048	0.0088	0.05	0.0041	0.22	34	0.02	0.000005	0.059	0.015	0.14	13	0.059	1.5	0.000042	954	0.71	0.000042	0.0005	0.019	0.005	0.01	6.3	0.79	0.14	358,049
2062	8.5	1,742	886	8.8	0.031	0.0031	0.0022	0.0021	0.4	0.00005	11	0.00052	0.0048	0.0089	0.05	0.0042	0.22	35	0.02	0.000005	0.059	0.015	0.14	13	0.059	1.5	0.000042	959	0.71	0.000042	0.0005	0.019	0.005	0.01	5.7	0.72	0.13	361,103
2063	8.5	1,753	891	8.7	0.031	0.0031	0.0022	0.0021	0.4	0.00005	11	0.00053	0.0049	0.0089	0.05	0.0043	0.22	35	0.02	0.000005	0.059	0.016	0.14	12	0.06	1.5	0.000042	965	0.7	0.000042	0.0005	0.019	0.005	0.01	5.1	0.65	0.12	363,501
2064	8.5	1,759	896	8.6	0.031	0.0031	0.0022	0.0021	0.4	0.00005	11	0.00053	0.005	0.0089	0.05	0.0044	0.22	35	0.021	0.000005	0.059	0.016	0.14	12	0.061	1.4	0.000042	969	0.69	0.000042	0.0005	0.019	0.005	0.01	5.3	0.67	0.12	367,099
2065	8.5	1,770	895	8.6	0.031	0.0031	0.0023	0.0021	0.39	0.00005	11	0.00053	0.0051	0.0089	0.05	0.0045	0.22	35	0.021	0.000005	0.06	0.016	0.14	12	0.062	1.4	0.000042	973	0.69	0.000043	0.0005	0.019	0.005	0.01	5.5	0.7	0.13	369,105
2066	8.5	1,790	909	8.5	0.032	0.0032	0.0023	0.0021	0.39	0.00005	10	0.00054	0.0052	0.009	0.05	0.0046	0.21	36	0.022	0.000005	0.06	0.017	0.14	12	0.064	1.4	0.000043	985	0.69	0.000043	0.0005	0.019	0.005	0.01	5.8	0.74	0.13	371,946
2067	8.5	1,785	952	8.5	0.033	0.0031	0.0023	0.0021	0.39	0.00005	9.5	0.00054	0.0053	0.0093	0.05	0.0047	0.21	36	0.022	0.000005	0.06	0.017	0.14	12	0.065	1.4	0.000043	993	0.68	0.000043	0.0005	0.019	0.005	0.01	6.1	0.77	0.14	374,952
2068	8.5	1,786	969	8.4	0.034	0.0031	0.0023	0.0021	0.38	0.00005	9.2	0.00054	0.0054	0.0094	0.05	0.0047	0.21	37	0.022	0.000005	0.06	0.017	0.13	12	0.066	1.4	0.000043	996	0.67	0.000043	0.0005	0.019	0.005	0.01	6.2	0.78	0.14	378,901
2069	8.5	1,803	1,003	8.3	0.035	0.0032	0.0024	0.0021	0.38	0.00005	8.7	0.00054	0.0055	0.0096	0.05	0.0048	0.21	38	0.023	0.000005	0.061	0.017	0.13	12	0.067	1.4	0.000043	1,012	0.67	0.000043	0.0005	0.019	0.005	0.01	6.1	0.77	0.14	381,313
2070	8.5	1,815	1,013	8.3	0.036	0.0032	0.0024	0.0021	0.38	0.00005	8.6	0.00055	0.0055	0.0097	0.05	0.0049	0.21	38	0.023	0.000005	0.061	0.018	0.13	12	0.068	1.4	0.000043	1,019	0.66	0.000044	0.0005	0.019	0.005	0.01	5.9	0.74	0.14	384,374
2071	8.6	1,818	1,048	8.2	0.037	0.0032	0.0024	0.0021	0.38	0.00005	8.1	0.00055	0.0056	0.01	0.05	0.005	0.21	38	0.023	0.000005	0.061	0.018	0.13	12	0.068	1.4	0.000044	1,028	0.66	0.000044	0.0005	0.019	0.005	0.01	5.7	0.72	0.13	386,328
2072	8.6	1,826	1,060	8.2	0.037	0.0032	0.0025	0.0021	0.37	0.00005	7.9	0.00055	0.0057	0.01	0.05	0.0051	0.2	39	0.024	0.000005	0.061	0.019	0.13	12	0.07	1.4	0.000044	1,034	0.66	0.000044	0.0005	0.019	0.005	0.01	5.6	0.71	0.13	388,982
2073	8.6	1,817	1,116	8.2	0.039	0.0032	0.0025	0.0022	0.37	0.00005	7.2	0.00055	0.0058	0.01	0.05	0.0051	0.2	39	0.024	0.000005	0.061	0.019	0.13	12	0.07	1.4	0.000044	1,043	0.66	0.000044	0.0005	0.019	0.005	0.01	5.7	0.72	0.13	389,390
2074	8.6	1,817	1,139	8.1	0.04	0.0032	0.0025	0.0022	0.37	0.00005	7.0	0.00055	0.0059	0.011	0.05	0.0052	0.2	40	0.024	0.000005	0.061	0.019	0.13	12	0.071	1.4	0.000044	1,047	0.65	0.000044	0.0005	0.019	0.005	0.01	5.8	0.74	0.13	391,164
2075	8.6	1,816	1,167	8.1	0.041	0.0032	0.0025	0.0022	0.37	0.00005	6.7	0.00055	0.0059	0.011	0.05	0.0052	0.2	40	0.024	0.000005	0.061	0.019	0.13	12	0.072	1.4	0.000043	1,052	0.65	0.000044	0.0005	0.019	0.005	0.01	6.0	0.76	0.14	391,961
2076	8.6	1,808	1,202	8.1	0.043	0.0032	0.0025	0.0022	0.37	0.00005	6.3	0.00054	0.0059	0.011	0.05	0.0052	0.2	41	0.025	0.000005	0.061	0.019	0.13	12	0.072	1.3	0.000043	1,056	0.65	0.000043	0.0005	0.019	0.005	0.01	6.1	0.77	0.14	394,086
2077	8.6	1,793	1,254	8.0	0.045	0.0032	0.0025	0.0022	0.37	0.00005	5.9	0.00054	0.0059	0.012	0.05	0.0052	0.2	42	0.025	0.000005	0.06	0.019	0.13	12	0.072	1.3	0.000043	1,060	0.65	0.000043	0.0005	0.019	0.005	0.01	5.9	0.75	0.14	394,666
2078	8.6	1,793	1,299	8.0	0.046	0.0032	0.0025	0.0022	0.37	0.00005	5.5	0.00054	0.0059	0.012	0.05	0.0052	0.2	42	0.024	0.000005	0.06	0.019	0.13	11	0.071	1.3	0.000043	1,070	0.64	0.000043	0.0005	0.019	0.005	0.01	5.7	0.72	0.13	396,324
2079	8.7	1,789	1,333	8.0	0.048	0.0032	0.0025	0.0022	0.37	0.00005	5.3	0.00054	0.0058	0.012	0.05	0.0052	0.2	43	0.024	0.000005	0.06	0.019	0.13	11	0.071	1.3	0.000043	1,074	0.64	0.000043	0.0005	0.019	0.005	0.01	5.1	0.64	0.12	397,336
2080	8.7	1,786	1,355	8.0	0.049	0.0031	0.0025	0.0022	0.36	0.00005	5.1	0.00054	0.0058	0.012	0.05	0.0053	0.2	43	0.024	0.000005	0.06	0.019	0.13	11	0.07	1.3	0.000043	1,077	0.64	0.000043	0.0005	0.019	0.005	0.01	4.6	0.58	0.11	398,998
2081	8.7	1,787	1,371	7.9	0.049	0.0032	0.0025	0.0022	0.36	0.00005	5.0	0.00054	0.0058	0.013	0.05	0.0053	0.2	44	0.024	0.000005	0.06	0.019	0.13	11	0.069	1.3	0.000043	1,081	0.64	0.000043	0.0005	0.019	0.005	0.01	3.8	0.48	0.086	399,482
2082	8.7	1,790	1,384	7.9	0.05	0.0032	0.0025	0.0023	0.36	0.00005	4.9	0.00054	0.0058	0.013	0.05	0.0054	0.2	44	0.024	0.000005	0.06	0.019	0.13	11	0.069	1.3	0.000043	1,085	0.64	0.000043	0.0005	0.019	0.005	0.01	3.4	0.43	0.077	400,065
2083	8.7	1,778	1,429	7.9	0.052	0.0031	0.0025	0.0023	0.36	0.00005	4.7	0.00053	0.0058	0.013	0.05	0.0054	0.2	45	0.024	0.000005	0.06	0.019	0.13	11	0.069	1.3	0.000043	1,089	0.64	0.000043	0.0005	0.019	0.005	0.01	2.9	0.37	0.067	400,547
2084	8.7	1,773	1,453	7.9	0.053	0.0031	0.0025	0.0023	0.36	0.00005	4.5	0.00053	0.0058	0.013	0.05	0.0054	0.2	45	0.024	0.000005	0.06	0.019	0.13	11	0.069	1.3	0.000042	1,091	0.64	0.000043	0.0005	0.019	0.005	0.01	2.8	0.35	0.064	401,921
2085	8.7	1,770	1,479	7.9	0.054	0.0031	0.0025	0.0023	0.36	0.00005	4.4	0.00053	0.0058	0.014	0.05	0.0054	0.2	46	0.024	0.000005	0.06	0.019	0.13	11	0.068	1.3	0.000042	1,095	0.64	0.000043	0.0005	0.019	0.005	0.01	2.7	0.34	0.061	401,543
2086	8.7	1,769	1,496	7.9	0.054	0.0031	0.0025	0.0023	0.36	0.00005	4.3	0.00053	0.0058	0.014	0.05	0.0054	0.2	46	0.023	0.000005	0.06	0.019	0.13	11	0.068	1.3	0.000042	1,097	0.64	0.000043	0.0005	0.019	0.005	0.01	2.6	0.33	0.06	401,553
2087	8.7	1,746	1,561	7.9	0.057	0.0031	0.0025	0.0023	0.36	0.00005	4.0	0.00052	0.0057	0.014	0.05	0.0053	0.2	47	0.023	0.000005	0.059	0.019	0.13	11	0.068	1.3	0.000042	1,100	0.64	0.000042	0.0005	0.019	0.005	0.01	2.6	0.33	0.06	401,267
2088	8.7	1,734	1,593	7.9	0.059	0.0031	0.0

Table A1. Source terms of the NAG backfill for the poorly graded cover system scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2135	8.8	1,554	1,955	7.9	0.076	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.0041	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.049	1.3	0.000037	1,087	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,364
2136	8.8	1,553	1,956	7.9	0.076	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.0041	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.049	1.3	0.000037	1,087	0.63	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	402,265
2137	8.8	1,553	1,955	7.9	0.076	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.0041	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,086	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,193
2138	8.8	1,553	1,956	7.9	0.076	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.0041	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,087	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	400,659
2139	8.8	1,553	1,955	7.9	0.076	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,086	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	400,865
2140	8.8	1,552	1,951	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,623
2141	8.8	1,552	1,953	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,086	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,098
2142	8.8	1,552	1,950	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.63	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	402,800
2143	8.8	1,552	1,948	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	402,142
2144	8.8	1,552	1,949	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,911
2145	8.8	1,552	1,950	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,364
2146	8.8	1,551	1,951	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.63	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	402,265
2147	8.8	1,551	1,950	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,193
2148	8.8	1,551	1,951	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	400,659
2149	8.8	1,550	1,950	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,084	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	400,865
2150	8.8	1,550	1,947	7.9	0.075	0.0027	0.002	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,083	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,623

Table A2. Annual loads of the NAG backfill for the poorly graded cover system scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Ti	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2023	20	1.5	0.19	0.0002	0.000034	0.000019	0.000037	0.0086	0.00000065	0.45	0.0000081	0.000092	0.000016	0.00081	0.0000016	0.0047	0.33	0.00054	0.00	0.00066	0.00012	0.003	0.27	0.0018	0.031	0.00000047	8.5	0.015	0.00000047	0.0000081	0.00021	0.000028	0.00007	1.1	0.13	0.024	16
2024	40	3.1	0.38	0.0004	0.00007	0.00004	0.000076	0.017	0.0000013	0.92	0.000017	0.00019	0.0000033	0.0016	0.0000033	0.0096	0.67	0.0011	0.00000016	0.0013	0.00025	0.0061	0.55	0.0036	0.064	0.00000096	17	0.031	0.00000096	0.000016	0.00043	0.000058	0.00014	2.2	0.27	0.05	33
2025	69	5.4	0.67	0.0007	0.00012	0.000069	0.00013	0.03	0.0000023	1.6	0.000029	0.00033	0.000058	0.0029	0.0000058	0.017	1.2	0.0019	0.00000029	0.0023	0.00043	0.011	0.95	0.0063	0.11	0.0000017	30	0.054	0.0000017	0.000029	0.00074	0.0001	0.00025	3.8	0.48	0.086	57
2026	106	8.2	1.0	0.0011	0.00019	0.00011	0.0002	0.046	0.0000035	2.4	0.000044	0.0005	0.000088	0.0044	0.0000088	0.025	1.8	0.0029	0.00000044	0.0036	0.00065	0.016	1.5	0.0097	0.17	0.0000025	46	0.082	0.0000025	0.000044	0.0011	0.00015	0.00038	5.7	0.72	0.13	87
2027	141	11	1.3	0.0014	0.00025	0.00014	0.00027	0.062	0.0000047	3.2	0.000058	0.0007	0.00012	0.0058	0.000012	0.034	2.3	0.0039	0.00000058	0.0047	0.00086	0.022	1.9	0.013	0.22	0.0000034	62	0.11	0.0000034	0.000058	0.0015	0.0002	0.0005	7.6	0.96	0.17	116
2028	236	18	2.3	0.0024	0.00042	0.00024	0.00045	0.1	0.0000078	5.4	0.000098	0.0011	0.0002	0.0098	0.00002	0.057	3.9	0.0066	0.00000098	0.008	0.0015	0.036	3.2	0.022	0.38	0.0000057	103	0.18	0.0000057	0.000098	0.0025	0.00034	0.00084	13	1.6	0.29	195
2029	267	21	2.6	0.0027	0.00047	0.00027	0.00051	0.12	0.0000089	6.1	0.00011	0.0013	0.00022	0.011	0.0000022	0.064	4.5	0.0074	0.00000011	0.009	0.0016	0.041	3.7	0.024	0.43	0.0000064	117	0.21	0.0000064	0.00011	0.0029	0.00039	0.00095	14	1.8	0.33	221
2030	321	25	3.1	0.0032	0.00057	0.00032	0.00061	0.14	0.0000011	7.4	0.00013	0.0015	0.00027	0.013	0.0000027	0.077	5.4	0.0089	0.0000013	0.011	0.002	0.049	4.4	0.029	0.51	0.0000077	141	0.25	0.0000077	0.00013	0.0034	0.00046	0.0011	17	2.2	0.4	266
2031	1,162	91	11	0.012	0.002	0.0012	0.0022	0.51	0.0000039	27	0.00048	0.0055	0.00096	0.048	0.0000096	0.28	19	0.032	0.0000048	0.039	0.0071	0.18	16	0.11	1.9	0.000028	509	0.9	0.000028	0.00048	0.012	0.0017	0.0041	63	8.0	1.4	961
2032	2,750	214	26	0.028	0.0048	0.0027	0.0052	1.2	0.0000091	63	0.0011	0.013	0.0023	0.11	0.00023	0.66	46	0.076	0.0000011	0.093	0.017	0.42	38	0.25	4.4	0.0000066	1,204	2.1	0.0000066	0.0011	0.029	0.004	0.0098	149	19	3.4	2,273
2033	859	67	8.2	0.0086	0.0015	0.00086	0.0016	0.38	0.0000028	20	0.00036	0.0041	0.00071	0.036	0.0000071	0.21	14	0.024	0.0000036	0.029	0.0053	0.13	12	0.078	1.4	0.0000021	376	0.66	0.0000021	0.00036	0.0092	0.0012	0.0031	46	5.9	1.1	710
2034	1,559	121	15	0.016	0.0027	0.0016	0.003	0.68	0.0000052	36	0.00065	0.0074	0.0013	0.064	0.0000013	0.37	26	0.043	0.0000064	0.052	0.0096	0.24	21	0.14	2.5	0.0000037	682	1.2	0.0000037	0.00064	0.017	0.0023	0.0056	84	11	1.9	1,289
2035	3,332	260	32	0.033	0.0059	0.0033	0.0063	1.5	0.00011	77	0.0014	0.016	0.0028	0.14	0.00028	0.8	56	0.093	0.000014	0.11	0.02	0.51	46	0.3	5.3	0.00008	1,459	2.6	0.00008	0.0014	0.036	0.0048	0.012	180	23	4.1	2,755
2036	8,174	637	78	0.082	0.014	0.0081	0.016	3.6	0.00027	188	0.0034	0.039	0.0068	0.34	0.00068	2.0	137	0.23	0.0000034	0.28	0.05	1.3	112	0.75	13	0.0002	3,579	6.3	0.0002	0.0034	0.087	0.012	0.029	442	56	10	6,758
2037	36,319	2,829	349	0.36	0.064	0.036	0.069	16	0.0012	835	0.015	0.17	0.03	1.5	0.003	8.7	607	1.0	0.00015	1.2	0.22	5.6	499	3.3	58	0.00087	15,900	28	0.00087	0.015	0.39	0.053	0.13	1,966	249	45	30,026
2038	114,469	8,916	1,099	1.1	0.2	0.11	0.22	50	0.0038	2,631	0.047	0.54	0.095	4.7	0.0095	28	1,914	3.2	0.00047	3.9	0.7	18	1,572	10	183	0.0027	50,111	88	0.0028	0.047	1.2	0.17	0.41	6,195	783	142	94,634
2039	294,759	108,602	2,074	3.9	0.52	0.27	0.38	95	0.0072	3,692	0.09	1.2	0.35	8.9	0.19	52	5,595	6.7	0.00089	9.9	2.0	33	2,968	22	346	0.0071	151,047	167	0.0071	0.089	3.1	0.43	1.2	5,376	680	124	178,458
2040	375,606	170,679	3,171	6.4	0.66	0.39	0.64	145	0.011	4,853	0.14	1.2	1.9	14	0.37	79	7,282	6.4	0.0014	13	2.3	51	4,538	20	529	0.009	199,379	255	0.009	0.14	4.0	0.54	1.4	6,406	810	147	272,969
2041	498,712	255,334	3,172	9.3	0.88	0.5	0.78	145	0.014	4,424	0.17	1.4	2.7	17	0.54	79	9,903	7.2	0.0017	17	2.9	51	4,539	23	529	0.012	273,283	255	0.012	0.17	5.3	0.72	1.8	2,699	341	62	338,914
2042	396,987	246,288	3,170	9.5	0.7	0.44	0.89	145	0.014	4,317	0.17	0.81	2.7	17	0.51	79	8,082	3.8	0.0017	13	2.1	51	4,537	11	529	0.0095	226,085	255	0.0095	0.17	4.2	0.57	1.4	3,408	431	78	343,355
2043	435,552	270,005	3,171	10	0.77	0.48	0.86	145	0.014	3,874	0.17	0.99	2.8	17	0.57	79	8,919	4.7	0.0017	15	2.5	51	4,538	14	529	0.01	248,909	255	0.01	0.17	4.7	0.63	1.6	3,841	486	88	345,155
2044	434,078	270,470	3,171	10	0.77	0.49	0.84	145	0.014	3,704	0.17	1.0	2.8	17	0.63	79	8,909	4.7	0.0017	15	2.6	51	4,538	14	529	0.01	248,527	255	0.01	0.17	4.6	0.63	1.7	1,031	130	24	339,203
2045	419,201	253,400	3,171	9.5	0.74	0.45	0.76	145	0.013	3,387	0.16	0.72	2.6	16	0.65	79	8,520	2.9	0.0016	14	2.3	51	4,539	8.4	529	0.01	238,585	255	0.01	0.16	4.5	0.61	1.5	607	77	14	312,231
2046	429,085	249,341	3,172	9.2	0.76	0.47	0.71	145	0.012	3,257	0.15	0.8	2.5	15	0.72	79	8,673	3.3	0.0015	14	2.6	51	4,539	9.4	529	0.01	242,238	255	0.01	0.15	4.6	0.62	1.7	703	89	16	301,366
2047	462,700	255,572	3,172	9.3	0.82	0.5	0.69	145	0.012	3,275	0.15	0.91	2.6	15	0.81	79	9,280	3.7	0.0015	16	2.9	51	4,540	11	529	0.011	258,595	255	0.011	0.15	4.9	0.67	1.9	851	108	20	302,616
2048	475,079	257,244	3,172	9.3	0.84	0.52	0.69	145	0.012	3,367	0.15	0.96	2.6	15	0.85	80	9,496	4.0	0.0015	16	3.1	51	4,540	12	529	0.011	264,392	255	0.011	0.15	5.1	0.69	2.0	1,024	129	24	305,970
2049	481,735	257,436	3,172	9.3	0.85	0.53	0.69	145	0.012	3,453	0.15	1.	2.6	15	0.87	80	9,605	4.1	0.0015	16	3.2	51	4,541	12	529	0.012	267,313	255	0.012	0.15	5.1	0.7	2.0	1,149	145	26	308,547
2050	495,931	266,156	3,173	9.6	0.87	0.55	0.7	145	0.013	3,386	0.16	1.1	2.7	16	0.93	80	9,905	4.4	0.0016	17	3.4	51	4,541	13	529	0.012	275,624	255	0.012	0.16	5.3	0.72	2.2	1,211	153	28	311,965
2051	506,546	269,609	3,173	9.7	0.89	0.57	0.7	145	0.013	3,451	0.16	1.1	2.7	16	0.98	80	10,108	4.7	0.0016	17	3.6	51	4,541	14	529	0.012	281,043	255	0.012	0.16	5.4	0.73	2.3	1,365	173	31	316,216
2052	519,492	272,711	3,173	9.8	0.92	0.59	0.71	145	0.013	3,560	0.16	1.2	2.8	16	1.0	80	10,331	5.1	0.0016	17	3.8	51	4,541	15	529	0.012	287,399	255	0.012	0.16	5.5	0.75	2.4	1,641	208	38	321,547
2053	527,425	272,692	3,173	9.8	0.93	0.61	0.72	145	0.013	3,677	0.16	1.3	2.8	16	1.1	80	10,460	5.3	0.0016	18	4.0	51	4,541	16	529	0.013	290,813	255	0.013	0.16	5.6	0.76	2.5	1,793	227	41	324,989
2054	541,271	279,264	3,173	10.0	0.95	0.62	0.73	145	0.013	3,726	0.17	1.3	2.8	17	1.1	80	10,735	5.4	0.0017	18	4.1	51	4,541	16	529	0.013	298,374	255	0.013	0.17	5.8	0.78	2.6	1,681	212	39	331,093
2055	549,412	281,438	3,173	10	0.97	0.64	0.74	145	0.013	3,827	0.17	1.3	2.9	17	1.1	80	10,886	5.5	0.0017	18	4.2	51	4,541	16	529	0.013	302,375	255	0.013	0.17	5.9	0.79	2.7	1,677	212	39	335,909
2056	567,386	292,614	3,173	10	1.0	0.66	0.75	145	0.014	3,782	0.17	1.4	3.0	17	1.2	80	11,257	5.8	0.0017	19	4.4	51	4,541	17	529	0.014	312,895	255	0.014	0.17	6.1	0.82	2.8	1,883	238	43	342,067
2057	577,274	295,022	3,173	10	1.0	0.68	0.75	145	0.014	3,843	0.17	1.5	3.0	17	1.2	80	11,440	6.2	0.0017	19	4.6	51	4,541	18	529	0.014	317,753	255	0.014	0.17	6.2	0.83	2.9	2,140	271	49	345,301
2058	585,688	296,388	3,173	11	1.0	0.7	0.76	145	0.014	3,914	0.18	1.5	3.0	17	1.3	80	11,577	6.4	0.0017	20	4.8	51	4,541	19	529	0.014	321,759	255	0.014	0.17	6.3	0.85	3.0	2,290	289	53	348,168
2059	599,004	301,717	3,173	11	1.1	0.72	0.76	145	0.014	3,937	0.18	1.6	3.1	18	1.3	80	11,834	6.7	0.0018	20	5.0	51	4,541	20	529	0.014	328,850	255	0.014	0.18	6.4	0.87	3.1	2,259	286	52	352,107
2060	614,185	309,045	3,173	11	1.1	0.74	0.76	145	0.014	3,924	0.18	1.7	3.1	18	1.4	80	12,138	7.0	0.0018	21	5.2	51	4,542	20	529	0.015	337,224	255	0.015	0.18	6.6	0.89	3.3	2,342	296	54	356,256
2061	623,220	310,786	3,173	11	1.1	0.77	0.76	145	0.014	3,961	0.19	1.7	3.1	18	1.5	80	12,296	7.2	0.0018	21	5.4	51	4,542	21	529	0.015	341,621	255	0.015	0.18	6.7	0.9	3.4	2,238	283	51	358,049
2062	629,113	320,078	3,174	11	1.1	0.78	0.77	145	0.014	3,848	0.19	1.7	3.2	18	1.5	80	12,494	7.3	0.0018	21	5.6	51	4,542	21	529	0.015	346,334	255	0.015	0.18	6.7	0.91	3.5	2,049	259	47	361,103
2063	637,217	323,857	3,174	11	1.1	0.8	0.78	145	0.015	3,851	0.19	1.8	3.2	18	1.6	80	12,682	7.4	0.0018	21	5.8	51	4,542	22	529	0.015	350,709	255	0.015	0.18	6.8	0.92	3.6	1,868	236	43	363,501
2064	645,763	328,913	3,174	12	1.1	0.82	0.78	145	0.015	3,857	0.19	1.8	3.3	18	1.6	80	12,901	7.6	0.0018	22	5.9	51	4,542	22	529	0.015	355,546	255	0.015	0.18	6.9	0.93	3.7	1,941	245	45	367,099
2065	653,279	330,460	3,174	12	1.2	0.84	0.78	145	0.015	3,897	0.2	1.9	3.3	18	1.7	80	13,064	7.9	0.0018	22	6.1	51	4,542	23	529	0.016	359,150	255	0.016	0.18	7.0	0.94	3.8	2,035	257	47	369,105
2066	665,895	338,047	3,174	12	1.2	0.86	0.79	145	0.015	3,846	0.2	2.0	3.4	19	1.7	80	13,365	8.1	0.0019	22	6.3	51	4,543	24	529	0.016	366,415	255	0.016	0.18	7.1	0.96	3.9	2,170	274	50	371,946
2067	669,364	357,055	3,174	13	1.2	0.87	0.8	145	0.015	3,559	0.2	2.0	3.5	19	1.7	80	13,668	8.3	0.0019	23	6.4	51	4,543	24	529	0.016	372,203	255	0.016	0.19	7.1	0.97	4.0	2,287	289	53	374,952
2068	676,528	366,985	3,174	13	1.2	0.89	0.81	145	0.015	3,489	0.2	2.0	3.6	19	1.8	80	13,925	8.5	0.0019	23	6.5	51	4,543	25	529	0.016	377,499	255	0.016	0.19	7.2	0.98	4.1	2,343	296	54	378,901
2069	687,621	382,571	3,174	13	1.2	0.9	0.81	145	0.015	3,316	0.21	2.1	3.7	19	1.8	80	14,316	8.7	0.0019	23	6.7	51	4,543	25	529	0.016	385,850	255	0.017	0.19	7.3	0.99	4.2	2,318	293	53	381,313
2070	697,446	389,524	3,174	14	1.2	0.92	0.82	145	0.015	3,294	0.21	2.1	3.7	19	1.9	80	14,580	8.9	0.0019	23	6.8	51	4,543	26	529	0.017	391,677	255	0.017	0.19	7.4	1.0	4.3	2,264	286	52	384,374
2071	702,460	404,872	3,174	14	1.2	0.94	0.83	145	0.016	3,122	0.21	2.2	3.9	19	1.9	80	14,860	9.0	0.0019	24	7.0	51	4,543	26	529	0.017	397,261	255	0.017	0.19	7.5	1.0	4.4	2,197	278	51	386,328
2072	710,321	412,321	3,175	14	1.3	0.96	0.83	145	0.016	3,088	0.21	2.2	3.9	19	2.0	80	15,089	9.2	0.0019	24	7.2	51	4,543	27	529	0.017	402,363	255	0.017	0.19	7.6	1.0	4.5	2,195	278	50	388,982
2073	707,678	434,637	3,175	15	1.2	0.97	0.84	145	0.016	2,815	0.21	2.3	4.1	19	2.0	80	15,360	9.4	0.0019	24	7.3	51	4,544	27	529	0.017	405,978	255	0.017	0.19	7.6	1.0	4.6	2,213	280	51	389,390
2074	710,667	445,575	3,175	16	1.3	0.98	0.85	145	0.016	2,728	0.21	2.3	4.2	20	2.0	80	15,593	9.5	0.002	24	7.4	51	4,544	28	530	0.017	409,588	255	0.017	0.2	7.6	1.0	4.6	2,280	288	52	391,164
2075	711,723	457,301	3,175	16	1.3	0.98	0.85	145	0.016	2,620	0.21	2.3	4.3	20	2.0	80	15,849	9.6	0.002	24	7.5	51	4,544	28	530	0.017	412,422	255	0.017	0.2	7.6	1.0	4.7	2,342	296	54	391,961
2076	712,311	473,534	3,175	17	1.3	0.99	0.86	145	0.016	2,496	0.21	2.3	4.4	20	2.1	80	16,115	9.7	0.002	24	7.5	51	4,544	28	530	0.017	416,076	255	0.017	0.2	7.6	1.0	4.7	2,398	303	55	394,086
2077	707,438	494,792	3,175	18	1.2	0.99	0.87	145	0.016	2,312	0.21	2.3	4.6	20	2.1	80	16,390	9.7	0.002	24	7.5	51	4,544	28	530	0.017	418,346	255	0.017	0.2	7.6	1.0	4.7	2,343	296	54	394,666
2078	710,609	514,944	3,175	18	1.3	1.	0.88	145	0.016	2,183	0.21	2.3	4.7	20	2.1	80	16,746	9.7	0.002	24	7.5	51	4,545	28	530	0.017	423,948	255	0.017	0.2	7.6	1.0	4.7	2,271	287	52	396,324
2079	710,676	529,490	3,175	19	1.3	1.	0.89	145	0.016	2,093	0.21	2.3	4.9	20	2.1	80	17,035	9.6	0.002	24	7.6	51	4,545	28	530	0.017	426,858	255	0.017	0.2	7.6	1.0	4.7	2,020	255	46	397,336
2080	712,491	540,563	3,175	19	1.3	1.0	0.9	145	0.016	2,041	0.21	2.3	5.0	20	2.1	80	17,272	9.6	0.002	24	7.6	51	4,545	28	530	0.017	429,881	255	0.017	0.2	7.6	1.0	4.8	1,826	231	42	398,998
2081	713,835	547,810	3,176	20	1.3	1.0	0.9	145	0.016	2,003	0.21	2.3	5.0	20	2.1	80	17,466	9.5	0.002	24	7.7	51	4,545	28	530	0.017	431,860	255	0.017	0.2	7.6	1.0	4.8	1,502	190	35	399,482
2082	716,077	553,651	3,176	20	1.3	1.0	0.9	145	0.016	1,977	0.22	2.3	5.1	20	2.1	80	17,644	9.5	0.002	24	7.7	51	4,545	28	530	0.017	433,991	255	0.017	0.2	7.6	1.0	4.8	1,347	170	31	400,065
2083	712,212	572,301	3,176	21	1.3	1.0	0.91	145	0.016	1,868	0.21	2.3	5.2	20	2.2	80	17,882	9.5	0.002	24	7.7	51	4,545	28	530	0.017	436,075	255	0.017	0.2	7.6	1.0	4.8	1,166	147	27	400,547
2084	712,767	584,072	3,176	21	1.3	1.0	0.92	145	0.016	1,819	0.21	2.3	5.4	20	2.2	80	18,123	9.5	0.002	24	7.7	51	4,545	28	530	0.017	438,657	255	0.017	0.2	7.6	1.0	4.9	1,115	141	26	401,921
2085	710,811	593,882	3,176	22	1.3	1.0	0.92	145	0.016	1,763	0.21	2.3	5.5	20	2.2	80	18,323	9.4	0.002	24	7.8	51	4,545	27	530	0.017	439,649	255	0.017	0.2	7.6	1.0	4.9	1,067	135	25	401,543
2086	710,147	600,804	3,176	22	1.3	1.0	0.92	145	0.016	1,728	0.21	2.3	5.5	20	2.2	80	18,494	9.4	0.002	24	7.7	51	4,546	27	530	0.017	440,624	255	0.017	0.2	7.6	1.0	4.9	1,057	134	24	401,553
2087	700,533	626,419	3,176	23	1.2	1.0	0.94	145	0.016	1,598	0.21	2.3	5.8	20	2.1	80	18,766	9.3	0.002	24	7.7	51	4,546	27	530	0.017	441,555	255	0.017	0.2	7.5	1.0	4.8	1,051	133	24	401,267
2088	697,502	640,694	3,176	24	1.2	1.0	0.95	145	0.016	1,545	0.21	2.3	5.9	20	2.1	80	18,989	9.3	0.002	23	7.6	51	4,546	27	530	0.017	443,035	255	0.017	0.2	7.4	1.0	4.8	1,055	133	24	402,320
2089	690,123	652,790	3,176	24	1.2	1.0	0.95	145	0.016	1,479	0.21	2.3	6.0	20	2.1	80	19,138	9.2	0.002	23	7.5	51	4,546	27	530	0.017	442,064	255	0.017	0.2	7.4	1.	4.7	1,054	133	24	401,001
2090	687,743	660,781	3,176	24	1.2	1.0	0.96	145	0.016	1,449	0.21	2.3	6.1	20	2.1	80	19,281	9.2	0.002	23	7.5	51	4,546	27	530	0.016	442,513	255	0.017	0.2	7.3	0.99	4.7	1,054	133	24	401,227
2091	684,634	670,516	3,176	25	1.2	1.	0.96	145	0.016	1,411	0.21	2.2	6.2	20	2.1	80	19,472	9.1	0.002	23	7.5	51	4,546	27	530	0.016	442,513	255	0.016	0.2	7.3	0.99	4.7	1,048	133	24	401,098
2092	685,888	678,557	3,176	25	1.2	1.	0.97	145	0.016	1,397	0.21	2.2	6.3	20	2.1	80	19,672	9.1	0.002	23	7.5	51	4,546	26	530	0.016	445,054	255	0.016	0.2	7.3	0.99	4.7	1,038	131	24	402,800
2093	682,917	684,848	3,176	25	1.2	0.99	0.97	145	0.016	1,369	0.21	2.2	6.3	20	2.1	80	19,826	9.0	0.002	23	7.4	51	4,546	26	530	0.016	444,809	255	0.016	0.2	7.3	0.99	4.6	980	124	23	402,142
2094	681,159	690,162	3,177	26	1.2	0.99	0.98	145	0.016	1,348	0.2	2.2	6.3	20	2.1	80	19,971	8.9	0.002	23	7.3	51	4,546	26	530	0.016	444,956	255	0.016	0.2	7.3	0.98	4.6	909	115	21	401,911
2095	671,241	710,213

Table A2. Annual loads of the NAG backfill for the poorly graded cover system scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2135	623,599	784,746	3,177	30	1.1	0.83	1.1	145	0.016	1,049	0.2	1.7	6.0	20	1.6	80	21,701	6.8	0.002	21	5.7	51	4,547	19	530	0.015	436,162	255	0.015	0.2	6.7	0.9	3.6	182	23	4.2	401,364
2136	624,879	786,710	3,177	30	1.1	0.83	1.1	145	0.016	1,050	0.2	1.7	6.0	20	1.6	80	21,751	6.8	0.002	21	5.7	51	4,547	20	530	0.015	437,142	255	0.015	0.2	6.7	0.9	3.6	183	23	4.2	402,265
2137	623,093	784,413	3,177	30	1.1	0.83	1.1	145	0.016	1,048	0.2	1.7	6.0	20	1.6	80	21,688	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,856	255	0.015	0.2	6.7	0.9	3.6	182	23	4.2	401,193
2138	622,223	783,769	3,177	30	1.1	0.82	1.1	145	0.016	1,046	0.2	1.7	6.0	20	1.6	80	21,667	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,356	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	400,659
2139	622,343	783,571	3,177	30	1.1	0.82	1.1	145	0.016	1,047	0.2	1.7	6.0	20	1.6	80	21,664	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,380	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	400,865
2140	623,439	783,727	3,177	30	1.1	0.83	1.1	145	0.016	1,052	0.2	1.7	6.0	20	1.6	80	21,678	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,922	255	0.015	0.2	6.7	0.9	3.6	182	23	4.2	401,623
2141	622,625	783,264	3,177	30	1.1	0.82	1.1	145	0.016	1,049	0.2	1.7	6.0	20	1.6	80	21,660	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,432	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	401,098
2142	625,105	785,541	3,177	30	1.1	0.83	1.1	145	0.016	1,056	0.2	1.7	6.0	20	1.6	80	21,729	6.8	0.002	21	5.7	51	4,547	19	530	0.015	436,998	255	0.015	0.2	6.7	0.9	3.6	183	23	4.2	402,800
2143	624,044	783,533	3,177	30	1.1	0.83	1.1	145	0.016	1,056	0.2	1.7	6.0	20	1.6	80	21,677	6.7	0.002	21	5.7	51	4,547	19	530	0.015	436,123	255	0.015	0.2	6.7	0.9	3.6	183	23	4.2	402,142
2144	623,645	783,204	3,177	30	1.1	0.83	1.1	145	0.016	1,055	0.2	1.7	6.0	20	1.6	80	21,666	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,873	255	0.015	0.2	6.7	0.9	3.6	183	23	4.2	401,911
2145	622,716	782,740	3,177	30	1.1	0.82	1.1	145	0.016	1,052	0.2	1.7	6.0	20	1.6	80	21,647	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,399	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	401,364
2146	623,994	784,699	3,177	30	1.1	0.83	1.1	145	0.016	1,054	0.2	1.7	6.0	20	1.6	80	21,697	6.7	0.002	21	5.7	51	4,547	19	530	0.015	436,337	255	0.015	0.2	6.7	0.9	3.6	183	23	4.2	402,265
2147	622,211	782,407	3,177	30	1.1	0.82	1.1	145	0.016	1,051	0.2	1.7	6.0	20	1.6	80	21,635	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,094	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	401,193
2148	621,342	781,766	3,177	30	1.1	0.82	1.1	145	0.016	1,049	0.2	1.7	5.9	20	1.6	80	21,614	6.7	0.002	21	5.7	51	4,547	19	530	0.015	434,555	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	400,659
2149	621,461	781,567	3,177	30	1.1	0.82	1.1	145	0.016	1,051	0.2	1.7	5.9	20	1.6	80	21,611	6.7	0.002	21	5.7	51	4,547	19	530	0.015	434,578	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	400,865
2150	622,596	781,759	3,177	30	1.1	0.82	1.1	145	0.016	1,055	0.2	1.7	6.0	20	1.6	80	21,625	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,118	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	401,623

Table A3. Source terms of the NAG backfill for the well graded cover system scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-		mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2023	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	16
2024	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	33
2025	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	57
2026	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	87
2027	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	116
2028	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	195
2029	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	221
2030	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	266
2031	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	961
2032	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	2,273
2033	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	710
2034	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	1,284
2035	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	10,477
2036	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	19,356
2037	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	14,018
2038	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	27,168
2039	8.1	1,311	237	27	0.015	0.0023	0.0013	0.0023	1.2	0.00005	31	0.0005	0.006	0.0012	0.05	0.00032	0.68	23	0.035	0.000005	0.044	0.0082	0.44	39	0.11	4.6	0.000031	601	2.2	0.000032	0.0005	0.014	0.005	0.01	65	3.8	0.69	48,784
2040	8.2	1,499	470	27	0.018	0.0026	0.0015	0.0022	1.2	0.00005	32	0.0005	0.0065	0.0017	0.05	0.00084	0.68	28	0.037	0.000005	0.05	0.01	0.44	39	0.12	4.6	0.000036	735	2.2	0.000036	0.0005	0.016	0.005	0.01	65	3.0	0.54	85,906
2041	8.4	1,703	762	27	0.027	0.003	0.0016	0.0021	1.2	0.00005	14	0.00051	0.0055	0.0058	0.05	0.0017	0.69	33	0.029	0.000005	0.057	0.011	0.44	39	0.094	4.6	0.000041	909	2.2	0.000041	0.0005	0.018	0.005	0.01	44	1.0	0.18	116,049
2042	8.5	1,409	792	24	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.0005	0.003	0.0082	0.05	0.002	0.6	28	0.014	0.000005	0.047	0.008	0.39	34	0.042	4.0	0.000034	788	1.9	0.000034	0.0005	0.015	0.005	0.01	12	1.3	0.23	131,728
2043	8.4	1,372	778	23	0.029	0.0024	0.0015	0.0024	1.1	0.00005	12	0.0005	0.0027	0.0081	0.05	0.002	0.59	28	0.012	0.000005	0.046	0.0077	0.37	33	0.034	3.9	0.000033	768	1.9	0.000033	0.0005	0.015	0.005	0.01	6.9	1.4	0.26	135,614
2044	8.4	1,350	755	23	0.028	0.0024	0.0014	0.0024	1.1	0.00005	12	0.0005	0.0026	0.008	0.05	0.002	0.58	27	0.011	0.000005	0.045	0.0075	0.37	33	0.034	3.8	0.000032	752	1.8	0.000032	0.0005	0.014	0.005	0.01	6.9	0.38	0.07	137,918
2045	8.5	1,400	788	24	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.0005	0.0028	0.0082	0.05	0.002	0.59	28	0.012	0.000005	0.047	0.0079	0.38	34	0.037	3.9	0.000034	783	1.9	0.000034	0.0005	0.015	0.005	0.01	8.2	0.25	0.045	134,843
2046	8.5	1,458	800	24	0.029	0.0026	0.0016	0.0023	1.1	0.00005	12	0.0005	0.0032	0.0083	0.05	0.0023	0.61	29	0.014	0.000005	0.049	0.009	0.39	35	0.043	4.1	0.000035	811	2.0	0.000035	0.0005	0.016	0.005	0.01	9.7	0.29	0.054	129,640
2047	8.5	1,576	822	25	0.03	0.0028	0.0017	0.0022	1.1	0.00005	12	0.0005	0.0035	0.0084	0.05	0.0029	0.62	31	0.015	0.000005	0.053	0.011	0.39	35	0.044	4.1	0.000038	869	2.0	0.000038	0.0005	0.017	0.005	0.01	6.2	0.36	0.065	128,811
2048	8.5	1,713	861	24	0.03	0.003	0.0019	0.0022	1.1	0.00005	11	0.00051	0.004	0.0087	0.05	0.0034	0.61	34	0.017	0.000005	0.058	0.013	0.39	35	0.05	4.1	0.000041	939	2.0	0.000041	0.0005	0.018	0.005	0.01	5.8	0.42	0.077	130,391
2049	8.5	1,776	893	24	0.031	0.0031	0.0021	0.0021	1.1	0.00005	11	0.00053	0.0045	0.0089	0.05	0.0038	0.6	35	0.019	0.000005	0.06	0.014	0.39	35	0.056	4.0	0.000043	975	1.9	0.000043	0.0005	0.019	0.005	0.01	6.3	0.47	0.086	131,655
2050	8.5	1,804	902	24	0.031	0.0032	0.0022	0.0021	1.1	0.00005	11	0.00054	0.0047	0.009	0.05	0.0042	0.6	36	0.02	0.000005	0.061	0.015	0.38	34	0.058	4.0	0.000043	989	1.9	0.000043	0.0005	0.019	0.005	0.01	5.3	0.49	0.089	133,193
2051	8.5	1,817	903	24	0.032	0.0032	0.0022	0.0021	1.1	0.00005	11	0.00055	0.0048	0.009	0.05	0.0043	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.058	3.9	0.000044	995	1.9	0.000044	0.0005	0.019	0.005	0.01	4.1	0.55	0.099	134,254
2052	8.5	1,827	904	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0048	0.009	0.05	0.0045	0.59	36	0.02	0.000005	0.062	0.016	0.37	34	0.057	3.9	0.000044	1,000	1.9	0.000044	0.0005	0.02	0.005	0.01	2.6	0.65	0.12	135,292
2053	8.5	1,837	904	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0049	0.009	0.05	0.0046	0.59	36	0.02	0.000005	0.062	0.016	0.37	34	0.057	3.9	0.000044	1,004	1.9	0.000044	0.0005	0.02	0.005	0.01	1.4	0.7	0.13	135,311
2054	8.5	1,840	903	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0049	0.009	0.05	0.0047	0.59	36	0.02	0.000005	0.062	0.016	0.37	33	0.057	3.9	0.000044	1,006	1.9	0.000044	0.0005	0.02	0.005	0.01	1.1	0.64	0.12	135,939
2055	8.5	1,851	902	23	0.031	0.0033	0.0023	0.0021	1.1	0.00005	11	0.00056	0.005	0.009	0.05	0.0048	0.58	36	0.02	0.000005	0.062	0.016	0.37	33	0.058	3.9	0.000044	1,010	1.9	0.000044	0.0005	0.02	0.005	0.011	1.1	0.63	0.11	136,744
2056	8.6	1,807	1,101	23	0.039	0.0037	0.0022	0.0022	1.1	0.00005	7.4	0.00054	0.0049	0.011	0.05	0.0046	0.58	38	0.02	0.000005	0.061	0.017	0.37	33	0.057	3.8	0.000043	1,036	1.9	0.000043	0.0005	0.019	0.005	0.01	1.3	0.7	0.13	137,789
2057	8.7	1,730	1,420	23	0.052	0.003	0.0022	0.0023	1.1	0.00005	4.7	0.00052	0.0044	0.013	0.05	0.0042	0.58	41	0.018	0.000005	0.058	0.015	0.37	33	0.052	3.8	0.000041	1,070	1.8	0.000042	0.0005	0.018	0.005	0.01	1.5	0.78	0.14	138,099
2058	8.7	1,684	1,602	23	0.059	0.003	0.0021	0.0024	1.0	0.00005	3.8	0.00051	0.0042	0.015	0.05	0.0039	0.58	42	0.017	0.000005	0.057	0.014	0.37	33	0.049	3.8	0.00004	1,088	1.8	0.00004	0.0005	0.018	0.005	0.01	1.7	0.83	0.15	138,393
2059	8.7	1,671	1,663	23	0.062	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.37	33	0.048	3.8	0.00004	1,094	1.8	0.00004	0.0005	0.018	0.005	0.01	2.0	0.81	0.15	138,657
2060	8.7	1,670	1,675	23	0.062	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.36	33	0.048	3.8	0.00004	1,096	1.8	0.00004	0.0005	0.018	0.005	0.01	2.3	0.83	0.15	139,741
2061	8.7	1,673	1,672	23	0.062	0.003	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.36	32	0.049	3.8	0.00004	1,097	1.8	0.00004	0.0005	0.018	0.005	0.01	2.6	0.79	0.14	140,084
2062	8.8	1,663	1,742	23	0.07	0.0029	0.002	0.0025	1.0	0.00005	3.1	0.0005	0.0041	0.014	0.05	0.0037	0.56	44	0.017	0.000005	0.056	0.013	0.36	32	0.049	3.8	0.00004	1,107	1.8	0.00004	0.0005	0.018	0.005	0.01	3.0	0.72	0.13	140,942
2063	8.8	1,642	1,814	22	0.077	0.0029	0.002	0.0025	1.0	0.00005	2.8	0.0005	0.004	0.014	0.05	0.0036	0.56	45	0.017	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,113	1.8	0.000039	0.0005	0.018	0.005	0.01	3.3	0.65	0.12	141,850
2064	8.8	1,636	1,828	22	0.076	0.0029	0.002	0.0025	1.0	0.00005	2.8	0.0005	0.004	0.014	0.05	0.0036	0.56	45	0.017	0.000005	0.055	0.013	0.35	32	0.046	3.7	0.000039	1,113	1.8	0.000039	0.0005	0.017	0.005	0.01	3.8	0.67	0.12	143,090
2065	8.9	1,636	1,899	22	0.094	0.0029	0.0019	0.0026	1.0	0.00005	2.4	0.0005	0.004	0.014	0.05	0.0035	0.55	46	0.016	0.000005	0.055	0.013	0.35	32	0.046	3.7	0.000039	1,128	1.8	0.000039	0.0005	0.017	0.005	0.01	4.2	0.7	0.13	143,729
2066	8.9	1,609	1,986	22	0.11	0.0028	0.0019	0.0026	1.0	0.00005	2.1	0.0005	0.0039	0.014	0.05	0.0034	0.55	47	0.016	0.000005	0.054	0.012	0.35	31	0.046	3.7	0.000039	1,134	1.8	0.000039	0.0005	0.017	0.005	0.01	4.6	0.74	0.13	144,914
2067	8.9	1,589	2,043	22	0.11	0.0028	0.0019	0.0027	0.99	0.00005	2.0	0.0005	0.0039	0.013	0.05	0.0033	0.54	47	0.016	0.000005	0.053	0.012	0.35	31	0.045	3.6	0.000038	1,137	1.7	0.000038	0.0005	0.017	0.005	0.01	5.1	0.77	0.14	146,084
2068	8.9	1,583	2,073	22	0.11	0.0028	0.0019	0.0027	0.98	0.00005	1.9	0.0005	0.0038	0.013	0.05	0.0033	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.045	3.6	0.000038	1,140	1.7	0.000038	0.0005	0.017	0.005	0.01	5.5	0.78	0.14	147,667
2069	8.9	1,580	2,092	21	0.11	0.0028	0.0019	0.0027	0.98	0.00005	1.9	0.0005	0.0038	0.013	0.05	0.0032	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.045	3.6	0.000038	1,141	1.7	0.000038	0.0005	0.017	0.005	0.01	5.9	0.77	0.14	148,435
2070	8.9	1,584	2,093	21	0.11	0.0028	0.0019	0.0027	0.97	0.00005	2.0	0.0005	0.0039	0.013	0.05	0.0032	0.53	48	0.016	0.000005	0.053	0.012	0.34	30	0.046	3.5	0.000038	1,143	1.7	0.000038	0.0005	0.017	0.005	0.01	6.0	0.74	0.14	149,714
2071	8.9	1,584	2,095	21	0.1	0.0028	0.0019	0.0027	0.96	0.00005	2.0	0.0005	0.0038	0.013	0.05	0.0032	0.53	49	0.016	0.000005	0.053	0.012	0.34	30	0.046	3.5	0.000038	1,143	1.7	0.000038	0.0005	0.017	0.005	0.01	5.7	0.72	0.13	150,869
2072	8.9	1,600	2,101	21	0.11	0.0028	0.0019	0.0027	0.95	0.00005	2.0	0.0005	0.0038	0.013	0.05	0.0033	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.046	3.5	0.000038	1,151	1.7	0.000038	0.0005	0.017	0.005	0.01	5.1	0.71	0.13	152,259
2073	8.9	1,607	2,096	21	0.11	0.0028	0.0019	0.0027	0.95	0.00005	2.0	0.0005	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000038	1,154	1.7	0.000039	0.0005	0.017	0.005	0.01	4.7	0.72	0.13	152,620
2074	8.9	1,614	2,086	21	0.11	0.0028	0.0019	0.0026	0.95	0.00005	2.0	0.0005	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.013	0.33	30	0.047	3.5	0.000039	1,155	1.7	0.000039	0.0005	0.017	0.005	0.01	4.6	0.74	0.13	153,555
2075	8.9	1,623	2,076	21	0.1	0.0029	0.0019	0.0026	0.94	0.00005	2.1	0.0005	0.004	0.014	0.05	0.0035	0.52	49	0.017	0.000005	0.055	0.013	0.33	29	0.048	3.4	0.000039	1,157	1.7	0.000039	0.0005	0.017	0.005	0.01	4.5	0.76	0.14	154,302
2076	8.9	1,650	2,086	20	0.11	0.0029	0.002	0.0026	0.94	0.00005	2.0	0.0005	0.0041	0.014	0.05	0.0036	0.51	50	0.017	0.000005	0.056	0.013	0.33	29	0.05	3.4	0.000039	1,171	1.6	0.00004	0.0005	0.018	0.005	0.01	4.6	0.77	0.14	155,300
2077	8.9	1,666	2,081	20	0.11	0.0029	0.002	0.0026	0.93	0.00005	2.0	0.0005	0.0043	0.014	0.05	0.0038	0.51	50	0.018	0.000005	0.056	0.014	0.33	29	0.052	3.4	0.00004	1,177	1.6	0.00004	0.0005	0.018	0.005	0.01	4.8	0.75	0.14	155,642
2078	8.9	1,680	2,074	20	0.11	0.003	0.0021	0.0026	0.93	0.00005	2.0	0.00051	0.0044	0.014	0.05	0.0039	0.51	50	0.018	0.000005	0.057	0.014	0.32	29	0.054	3.4	0.00004	1,182	1.6	0.00004	0.0005	0.018	0.005	0.01	5.0	0.72	0.13	156,520
2079	8.9	1,691	2,082	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.00051	0.0046	0.014	0.05	0.004	0.51	50	0.019	0.000005	0.057	0.015	0.32	29	0.056	3.4	0.00004	1,188	1.6	0.00004	0.0005	0.018	0.005	0.01	5.2	0.64	0.12	157,526
2080	8.9	1,698	2,093	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.00051	0.0047	0.014	0.05	0.0041	0.5	50	0.02	0.000005	0.057	0.015	0.32	29	0.057	3.3	0.000041	1,194	1.6	0.00004	0.0005	0.018	0.005	0.01	5.5	0.58	0.11	158,727
2081	8.9	1,711	2,092	20	0.11	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.00051	0.0048	0.014	0.05	0.0042	0.5	51	0.02	0.000005	0.058	0.015	0.32	29	0.059	3.3	0.000041	1,199	1.6	0.000041	0.0005	0.018	0.005	0.01	5.7	0.48	0.086	159,076
2082	9.0	1,705	2,128	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.00051	0.0049	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.016	0.32	28	0.06	3.3	0.000041	1,204	1.6	0.000041	0.0005	0.018	0.005	0.01	5.8	0.43	0.077	160,041
2083	9.0	1,694	2,167	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.9	0.00051	0.0049	0.014	0.05	0.0043	0.5	52	0.021	0.000005	0.057	0.016	0.32	28	0.061	3.3	0.000041	1,207	1.6	0.000041	0.0005	0.018	0.005	0.01	5.9	0.37	0.067	160,609
2084	9.0	1,698	2,182	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.9	0.00051	0.005	0.014	0.05	0.0044	0.49	52	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.3	0.000041	1,212	1.6	0.000041	0.0005	0.018	0.005	0.01	5.7	0.35	0.064	161,869
2085	9.0	1,691	2,202	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.8	0.00051	0.005	0.014	0.05	0.0044	0.49	52	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.3	0.00004	1,212	1.6	0.000041	0.0005	0.018	0.005	0.01	5.8	0.34	0.061	162,127
2086	9.0	1,695	2,209	19	0.12	0.003	0.0023	0.0026	0.89	0.00005	1.9	0.00051	0.0051	0.014	0.05	0.0045	0.49	53	0.021	0.000005	0.057	0.016	0.31	28	0.062	3.3	0.000041	1,215	1.6	0.000041	0.0005	0.018	0.005	0.01	5.4	0.33	0.06	163,022
2087	8.9	1,689	2,222	19	0.11	0.003	0.0022	0.0026	0.89	0.00005	1.9	0.00051	0.005	0.014	0.05	0.0044	0.49	53	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.2	0.00004	1,215	1.6	0.000041	0.0005	0.018	0.005	0.01	5.3	0.33	0.06	163,716
2088	9.0	1,701	2,235	19	0.12	0.003	0.0023	0.0026	0.88	0.00005	1.8	0.00051	0.005	0.015	0.05	0.

Table A3. Source terms of the NAG backfill for the well graded cover system scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2135	9.2	1,577	3,187	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	77	0.02	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,338	1.4	0.000038	0.0005	0.017	0.005	0.01	2.7	0.057	0.01	186,587
2136	9.2	1,578	3,192	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	78	0.02	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,339	1.4	0.000038	0.0005	0.017	0.005	0.01	2.7	0.057	0.01	187,193
2137	9.2	1,581	3,204	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,342	1.4	0.000038	0.0005	0.017	0.005	0.01	2.6	0.057	0.01	186,724
2138	9.2	1,570	3,233	17	0.24	0.0028	0.0022	0.0032	0.78	0.00005	0.94	0.0005	0.0048	0.015	0.05	0.0044	0.43	79	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,342	1.4	0.000038	0.0005	0.017	0.005	0.01	2.6	0.057	0.01	186,796
2139	9.2	1,553	3,271	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.92	0.0005	0.0047	0.015	0.05	0.0043	0.43	79	0.019	0.000005	0.052	0.016	0.27	24	0.055	2.8	0.000037	1,342	1.4	0.000037	0.0005	0.017	0.005	0.01	2.6	0.057	0.01	187,060
2140	9.2	1,545	3,291	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.91	0.0005	0.0046	0.015	0.05	0.0043	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.055	2.8	0.000037	1,342	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,517
2141	9.2	1,532	3,320	17	0.25	0.0027	0.0022	0.0033	0.78	0.00005	0.9	0.0005	0.0046	0.015	0.05	0.0042	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.054	2.8	0.000037	1,341	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	186,898
2142	9.2	1,525	3,335	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.89	0.0005	0.0045	0.015	0.05	0.0042	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000036	1,341	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	186,889
2143	9.2	1,516	3,353	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.0005	0.0045	0.015	0.05	0.0041	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000036	1,340	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,035
2144	9.2	1,509	3,369	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.0005	0.0044	0.015	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.052	2.8	0.000036	1,339	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,551
2145	9.2	1,502	3,386	17	0.26	0.0026	0.0021	0.0033	0.78	0.00005	0.87	0.0005	0.0043	0.014	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.051	2.8	0.000036	1,338	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,020
2146	9.2	1,496	3,399	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.87	0.0005	0.0042	0.014	0.05	0.0039	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.05	2.8	0.000036	1,337	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,082
2147	9.2	1,490	3,412	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.0005	0.0042	0.014	0.05	0.0038	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.049	2.8	0.000036	1,337	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,212
2148	9.2	1,485	3,424	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.0005	0.0041	0.014	0.05	0.0037	0.42	84	0.017	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000035	1,336	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,667
2149	9.2	1,480	3,436	17	0.27	0.0026	0.002	0.0034	0.78	0.00005	0.85	0.0005	0.004	0.014	0.05	0.0037	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.047	2.8	0.000035	1,336	1.4	0.000036	0.0005	0.016	0.005	0.01	2.5	0.057	0.01	187,030
2150	9.2	1,476	3,445	17	0.27	0.0026	0.0019	0.0034	0.78	0.00005	0.85	0.0005	0.0039	0.014	0.05	0.0036	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000035	1,335	1.4	0.000036	0.0005	0.016	0.005	0.01	2.4	0.057	0.01	186,985

Table A4. Annual loads of the NAG backfill for the well graded cover system scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m³/year
2023	20	1.5	0.44	0.00019	0.0000034	0.0000019	0.0000037	0.02	0.00000065	0.45	0.0000081	0.000092	0.000016	0.00081	0.0000016	0.011	0.33	0.00054	0.00	0.00066	0.00012	0.007	0.63	0.0018	0.073	0.00000047	8.5	0.035	0.0000047	0.0000081	0.00021	0.000028	0.00007	1.1	0.13	0.024	16
2024	40	3.1	0.9	0.00038	0.00007	0.00004	0.000076	0.041	0.0000013	0.92	0.0000017	0.00019	0.0000033	0.0016	0.0000033	0.023	0.67	0.0011	0.00000016	0.0013	0.00025	0.014	1.3	0.0036	0.15	0.00000096	17	0.072	0.00000096	0.000016	0.00043	0.000058	0.00014	2.2	0.27	0.05	33
2025	69	5.4	1.6	0.00067	0.00012	0.0000069	0.00013	0.072	0.0000023	1.6	0.0000029	0.00033	0.0000058	0.0029	0.0000058	0.039	1.2	0.0019	0.00000029	0.0023	0.00043	0.025	2.2	0.0063	0.26	0.0000017	30	0.13	0.0000017	0.000029	0.00074	0.0001	0.00025	3.8	0.48	0.086	57
2026	106	8.2	2.4	0.001	0.00019	0.00011	0.0002	0.11	0.0000035	2.4	0.0000044	0.0005	0.0000088	0.0044	0.0000088	0.06	1.8	0.0029	0.00000044	0.0036	0.00065	0.038	3.4	0.0097	0.4	0.0000025	46	0.19	0.0000025	0.0000044	0.0011	0.00015	0.00038	5.7	0.72	0.13	87
2027	141	11	3.2	0.0013	0.00025	0.00014	0.00027	0.15	0.0000047	3.2	0.0000058	0.00067	0.00012	0.0058	0.0000012	0.08	2.3	0.0039	0.00000058	0.0047	0.00086	0.051	4.5	0.013	0.53	0.0000034	61	0.26	0.0000034	0.0000058	0.0015	0.0002	0.0005	7.6	0.96	0.17	116
2028	236	18	5.3	0.0023	0.00042	0.00024	0.00045	0.24	0.0000078	5.4	0.0000098	0.0011	0.0002	0.0098	0.00002	0.13	4.0	0.0066	0.00000098	0.008	0.0015	0.085	7.6	0.022	0.89	0.0000057	103	0.43	0.0000057	0.0000098	0.0025	0.00034	0.00084	13	1.6	0.29	195
2029	267	21	6.0	0.0026	0.00047	0.00027	0.00051	0.28	0.0000089	6.1	0.00011	0.0013	0.00022	0.011	0.0000022	0.15	4.5	0.0074	0.00000011	0.009	0.0016	0.097	8.6	0.024	1.0	0.0000064	117	0.49	0.0000064	0.00011	0.0029	0.00039	0.00095	14	1.8	0.33	221
2030	321	25	7.3	0.0031	0.00057	0.00032	0.00062	0.33	0.0000111	7.4	0.00013	0.0015	0.00027	0.013	0.0000027	0.18	5.4	0.0089	0.00000013	0.011	0.002	0.12	10	0.029	1.2	0.0000077	140	0.58	0.0000077	0.00013	0.0034	0.00046	0.0011	17	2.2	0.4	266
2031	1,162	91	26	0.011	0.002	0.0012	0.0022	1.2	0.0000039	27	0.00048	0.0055	0.00097	0.048	0.0000096	0.66	19	0.032	0.00000048	0.039	0.0071	0.42	38	0.11	4.4	0.000028	508	2.1	0.000028	0.00048	0.012	0.0017	0.0041	63	8.0	1.4	961
2032	2,750	214	62	0.026	0.0048	0.0027	0.0053	2.8	0.0000091	63	0.0011	0.013	0.0023	0.11	0.00023	1.6	46	0.076	0.00000011	0.093	0.017	0.99	89	0.25	10	0.0000066	1,201	5.0	0.0000066	0.0011	0.029	0.004	0.0098	149	19	3.4	2,273
2033	858	67	19	0.0082	0.0015	0.00086	0.0016	0.89	0.0000028	20	0.00036	0.0041	0.00071	0.035	0.0000071	0.49	14	0.024	0.00000035	0.029	0.0053	0.31	28	0.078	3.2	0.0000021	375	1.6	0.0000021	0.00035	0.0092	0.0012	0.0031	46	5.9	1.1	710
2034	1,554	121	35	0.015	0.0027	0.0015	0.003	1.6	0.0000051	36	0.00064	0.0074	0.0013	0.064	0.00013	0.88	26	0.043	0.00000064	0.052	0.0095	0.56	50	0.14	5.8	0.0000037	679	2.8	0.0000037	0.00064	0.017	0.0022	0.0055	84	11	1.9	1,284
2035	12,672	987	286	0.12	0.022	0.013	0.024	13	0.00042	291	0.0052	0.06	0.011	0.52	0.0011	7.2	212	0.35	0.0000052	0.43	0.078	4.6	409	1.2	48	0.0003	5,534	23	0.0003	0.0052	0.14	0.018	0.045	686	87	16	10,477
2036	23,413	1,824	529	0.22	0.041	0.023	0.045	24	0.00078	538	0.0097	0.11	0.019	0.97	0.0019	13	391	0.65	0.0000097	0.79	0.14	8.5	756	2.1	88	0.00056	10,225	42	0.00056	0.0097	0.25	0.034	0.084	1,267	160	29	19,356
2037	16,957	1,321	383	0.16	0.03	0.017	0.033	17	0.00056	390	0.007	0.08	0.014	0.7	0.0014	9.6	283	0.47	0.00007	0.57	0.1	6.1	548	1.5	64	0.00041	7,405	31	0.00041	0.007	0.18	0.025	0.061	918	116	21	14,018
2038	32,863	2,560	742	0.32	0.058	0.033	0.063	34	0.0011	755	0.014	0.16	0.027	1.4	0.0027	19	549	0.91	0.00014	1.1	0.2	12	1,062	3.0	124	0.00079	14,352	60	0.00079	0.014	0.35	0.048	0.12	1,778	225	41	27,168
2039	63,961	11,571	1,332	0.72	0.11	0.062	0.11	61	0.002	1,527	0.024	0.29	0.059	2.4	0.015	33	1,111	1.7	0.00024	2.2	0.4	21	1,907	5.5	222	0.0015	29,310	107	0.0015	0.024	0.68	0.092	0.23	3,194	186	34	48,784
2040	128,782	40,409	2,348	1.5	0.23	0.13	0.19	107	0.0034	2,749	0.043	0.56	0.15	4.3	0.073	59	2,362	3.2	0.00043	4.3	0.87	38	3,360	10	392	0.0031	63,111	189	0.0031	0.043	1.4	0.19	0.51	5,626	255	46	85,906
2041	197,654	88,386	3,173	3.1	0.35	0.19	0.25	145	0.0047	1,619	0.059	0.64	0.67	5.8	0.2	80	3,854	3.4	0.00058	6.7	1.2	51	4,542	11	529	0.0047	105,502	255	0.0048	0.058	2.1	0.29	0.76	5,144	117	21	116,049
2042	185,591	104,355	3,172	3.9	0.33	0.19	0.31	145	0.0053	1,539	0.066	0.4	1.1	6.6	0.26	79	3,722	1.8	0.00066	6.2	1.1	51	4,539	5.5	529	0.0045	103,736	255	0.0045	0.066	2.0	0.27	0.68	1,545	165	30	131,728
2043	186,076	105,488	3,171	3.9	0.33	0.2	0.33	145	0.0054	1,615	0.068	0.36	1.1	6.8	0.27	79	3,734	1.6	0.00068	6.3	1.0	51	4,539	4.7	529	0.0045	104,118	255	0.0045	0.068	2.0	0.27	0.68	942	191	35	135,614
2044	186,190	104,188	3,171	3.9	0.33	0.2	0.33	145	0.0055	1,717	0.069	0.36	1.1	6.9	0.27	79	3,726	1.6	0.00069	6.3	1.0	51	4,539	4.7	529	0.0045	103,774	255	0.0045	0.069	2.0	0.27	0.68	947	53	9.6	137,918
2045	188,820	106,262	3,172	3.9	0.33	0.2	0.32	145	0.0054	1,585	0.068	0.38	1.1	6.7	0.28	79	3,791	1.7	0.00067	6.4	1.1	51	4,539	5.0	529	0.0045	105,535	255	0.0045	0.067	2.0	0.27	0.69	1,107	33	6.0	134,843
2046	188,964	103,720	3,172	3.8	0.33	0.2	0.3	145	0.0052	1,515	0.065	0.41	1.1	6.5	0.3	79	3,787	1.8	0.00065	6.4	1.2	51	4,540	5.5	529	0.0045	105,107	255	0.0045	0.065	2.0	0.27	0.75	1,252	38	6.9	129,640
2047	203,032	105,866	3,173	3.8	0.36	0.22	0.29	145	0.0052	1,496	0.065	0.45	1.1	6.4	0.37	80	4,033	1.9	0.00064	6.8	1.4	51	4,541	5.6	529	0.0049	111,892	255	0.0049	0.064	2.2	0.29	0.88	792	46	8.3	128,811
2048	223,360	112,202	3,173	4.0	0.39	0.25	0.28	145	0.0052	1,458	0.067	0.53	1.1	6.5	0.45	80	4,420	2.2	0.00065	7.5	1.7	51	4,542	6.5	529	0.0054	122,389	255	0.0054	0.065	2.4	0.32	1.0	762	55	10	130,391
2049	233,846	117,629	3,174	4.1	0.41	0.27	0.28	145	0.0053	1,404	0.07	0.59	1.2	6.6	0.51	80	4,637	2.5	0.00066	7.9	1.9	51	4,543	7.4	529	0.0056	128,307	255	0.0056	0.066	2.5	0.34	1.2	833	62	11	131,655
2050	240,268	120,082	3,174	4.2	0.42	0.29	0.28	145	0.0053	1,409	0.072	0.63	1.2	6.7	0.55	80	4,757	2.6	0.00067	8.1	2.0	51	4,543	7.7	529	0.0058	131,710	255	0.0058	0.067	2.6	0.35	1.3	710	65	12	133,193
2051	243,939	121,288	3,174	4.2	0.43	0.3	0.28	145	0.0054	1,421	0.073	0.65	1.2	6.7	0.58	80	4,821	2.7	0.00067	8.2	2.1	51	4,543	7.8	529	0.0058	133,609	255	0.0059	0.067	2.6	0.35	1.3	552	73	13	134,254
2052	247,218	122,306	3,174	4.3	0.44	0.31	0.28	145	0.0054	1,435	0.074	0.66	1.2	6.8	0.61	80	4,882	2.7	0.00068	8.3	2.2	51	4,543	7.7	529	0.0059	135,278	255	0.0059	0.068	2.6	0.36	1.4	353	87	16	135,292
2053	248,540	122,377	3,174	4.3	0.44	0.31	0.28	145	0.0054	1,438	0.075	0.66	1.2	6.8	0.62	80	4,905	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.006	135,880	255	0.006	0.068	2.7	0.36	1.4	193	94	17	135,311
2054	250,169	122,780	3,174	4.3	0.44	0.31	0.29	145	0.0055	1,450	0.075	0.67	1.2	6.8	0.63	80	4,934	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.006	136,687	255	0.006	0.068	2.7	0.36	1.4	145	87	16	135,939
2055	253,168	123,343	3,174	4.3	0.45	0.32	0.29	145	0.0055	1,467	0.076	0.68	1.2	6.8	0.65	80	4,987	2.7	0.00068	8.5	2.3	51	4,543	8.0	529	0.0061	138,125	255	0.0061	0.068	2.7	0.37	1.5	151	86	16	136,744
2056	249,012	151,733	3,175	5.3	0.44	0.32	0.3	145	0.0055	1,021	0.075	0.67	1.4	6.9	0.63	80	5,237	2.7	0.00069	8.4	2.2	51	4,544	7.8	529	0.006	142,694	255	0.006	0.069	2.7	0.36	1.4	174	96	17	137,789
2057	238,870	196,129	3,175	7.1	0.42	0.3	0.32	145	0.0055	643	0.072	0.61	1.8	6.9	0.58	80	5,612	2.5	0.00069	8.0	2.1	51	4,544	7.2	530	0.0057	147,766	255	0.0057	0.069	2.6	0.35	1.3	202	108	20	138,099
2058	233,012	221,733	3,176	8.2	0.41	0.28	0.33	145	0.0056	520	0.07	0.58	2.0	6.9	0.54	80	5,863	2.3	0.00069	7.8	1.9	51	4,545	6.8	530	0.0056	150,502	255	0.0056	0.069	2.5	0.34	1.2	234	115	21	138,393
2059	231,696	230,559	3,176	8.6	0.41	0.28	0.34	145	0.0056	488	0.07	0.57	2.0	6.9	0.53	80	5,977	2.3	0.00069	7.8	1.9	51	4,545	6.7	530	0.0055	151,719	255	0.0056	0.069	2.5	0.33	1.2	271	112	20	138,657
2060	233,410	234,067	3,176	8.7	0.41	0.28	0.34	145	0.0056	486	0.07	0.57	2.0	7.0	0.53	80	6,061	2.3	0.0007	7.9	1.9	51	4,545	6.8	530	0.0056	153,184	255	0.0056	0.07	2.5	0.34	1.2	316	116	21	139,741
2061	234,402	234,276	3,176	8.7	0.41	0.28	0.34	145	0.0056	489	0.07	0.58	2.0	7.0	0.53	80	6,088	2.4	0.0007	7.9	1.9	51	4,545	6.9	530	0.0056	153,658	255	0.0056	0.07	2.5	0.34	1.2	364	111	20	140,084
2062	234,343	245,464	3,176	9.9	0.41	0.28	0.35	145	0.0057	436	0.071	0.58	2.0	7.0	0.53	80	6,206	2.4	0.0007	7.9	1.9	51	4,546	6.9	530	0.0056	156,036	255	0.0056	0.07	2.5	0.34	1.2	417	101	18	140,942
2063	232,890	257,359	3,176	11	0.41	0.28	0.36	145	0.0057	398	0.071	0.57	2.0	7.1	0.51	80	6,350	2.3	0.00071	7.8	1.9	51	4,546	6.8	530	0.0056	157,837	255	0.0056	0.071	2.5	0.34	1.2	474	92	17	141,850
2064	234,081	261,497	3,176	11	0.41	0.28	0.36	145	0.0057	402	0.072	0.57	2.0	7.2	0.51	80	6,432	2.4	0.00072	7.9	1.8	51	4,546	6.6	530	0.0056	159,202	255	0.0056	0.072	2.5	0.34	1.2	537	96	17	143,090
2065	235,155	272,984	3,176	14	0.41	0.28	0.37	145	0.0058	339	0.072	0.57	2.0	7.2	0.51	80	6,587	2.4	0.00072	7.9	1.8	51	4,546	6.6	530	0.0056	162,126	255	0.0057	0.072	2.5	0.34	1.2	600	100	18	143,729
2066	233,224	287,755	3,177	16	0.41	0.28	0.38	145	0.0058	303	0.073	0.57	2.0	7.2	0.49	80	6,742	2.4	0.00072	7.8	1.8	51	4,546	6.6	530	0.0056	164,332	255	0.0056	0.072	2.5	0.34	1.1	669	107	19	144,914
2067	232,156	298,507	3,177	17	0.41	0.28	0.39	145	0.0059	288	0.073	0.56	2.0	7.3	0.49	80	6,877	2.4	0.00073	7.8	1.8	51	4,546	6.6	530	0.0056	166,053	255	0.0056	0.073	2.5	0.34	1.1	741	113	20	146,084
2068	233,756	306,039	3,177	17	0.41	0.28	0.4	145	0.0059	287	0.074	0.57	2.0	7.4	0.48	80	7,031	2.4	0.00074	7.9	1.8	51	4,546	6.7	530	0.0056	168,266	255	0.0056	0.074	2.5	0.34	1.1	813	115	21	147,667
2069	234,467	310,511	3,177	17	0.42	0.28	0.4	145	0.006	288	0.075	0.57	2.0	7.4	0.48	80	7,136	2.4	0.00074	7.9	1.7	51	4,547	6.7	530	0.0056	169,423	255	0.0056	0.074	2.5	0.34	1.1	871	114	21	148,435
2070	237,133	313,382	3,177	16	0.42	0.28	0.4	145	0.006	297	0.075	0.58	2.0	7.5	0.49	80	7,238	2.4	0.00075	8.0	1.8	51	4,547	6.9	530	0.0057	171,153	255	0.0057	0.075	2.5	0.34	1.1	897	112	20	149,714
2071	238,917	316,056	3,177	16	0.42	0.28	0.4	145	0.0061	305	0.076	0.58	2.0	7.5	0.49	80	7,328	2.4	0.00075	8.0	1.8	51	4,547	6.9	530	0.0057	172,459	255	0.0057	0.075	2.6	0.35	1.1	857	108	20	150,869
2072	243,538	319,835	3,177	17	0.43	0.28	0.41	145	0.0061	297	0.076	0.58	2.0	7.6	0.5	80	7,448	2.4	0.00076	8.2	1.8	51	4,547	7.0	530	0.0058	175,311	255	0.0059	0.076	2.6	0.35	1.2	780	109	20	152,259
2073	245,306	319,891	3,177	17	0.43	0.29	0.41	145	0.0061	303	0.077	0.59	2.1	7.6	0.51	80	7,488	2.5	0.00076	8.3	1.9	51	4,547	7.1	530	0.0059	176,093	255	0.0059	0.076	2.6	0.35	1.2	721	110	20	152,620
2074	247,823	320,362	3,177	16	0.44	0.29	0.41	145	0.0062	312	0.077	0.6	2.1	7.7	0.53	80	7,532	2.5	0.00077	8.3	1.9	51	4,547	7.3	530	0.0059	177,310	255	0.006	0.077	2.6	0.36	1.2	707	113	21	153,555
2075	250,494	320,300	3,177	16	0.44	0.3	0.41	145	0.0062	322	0.078	0.62	2.1	7.7	0.54	80	7,577	2.6	0.00077	8.4	2.0	51	4,547	7.5	530	0.006	178,481	255	0.006	0.077	2.7	0.36	1.3	694	117	21	154,302
2076	256,213	323,939	3,177	18	0.45	0.31	0.41	145	0.0062	304	0.078	0.64	2.1	7.8	0.56	80	7,698	2.7	0.00078	8.6	2.1	51	4,547	7.8	530	0.0061	181,840	255	0.0062	0.078	2.7	0.37	1.3	716	119	22	155,300
2077	259,315	323,891	3,177	18	0.46	0.31	0.4	145	0.0063	308	0.078	0.67	2.2	7.8	0.58	80	7,746	2.8	0.00078	8.7	2.1	51	4,547	8.1	530	0.0062	183,222	255	0.0062	0.078	2.8	0.37	1.3	741	117	21	155,642
2078	262,984	324,669	3,177	17	0.46	0.32	0.4	145	0.0063	314	0.079	0.69	2.2	7.8	0.61	80	7,807	2.9	0.00078	8.9	2.2	51	4,547	8.4	530	0.0063	185,022	255	0.0063	0.078	2.8	0.38	1.4	781	113	21	156,520
2079	266,345	327,890	3,177	18	0.47	0.33	0.41	145	0.0063	314	0.08	0.72	2.2	7.9	0.63	80	7,896	3.0	0.00079	9.0	2.3	51	4,547	8.8	530	0.0064	187,204	255	0.0064	0.079	2.8	0.39	1.5	824	101	18	157,526
2080	269,535	332,232	3,177	18	0.48	0.34	0.41	145	0.0064	315	0.081	0.75	2.2	7.9	0.65	80	8,005	3.1	0.00079	9.1	2.4	51	4,547	9.1	530	0.0065	189,520	255	0.0065	0.079	2.9	0.39	1.5	867	92	17	158,727
2081	272,116	332,708	3,177	18	0.48	0.35	0.41	145	0.0064	320	0.082	0.77	2.3	8.0	0.67	80	8,059	3.2	0.0008	9.2	2.5	51	4,548	9.4	530	0.0065	190,764	255	0.0065	0.08	2.9	0.39	1.5	903	76	14	159,076
2082	272,869	340,630	3,177	19	0.48	0.35	0.41	145	0.0064	308	0.082	0.78	2.3	8.0	0.68	80	8,173	3.3	0.0008	9.2	2.5	51	4,548	9.6	530	0.0065	192,737	255	0.0066	0.08	2.9	0.39	1.6	921	68	12	160,041
2083	272,120	348,104	3,177	19	0.48	0.35	0.42	145	0.0065	299	0.082	0.79	2.3	8.0	0.69	80	8,273	3.3	0.0008	9.2	2.5	51	4,548	9.7	530	0.0065	193,919	255	0.0066	0.08	2.9	0.39	1.6	944	59	11	160,609
2084	274,821	353,230	3,178	19	0.48	0.36	0.42	145	0.0065	301	0.083	0.81	2.3	8.1	0.71	80	8,405	3.4	0.00081	9.2	2.6	51	4,548	9.9	530	0.0066	196,136	255	0.0066	0.081	2.9	0.4	1.6	930	57	10	161,869
2085	274,109	357,053	3,178	19	0.48	0.36	0.42	145	0.0065	299	0.082	0.81	2.3	8.1	0.71	80	8,478	3.4	0.00081	9.2	2.6	51	4,548	10.0	530	0.0066	196,531	255	0.0066	0.081	2.9	0.4	1.6	934	54	9.9	162,127
2086	276,257	360,164	3,178	19	0.49	0.37	0.43	145	0.0066	304	0.083	0.82	2.4	8.2	0.73	80	8,584	3.4	0.00082	9.3	2.6	51	4,548	10	530	0.0066	198,072	255	0.0067	0.082	2.9	0.4	1.7	880	54	9.9	163,022
2087	276,500	363,696	3,178	19	0.49	0.37	0.43	145	0.0066	306	0.083	0.82	2.4	8.2	0.72	80	8,675	3.4	0.00082	9.3	2.6	51	4,548	10	530	0.0066	198,833	255	0.0066	0.082	3.0	0.4	1.7	869	54	9.9	163,716
2088	280,271	368,398	3,178	20	0.49	0.37	0.43	145	0.0066	299	0.084	0.83	2.4	8.2	0.74	80	8,822	3.4	0.00082	9.4	2.7	51	4,548	10	530	0.0067	201,439	255	0.0067	0.082	3.0	0.41	1.7	795	55	9.9	164,817
2089	275,396	376,485	3,178	22	0.49	0.36	0.44	145	0.0066	274	0.083	0.78	2.4	8.3	0.7	80	8,871	3.2	0.00083	9.3	2.5	51	4,548	9.5	530	0.0066	200,891	255	0.0066	0.083	2.9	0.4	1.6	749	55	10.0	165,016
2090	275,529	383,534	3,178	23	0.49	0.36	0.45	145	0.0067	268	0.083	0.78	2.4	8.3	0.7	80	9,001	3.2	0.00083	9.3	2.5	51	4,549	9.4	530	0.0066	202,339	255	0.0066	0.083	2.9	0.4	1.6	707	55	10	165,702
2091	276,362	388,183	3,178	23	0.49	0.36	0.45	145	0.0067	268	0.084	0.78	2.4	8.3	0.7	80	9,122	3.2	0.00083	9.3	2.5	51	4,549	9.4	530	0.0066	203,575	255	0.0066	0.083	3.0	0.4	1.6	718	55	10	166,524
2092	278,748	393,879	3,178	23	0.49	0.36	0.45	145	0.0067	270	0.084	0.79	2.4	8.4	0.7	80	9,285	3.2	0.00084	9.4	2.5	51	4,549	9.5	530	0.0067	205,708	255	0.0067	0.084	3.0	0.4	1.6	711	55	9.9	167,829
2093	277,320	402,001	3,178	24	0.49	0.36	0.46	145	0.0068	260	0.085	0.78	2.4	8.4	0.69

Table A4. Annual loads of the NAG backfill for the well graded cover system scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2135	294,248	594,560	3,182	43	0.52	0.42	0.59	145	0.0075	181	0.094	0.9	2.8	9.3	0.83	80	14,424	3.7	0.00093	9.9	3.0	51	4,554	11	531	0.007	249,560	256	0.0071	0.093	3.1	0.43	1.9	506	11	1.9	186,587
2136	295,465	597,538	3,182	43	0.52	0.42	0.59	145	0.0075	181	0.094	0.9	2.8	9.4	0.83	80	14,530	3.7	0.00094	9.9	3.0	51	4,554	11	531	0.0071	250,632	256	0.0071	0.094	3.2	0.43	1.9	503	11	2.0	187,193
2137	295,267	598,264	3,182	43	0.52	0.42	0.59	145	0.0075	180	0.094	0.89	2.8	9.3	0.83	80	14,607	3.6	0.00093	9.9	3.0	51	4,554	11	531	0.0071	250,546	256	0.0071	0.093	3.2	0.43	1.9	494	11	1.9	186,724
2138	293,288	603,873	3,182	45	0.52	0.41	0.59	145	0.0075	176	0.094	0.89	2.8	9.3	0.82	80	14,678	3.6	0.00093	9.9	2.9	51	4,554	10	531	0.007	250,755	256	0.007	0.093	3.1	0.42	1.9	493	11	2.0	186,796
2139	290,505	611,856	3,182	46	0.51	0.41	0.6	145	0.0075	172	0.094	0.88	2.8	9.4	0.81	80	14,802	3.6	0.00094	9.8	2.9	51	4,554	10	531	0.0069	251,035	256	0.007	0.094	3.1	0.42	1.8	492	11	2.0	187,060
2140	289,638	617,098	3,182	47	0.51	0.41	0.61	145	0.0075	171	0.094	0.87	2.8	9.4	0.8	80	14,924	3.5	0.00094	9.7	2.9	51	4,554	10	531	0.0069	251,572	256	0.007	0.094	3.1	0.42	1.8	492	11	2.0	187,517
2141	286,309	620,463	3,182	48	0.5	0.4	0.61	145	0.0075	167	0.094	0.86	2.8	9.3	0.79	80	14,989	3.5	0.00093	9.6	2.8	51	4,555	10	531	0.0068	250,649	256	0.0069	0.093	3.1	0.41	1.8	492	11	2.0	186,898
2142	285,025	623,257	3,182	48	0.5	0.4	0.61	145	0.0075	166	0.094	0.84	2.7	9.3	0.78	80	15,070	3.4	0.00093	9.6	2.8	51	4,554	10.0	531	0.0068	250,525	256	0.0068	0.093	3.0	0.41	1.8	492	11	2.0	186,889
2143	283,564	627,204	3,182	48	0.5	0.4	0.62	145	0.0075	165	0.094	0.84	2.7	9.4	0.77	80	15,161	3.4	0.00094	9.5	2.8	51	4,554	9.9	531	0.0068	250,553	256	0.0068	0.094	3.0	0.41	1.7	493	11	2.0	187,035
2144	283,034	631,917	3,182	49	0.5	0.39	0.62	145	0.0075	164	0.094	0.82	2.7	9.4	0.75	80	15,311	3.3	0.00094	9.5	2.7	51	4,555	9.7	531	0.0068	251,094	256	0.0068	0.094	3.0	0.41	1.7	495	11	2.0	187,551
2145	280,847	633,211	3,183	49	0.5	0.39	0.62	145	0.0075	163	0.094	0.81	2.7	9.4	0.74	80	15,352	3.3	0.00094	9.5	2.7	51	4,555	9.6	531	0.0067	250,270	256	0.0068	0.094	3.0	0.41	1.7	493	11	2.0	187,020
2146	279,837	635,834	3,182	49	0.49	0.38	0.63	145	0.0075	162	0.094	0.79	2.7	9.4	0.72	80	15,458	3.2	0.00094	9.4	2.6	51	4,555	9.3	531	0.0067	250,203	256	0.0067	0.094	3.0	0.4	1.6	492	11	2.0	187,082
2147	278,890	638,693	3,183	49	0.49	0.38	0.63	145	0.0075	161	0.094	0.78	2.7	9.4	0.72	80	15,545	3.2	0.00094	9.4	2.6	51	4,555	9.2	531	0.0067	250,228	256	0.0067	0.094	3.0	0.4	1.6	488	11	2.0	187,212
2148	278,629	642,477	3,183	50	0.49	0.37	0.64	145	0.0076	161	0.094	0.76	2.7	9.4	0.7	80	15,681	3.1	0.00094	9.4	2.5	51	4,555	9.0	531	0.0067	250,723	256	0.0067	0.094	3.0	0.4	1.6	485	11	2.0	187,667
2149	276,730	642,673	3,183	50	0.49	0.37	0.64	145	0.0075	159	0.094	0.75	2.7	9.4	0.69	80	15,708	3.0	0.00094	9.3	2.5	51	4,555	8.8	531	0.0066	249,798	256	0.0067	0.094	3.0	0.4	1.6	469	11	2.0	187,030
2150	275,915	644,201	3,183	50	0.49	0.36	0.64	145	0.0075	159	0.094	0.73	2.6	9.3	0.67	80	15,786	3.0	0.00093	9.3	2.4	51	4,555	8.6	531	0.0066	249,606	256	0.0066	0.093	2.9	0.4	1.5	458	11	2.0	186,985

Table A5. Source terms of the NAG backfill for the well graded cover system and no internal layer scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2023	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	24
2024	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	44
2025	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	80
2026	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	125
2027	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	158
2028	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	289
2029	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	270
2030	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	348
2031	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	2,236
2032	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	3,634
2033	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	620
2034	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	2,492
2035	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	7,085
2036	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	12,083
2037	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	13,464
2038	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	26,952
2039	8.1	1,310	236	29	0.015	0.0023	0.0013	0.0023	1.3	0.00005	31	0.0005	0.0059	0.004	0.05	0.00032	0.72	23	0.035	0.000005	0.044	0.0082	0.46	41	0.11	4.8	0.000031	600	2.3	0.000031	0.0005	0.014	0.005	0.01	65	8.3	1.5	45,912
2040	8.2	1,513	481	29	0.018	0.0027	0.0015	0.0022	1.3	0.00005	31	0.0005	0.0065	0.004	0.05	0.00088	0.72	28	0.037	0.000005	0.051	0.01	0.46	41	0.12	4.8	0.000035	744	2.3	0.000036	0.0005	0.016	0.005	0.01	65	8.3	1.5	79,056
2041	8.4	1,702	763	29	0.027	0.003	0.0016	0.0022	1.3	0.00005	14	0.00051	0.0055	0.0059	0.05	0.0017	0.72	33	0.029	0.000005	0.057	0.011	0.46	41	0.093	4.8	0.000036	909	2.3	0.000041	0.0005	0.018	0.005	0.01	44	5.5	1.0	110,907
2042	8.5	1,410	794	25	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.0005	0.003	0.0082	0.05	0.002	0.62	28	0.014	0.000005	0.047	0.008	0.39	35	0.041	4.1	0.000034	788	2.0	0.000034	0.0005	0.015	0.005	0.01	12	1.5	0.26	128,839
2043	8.4	1,372	781	24	0.029	0.0024	0.0015	0.0024	1.1	0.00005	12	0.0005	0.0026	0.0081	0.05	0.002	0.59	28	0.012	0.000005	0.046	0.0077	0.38	34	0.034	4.0	0.000033	768	1.9	0.000033	0.0005	0.015	0.005	0.01	6.7	0.84	0.15	133,866
2044	8.4	1,350	759	23	0.028	0.0024	0.0014	0.0024	1.1	0.00005	12	0.0005	0.0026	0.008	0.05	0.002	0.58	27	0.011	0.000005	0.045	0.0075	0.37	33	0.033	3.9	0.000032	753	1.9	0.000032	0.0005	0.014	0.005	0.01	6.5	0.83	0.15	136,575
2045	8.5	1,399	790	24	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.0005	0.0028	0.0082	0.05	0.002	0.59	28	0.012	0.000005	0.047	0.0079	0.38	34	0.037	4.0	0.000034	783	1.9	0.000034	0.0005	0.015	0.005	0.01	7.9	1.	0.18	133,758
2046	8.5	1,457	802	25	0.029	0.0026	0.0016	0.0023	1.1	0.00005	12	0.0005	0.0032	0.0083	0.05	0.0023	0.62	29	0.014	0.000005	0.049	0.009	0.39	35	0.042	4.1	0.000035	811	2.0	0.000035	0.0005	0.016	0.005	0.01	9.4	1.2	0.21	128,763
2047	8.5	1,577	824	25	0.03	0.0028	0.0017	0.0022	1.1	0.00005	12	0.0005	0.0035	0.0084	0.05	0.0029	0.62	31	0.015	0.000005	0.053	0.011	0.4	35	0.043	4.1	0.000038	870	2.0	0.000038	0.0005	0.017	0.005	0.01	5.9	0.75	0.14	128,089
2048	8.5	1,714	862	24	0.03	0.003	0.0019	0.0022	1.1	0.00005	11	0.00051	0.004	0.0087	0.05	0.0034	0.61	34	0.017	0.000005	0.058	0.013	0.39	35	0.05	4.1	0.000041	939	2.0	0.000041	0.0005	0.018	0.005	0.01	5.6	0.71	0.13	129,793
2049	8.5	1,776	894	24	0.031	0.0031	0.0021	0.0021	1.1	0.00005	11	0.00053	0.0045	0.0089	0.05	0.0038	0.61	35	0.019	0.000005	0.06	0.014	0.39	35	0.056	4.0	0.000043	975	1.9	0.000043	0.0005	0.019	0.005	0.01	6.2	0.78	0.14	131,172
2050	8.5	1,804	902	24	0.031	0.0032	0.0022	0.0021	1.1	0.00005	11	0.00054	0.0047	0.009	0.05	0.0042	0.6	36	0.02	0.000005	0.061	0.015	0.38	34	0.058	4.0	0.000043	989	1.9	0.000043	0.0005	0.019	0.005	0.01	5.2	0.66	0.12	132,811
2051	8.5	1,817	904	24	0.032	0.0032	0.0022	0.0021	1.1	0.00005	11	0.00055	0.0048	0.009	0.05	0.0043	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.058	4.0	0.000044	995	1.9	0.000044	0.0005	0.019	0.005	0.01	4.0	0.51	0.093	133,964
2052	8.5	1,827	904	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0048	0.009	0.05	0.0045	0.59	36	0.02	0.000005	0.062	0.016	0.38	34	0.057	3.9	0.000044	1,000	1.9	0.000044	0.0005	0.02	0.005	0.01	2.6	0.33	0.059	135,076
2053	8.5	1,837	905	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0049	0.009	0.05	0.0046	0.59	36	0.02	0.000005	0.062	0.016	0.38	34	0.057	3.9	0.000044	1,004	1.9	0.000044	0.0005	0.02	0.005	0.01	1.4	0.18	0.032	135,145
2054	8.5	1,841	904	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0049	0.009	0.05	0.0047	0.59	36	0.02	0.000005	0.062	0.016	0.37	33	0.057	3.9	0.000044	1,006	1.9	0.000044	0.0005	0.02	0.005	0.01	1.0	0.13	0.024	135,795
2055	8.5	1,852	903	23	0.031	0.0033	0.0023	0.0021	1.1	0.00005	11	0.00056	0.005	0.009	0.05	0.0048	0.58	36	0.02	0.000005	0.062	0.017	0.37	33	0.058	3.9	0.000044	1,011	1.9	0.000045	0.0005	0.02	0.005	0.011	1.1	0.13	0.024	136,601
2056	8.6	1,808	1,102	23	0.039	0.0032	0.0023	0.0022	1.1	0.00005	7.4	0.00054	0.0048	0.01	0.05	0.0046	0.58	38	0.02	0.000005	0.061	0.016	0.37	33	0.057	3.8	0.000043	1,036	1.9	0.000043	0.0005	0.019	0.005	0.01	1.2	0.15	0.028	137,639
2057	8.7	1,730	1,422	23	0.052	0.0031	0.0022	0.0023	1.1	0.00005	4.6	0.00052	0.0044	0.013	0.05	0.0042	0.58	41	0.018	0.000005	0.058	0.015	0.37	33	0.052	3.8	0.000041	1,071	1.9	0.000042	0.0005	0.018	0.005	0.01	1.4	0.18	0.032	137,940
2058	8.7	1,684	1,604	23	0.059	0.003	0.0021	0.0024	1.1	0.00005	3.7	0.00051	0.0042	0.015	0.05	0.0039	0.58	42	0.017	0.000005	0.057	0.014	0.37	33	0.049	3.8	0.00004	1,088	1.8	0.00004	0.0005	0.018	0.005	0.01	1.6	0.2	0.037	138,218
2059	8.7	1,672	1,665	23	0.062	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.37	33	0.048	3.8	0.00004	1,095	1.8	0.00004	0.0005	0.018	0.005	0.01	1.9	0.24	0.043	138,460
2060	8.7	1,671	1,678	23	0.063	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.36	33	0.048	3.8	0.00004	1,097	1.8	0.00004	0.0005	0.018	0.005	0.01	2.2	0.27	0.05	139,518
2061	8.7	1,674	1,676	23	0.062	0.003	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.014	0.36	33	0.049	3.8	0.00004	1,098	1.8	0.00004	0.0005	0.018	0.005	0.01	2.5	0.31	0.057	139,838
2062	8.8	1,663	1,745	23	0.071	0.0029	0.002	0.0025	1.0	0.00005	3.1	0.0005	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.013	0.36	32	0.049	3.8	0.00004	1,108	1.8	0.00004	0.0005	0.018	0.005	0.01	2.8	0.36	0.065	140,676
2063	8.8	1,642	1,818	22	0.078	0.0029	0.002	0.0025	1.0	0.00005	2.8	0.0005	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,114	1.8	0.000039	0.0005	0.018	0.005	0.01	3.2	0.41	0.074	141,568
2064	8.8	1,637	1,831	22	0.077	0.0029	0.002	0.0025	1.0	0.00005	2.8	0.0005	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.046	3.7	0.000039	1,114	1.8	0.000039	0.0005	0.017	0.005	0.01	3.6	0.46	0.083	142,789
2065	8.9	1,636	1,903	22	0.095	0.0029	0.0019	0.0026	1.0	0.00005	2.3	0.0005	0.004	0.014	0.05	0.0035	0.56	46	0.016	0.000005	0.055	0.013	0.35	32	0.046	3.7	0.000039	1,129	1.8	0.000039	0.0005	0.017	0.005	0.01	4.0	0.51	0.093	143,409
2066	8.9	1,609	1,989	22	0.11	0.0028	0.0019	0.0026	1.0	0.00005	2.1	0.0005	0.0039	0.014	0.05	0.0034	0.55	47	0.016	0.000005	0.054	0.012	0.35	31	0.045	3.7	0.000039	1,135	1.8	0.000039	0.0005	0.017	0.005	0.01	4.5	0.57	0.1	144,573
2067	8.9	1,589	2,048	22	0.11	0.0028	0.0019	0.0027	1.	0.00005	2.0	0.0005	0.0039	0.013	0.05	0.0033	0.55	47	0.016	0.000005	0.053	0.012	0.35	31	0.045	3.6	0.000038	1,138	1.8	0.000038	0.0005	0.017	0.005	0.01	4.9	0.62	0.11	145,722
2068	8.9	1,583	2,077	22	0.11	0.0028	0.0019	0.0027	0.99	0.00005	1.9	0.0005	0.0038	0.013	0.05	0.0033	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.045	3.6	0.000038	1,140	1.7	0.000038	0.0005	0.017	0.005	0.01	5.3	0.68	0.12	147,284
2069	8.9	1,580	2,097	21	0.11	0.0028	0.0019	0.0027	0.98	0.00005	1.9	0.0005	0.0038	0.013	0.05	0.0032	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.045	3.6	0.000038	1,142	1.7	0.000038	0.0005	0.017	0.005	0.01	5.7	0.72	0.13	148,241
2070	8.9	1,584	2,098	21	0.11	0.0028	0.0019	0.0027	0.97	0.00005	2.0	0.0005	0.0038	0.013	0.05	0.0032	0.53	48	0.016	0.000005	0.053	0.012	0.34	30	0.046	3.5	0.000038	1,144	1.7	0.000038	0.0005	0.017	0.005	0.01	5.8	0.74	0.13	149,328
2071	8.9	1,584	2,100	21	0.11	0.0028	0.0019	0.0027	0.96	0.00005	2.0	0.0005	0.0038	0.013	0.05	0.0032	0.53	49	0.016	0.000005	0.053	0.012	0.34	30	0.045	3.5	0.000038	1,144	1.7	0.000038	0.0005	0.017	0.005	0.01	5.5	0.7	0.13	150,505
2072	8.9	1,599	2,104	21	0.11	0.0028	0.0019	0.0027	0.96	0.00005	1.9	0.0005	0.0038	0.013	0.05	0.0033	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.046	3.5	0.000038	1,152	1.7	0.000038	0.0005	0.017	0.005	0.01	5.0	0.63	0.12	151,916
2073	8.9	1,607	2,100	21	0.11	0.0028	0.0019	0.0027	0.95	0.00005	2.0	0.0005	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.046	3.5	0.000038	1,154	1.7	0.000039	0.0005	0.017	0.005	0.01	4.6	0.58	0.11	152,292
2074	8.9	1,614	2,090	21	0.11	0.0028	0.0019	0.0026	0.95	0.00005	2.0	0.0005	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000039	1,155	1.7	0.000039	0.0005	0.017	0.005	0.01	4.5	0.57	0.1	153,237
2075	8.9	1,623	2,079	21	0.1	0.0029	0.0019	0.0026	0.94	0.00005	2.1	0.0005	0.004	0.014	0.05	0.0035	0.52	49	0.017	0.000005	0.055	0.013	0.33	30	0.048	3.4	0.000039	1,157	1.7	0.000039	0.0005	0.017	0.005	0.01	4.4	0.55	0.1	153,995
2076	8.9	1,649	2,089	20	0.11	0.0029	0.002	0.0026	0.94	0.00005	2.0	0.0005	0.0041	0.014	0.05	0.0036	0.51	50	0.017	0.000005	0.056	0.013	0.33	29	0.05	3.4	0.000039	1,171	1.6	0.00004	0.0005	0.018	0.005	0.01	4.5	0.57	0.1	155,005
2077	8.9	1,665	2,084	20	0.11	0.0029	0.002	0.0026	0.93	0.00005	2.0	0.0005	0.0043	0.014	0.05	0.0038	0.51	50	0.018	0.000005	0.056	0.014	0.33	29	0.052	3.4	0.00004	1,177	1.6	0.00004	0.0005	0.018	0.005	0.01	4.6	0.59	0.11	155,356
2078	8.9	1,680	2,077	20	0.11	0.003	0.0021	0.0026	0.93	0.00005	2.0	0.00051	0.0044	0.014	0.05	0.0039	0.51	50	0.018	0.000005	0.057	0.014	0.32	29	0.054	3.4	0.00004	1,182	1.6	0.00004	0.0005	0.018	0.005	0.01	4.9	0.62	0.11	156,236
2079	8.9	1,690	2,084	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.00051	0.0046	0.014	0.05	0.004	0.51	50	0.019	0.000005	0.057	0.015	0.32	29	0.055	3.4	0.00004	1,189	1.6	0.00004	0.0005	0.018	0.005	0.01	5.1	0.65	0.12	157,251
2080	8.9	1,698	2,096	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.00051	0.0047	0.014	0.05	0.0041	0.5	50	0.02	0.000005	0.057	0.015	0.32	29	0.057	3.3	0.000041	1,194	1.6	0.000041	0.0005	0.018	0.005	0.01	5.4	0.68	0.12	158,470
2081	8.9	1,710	2,094	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.00051	0.0048	0.014	0.05	0.0042	0.5	51	0.02	0.000005	0.058	0.015	0.32	29	0.059	3.3	0.000041	1,202	1.6	0.000041	0.0005	0.018	0.005	0.01	5.6	0.71	0.13	158,338
2082	9.0	1,705	2,131	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.00051	0.0049	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.016	0.32	28	0.06	3.3	0.000041	1,205	1.6	0.000041	0.0005	0.018	0.005	0.01	5.7	0.72	0.13	159,814
2083	9.0	1,694	2,170	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.00051	0.0049	0.014	0.05	0.0043	0.5	52	0.021	0.000005	0.057	0.016	0.32	28	0.06	3.3	0.000041	1,208	1.6	0.000041	0.0005	0.018	0.005	0.01	5.8	0.73	0.13	160,383
2084	9.0	1,698	2,185	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.8	0.00051	0.005	0.014	0.05	0.0044	0.49	52	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.3	0.000041	1,212	1.6	0.000041	0.0005	0.018	0.005	0.01	5.7	0.72	0.13	161,637
2085	9.0	1,691	2,205	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.8	0.00051	0.005	0.014	0.05	0.0044	0.49	52	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.3	0.00004	1,213	1.6	0.000041	0.0005	0.018	0.005	0.01	5.7	0.72	0.13	161,890
2086	9.0	1,695	2,213	20	0.12	0.003	0.0023	0.0026	0.89	0.00005	1.9	0.00051	0.0051	0.015	0.05	0.0045	0.49	53	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.3	0.000041	1,216	1.6	0.000041	0.0005	0.018	0.005	0.01	5.3	0.67	0.12	162,778
2087	8.9	1,689	2,225	19	0.12	0.003	0.0022	0.0026	0.89	0.00005	1.9	0.00051	0.005	0.014	0.05	0.0044	0.49	53	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.2	0.00004	1,215	1.6	0.000041	0.0005	0.018	0.005	0.01	5.2	0.66	0.12	163,470
2088	9.0	1,701	2,239	19	0.12	0.003	0.0023	0.0026	0.88	0.00005	1.8	0.00051	0.005	0.015	0.05

Table A5. Source terms of the NAG backfill for the well graded cover system and no internal layer scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2135	9.2	1,577	3,187	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	77	0.02	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,338	1.4	0.000038	0.0005	0.017	0.005	0.01	2.7	0.34	0.062	186,569
2136	9.2	1,578	3,193	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	78	0.02	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,339	1.4	0.000038	0.0005	0.017	0.005	0.01	2.7	0.34	0.062	187,180
2137	9.2	1,581	3,204	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,342	1.4	0.000038	0.0005	0.017	0.005	0.01	2.6	0.33	0.061	186,716
2138	9.2	1,570	3,233	17	0.24	0.0028	0.0022	0.0032	0.78	0.00005	0.94	0.0005	0.0047	0.015	0.05	0.0044	0.43	79	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,342	1.4	0.000038	0.0005	0.017	0.005	0.01	2.6	0.33	0.061	186,790
2139	9.2	1,553	3,271	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.92	0.0005	0.0047	0.015	0.05	0.0043	0.43	79	0.019	0.000005	0.052	0.016	0.27	24	0.055	2.8	0.000037	1,342	1.4	0.000037	0.0005	0.017	0.005	0.01	2.6	0.33	0.06	187,056
2140	9.2	1,545	3,291	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.91	0.0005	0.0046	0.015	0.05	0.0043	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.055	2.8	0.000037	1,342	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.33	0.06	187,514
2141	9.2	1,532	3,320	17	0.25	0.0027	0.0022	0.0033	0.78	0.00005	0.9	0.0005	0.0046	0.015	0.05	0.0042	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.054	2.8	0.000037	1,341	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.33	0.06	186,895
2142	9.2	1,525	3,335	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.89	0.0005	0.0045	0.015	0.05	0.0042	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000036	1,341	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.33	0.061	186,886
2143	9.2	1,516	3,354	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.0005	0.0045	0.015	0.05	0.0041	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000036	1,340	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.061	187,034
2144	9.2	1,509	3,370	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.0005	0.0044	0.015	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.052	2.8	0.000036	1,339	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.061	187,551
2145	9.2	1,502	3,386	17	0.26	0.0026	0.0021	0.0033	0.78	0.00005	0.87	0.0005	0.0043	0.014	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.051	2.8	0.000036	1,338	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.061	187,019
2146	9.2	1,496	3,399	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.87	0.0005	0.0042	0.014	0.05	0.0039	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.05	2.8	0.000036	1,337	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.06	187,081
2147	9.2	1,490	3,412	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.0005	0.0042	0.014	0.05	0.0038	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.049	2.8	0.000036	1,337	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.06	187,212
2148	9.2	1,485	3,424	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.0005	0.0041	0.014	0.05	0.0037	0.42	84	0.017	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000035	1,336	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.059	187,667
2149	9.2	1,480	3,436	17	0.27	0.0026	0.002	0.0034	0.78	0.00005	0.85	0.0005	0.004	0.014	0.05	0.0037	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.047	2.8	0.000035	1,336	1.4	0.000036	0.0005	0.016	0.005	0.01	2.5	0.32	0.058	187,030
2150	9.2	1,476	3,445	17	0.27	0.0026	0.0019	0.0034	0.78	0.00005	0.85	0.0005	0.0039	0.014	0.05	0.0036	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000035	1,335	1.4	0.000036	0.0005	0.016	0.005	0.01	2.4	0.31	0.056	186,985

Table A6. Annual loads of the NAG backfill for the well graded cover system and no internal layer scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m³/year
2023	29	2.3	0.69	0.00029	0.000052	0.000029	0.000056	0.032	0.0000012	0.67	0.000024	0.00014	0.000097	0.0012	0.0000024	0.017	0.49	0.00081	0.00000012	0.00098	0.00018	0.011	0.99	0.0027	0.12	0.0000007	13	0.056	0.0000007	0.000007	0.00031	0.00012	0.00024	1.6	0.2	0.036	24
2024	53	4.1	1.3	0.00052	0.000094	0.000053	0.0001	0.057	0.0000022	1.2	0.000044	0.00025	0.00018	0.0022	0.0000044	0.031	0.89	0.0015	0.00000022	0.0018	0.00033	0.02	1.8	0.0048	0.21	0.0000013	23	0.1	0.0000013	0.000013	0.00057	0.00022	0.00044	2.9	0.36	0.066	44
2025	97	7.6	2.3	0.00096	0.00017	0.000097	0.00019	0.11	0.000004	2.2	0.00008	0.00046	0.00032	0.004	0.0000081	0.058	1.6	0.0027	0.0000004	0.0033	0.0006	0.037	3.3	0.0089	0.38	0.0000023	42	0.18	0.0000023	0.000023	0.001	0.0004	0.0008	5.3	0.67	0.12	80
2026	152	12	3.6	0.0015	0.00027	0.00015	0.00029	0.16	0.0000063	3.5	0.00013	0.00072	0.0005	0.0063	0.000013	0.09	2.5	0.0042	0.00000063	0.0051	0.00093	0.057	5.1	0.014	0.6	0.0000036	66	0.29	0.0000036	0.000036	0.0016	0.00063	0.0013	8.2	1.0	0.19	125
2027	191	15	4.5	0.0019	0.00034	0.00019	0.00037	0.21	0.0000079	4.4	0.00016	0.0009	0.00063	0.0079	0.000016	0.11	3.2	0.0053	0.00000079	0.0064	0.0012	0.072	6.5	0.017	0.75	0.0000046	83	0.36	0.0000046	0.000046	0.002	0.00079	0.0016	10	1.3	0.24	158
2028	349	27	8.2	0.0034	0.00062	0.00035	0.00067	0.38	0.000014	8.0	0.00029	0.0017	0.0012	0.014	0.000029	0.21	5.8	0.0097	0.0000014	0.012	0.0021	0.13	12	0.032	1.4	0.0000084	152	0.66	0.0000084	0.000084	0.0037	0.0014	0.0029	19	2.4	0.43	289
2029	326	25	7.7	0.0032	0.00057	0.00032	0.00063	0.35	0.000013	7.5	0.00027	0.0015	0.0011	0.013	0.000027	0.19	5.5	0.0091	0.0000013	0.011	0.002	0.12	11	0.03	1.3	0.0000078	142	0.62	0.0000078	0.000078	0.0035	0.0013	0.0027	18	2.2	0.41	270
2030	421	33	9.9	0.0041	0.00074	0.00042	0.00081	0.45	0.000017	9.7	0.00035	0.002	0.0014	0.017	0.000035	0.25	7.0	0.012	0.0000017	0.014	0.0026	0.16	14	0.038	1.7	0.00001	184	0.8	0.00001	0.0001	0.0045	0.0017	0.0035	23	2.9	0.52	348
2031	2,705	211	64	0.027	0.0048	0.0027	0.0052	2.9	0.00011	62	0.0022	0.013	0.0089	0.11	0.00022	1.6	45	0.075	0.000011	0.091	0.017	1.0	91	0.25	11	0.000065	1,181	5.1	0.000065	0.00065	0.029	0.011	0.022	146	19	3.4	2,236
2032	4,396	343	104	0.043	0.0078	0.0044	0.0084	4.7	0.00018	101	0.0036	0.021	0.015	0.18	0.00036	2.6	73	0.12	0.000018	0.15	0.027	1.7	149	0.4	17	0.00011	1,919	8.3	0.00011	0.0011	0.047	0.018	0.036	238	30	5.5	3,634
2033	750	58	18	0.0074	0.0013	0.00075	0.0014	0.81	0.0000031	17	0.00062	0.0035	0.0025	0.031	0.000062	0.44	13	0.021	0.0000031	0.025	0.0046	0.28	25	0.068	3.0	0.000018	327	1.4	0.000018	0.00018	0.008	0.0031	0.0062	41	5.1	0.93	620
2034	3,014	235	71	0.03	0.0053	0.003	0.0058	3.3	0.00012	69	0.0025	0.014	0.01	0.12	0.00025	1.8	50	0.084	0.00012	0.1	0.019	1.1	102	0.28	12	0.000072	1,316	5.7	0.000072	0.00072	0.032	0.012	0.025	163	21	3.8	2,492
2035	8,570	669	202	0.084	0.015	0.0085	0.016	9.3	0.00035	197	0.0071	0.041	0.028	0.35	0.00071	5.1	143	0.24	0.000035	0.29	0.053	3.2	290	0.78	34	0.00021	3,742	16	0.00021	0.0021	0.092	0.035	0.071	464	59	11	7,085
2036	14,615	1,141	345	0.14	0.026	0.015	0.028	16	0.0006	336	0.012	0.069	0.048	0.6	0.0012	8.7	244	0.41	0.00006	0.49	0.09	5.5	494	1.3	58	0.00035	6,382	28	0.00035	0.0035	0.16	0.06	0.12	791	100	18	12,083
2037	16,286	1,271	385	0.16	0.029	0.016	0.031	18	0.00067	374	0.013	0.077	0.054	0.67	0.0014	9.6	272	0.45	0.000067	0.55	0.1	6.2	551	1.5	64	0.00039	7,112	31	0.00039	0.0039	0.17	0.067	0.13	881	111	20	13,464
2038	32,601	2,544	770	0.32	0.057	0.032	0.063	35	0.0013	749	0.027	0.15	0.11	1.3	0.0027	19	545	0.91	0.00013	1.1	0.2	12	1,102	3.0	128	0.00078	14,236	62	0.00078	0.0078	0.35	0.13	0.27	1,764	223	41	26,952
2039	60,149	10,833	1,312	0.69	0.11	0.059	0.11	60	0.0023	1,436	0.046	0.27	0.18	2.3	0.014	33	1,044	1.6	0.00023	2.0	0.38	21	1,878	5.2	219	0.0014	27,549	105	0.0014	0.014	0.64	0.23	0.46	3,006	380	69	45,912
2040	119,581	38,041	2,261	1.4	0.21	0.12	0.17	103	0.004	2,436	0.079	0.52	0.32	4.0	0.07	57	2,201	2.9	0.0004	4.0	0.81	36	3,235	9.5	377	0.0028	58,833	182	0.0029	0.029	1.3	0.4	0.79	5,177	655	119	79,056
2041	188,787	84,647	3,173	3.0	0.33	0.18	0.24	145	0.0055	1,541	0.11	0.61	0.65	5.5	0.19	80	3,682	3.2	0.00055	6.4	1.2	51	4,542	10	529	0.004	100,813	255	0.0045	0.045	2.0	0.55	1.1	4,861	615	112	110,907
2042	181,599	102,301	3,172	3.8	0.32	0.19	0.31	145	0.0064	1,499	0.13	0.39	1.1	6.4	0.25	79	3,643	1.8	0.00064	6.1	1.0	51	4,539	5.3	529	0.0044	101,547	255	0.0044	0.044	1.9	0.64	1.3	1,485	188	34	128,839
2043	183,623	104,498	3,172	3.9	0.32	0.19	0.32	145	0.0067	1,583	0.13	0.35	1.1	6.7	0.27	79	3,687	1.5	0.00067	6.2	1.0	51	4,539	4.5	529	0.0044	102,842	255	0.0044	0.044	2.0	0.67	1.3	894	113	21	133,866
2044	184,376	103,656	3,171	3.9	0.33	0.2	0.33	145	0.0068	1,686	0.14	0.35	1.1	6.8	0.27	79	3,693	1.5	0.00068	6.2	1.0	51	4,539	4.6	529	0.0044	102,878	255	0.0044	0.044	2.0	0.68	1.4	893	113	21	136,575
2045	187,168	105,697	3,172	3.9	0.33	0.2	0.32	145	0.0067	1,564	0.13	0.37	1.1	6.7	0.27	79	3,760	1.6	0.00067	6.3	1.1	51	4,539	4.9	529	0.0045	104,694	255	0.0045	0.045	2.0	0.67	1.3	1,055	133	24	133,758
2046	187,633	103,314	3,172	3.8	0.33	0.2	0.3	145	0.0064	1,497	0.13	0.41	1.1	6.4	0.3	79	3,762	1.8	0.00064	6.3	1.2	51	4,540	5.4	529	0.0045	104,445	255	0.0045	0.045	2.0	0.64	1.3	1,204	152	28	128,763
2047	202,021	105,599	3,173	3.8	0.36	0.22	0.29	145	0.0064	1,480	0.13	0.44	1.1	6.4	0.37	80	4,014	1.9	0.00064	6.8	1.4	51	4,541	5.5	529	0.0048	111,397	255	0.0049	0.049	2.2	0.64	1.3	760	96	17	128,089
2048	222,427	111,893	3,173	4.0	0.39	0.25	0.28	145	0.0065	1,447	0.13	0.52	1.1	6.5	0.45	80	4,403	2.2	0.00065	7.5	1.6	51	4,542	6.5	529	0.0053	121,916	255	0.0054	0.053	2.4	0.65	1.3	733	93	17	129,793
2049	232,948	117,236	3,174	4.1	0.41	0.27	0.28	145	0.0066	1,398	0.13	0.59	1.2	6.6	0.5	80	4,619	2.5	0.00066	7.8	1.9	51	4,542	7.3	529	0.0056	127,828	255	0.0056	0.056	2.5	0.66	1.3	808	102	19	131,172
2050	239,538	119,755	3,174	4.2	0.42	0.29	0.28	145	0.0066	1,405	0.13	0.63	1.2	6.6	0.55	80	4,743	2.6	0.00066	8.1	2.0	51	4,543	7.7	529	0.0057	131,320	255	0.0058	0.058	2.6	0.66	1.3	693	88	16	132,811
2051	243,385	121,046	3,174	4.2	0.43	0.3	0.28	145	0.0067	1,417	0.13	0.65	1.2	6.7	0.58	80	4,810	2.7	0.00067	8.2	2.1	51	4,543	7.7	529	0.0058	133,315	255	0.0058	0.059	2.6	0.67	1.3	542	68	12	133,964
2052	246,811	122,148	3,174	4.3	0.44	0.3	0.28	145	0.0068	1,432	0.14	0.65	1.2	6.8	0.61	80	4,874	2.7	0.00068	8.3	2.2	51	4,543	7.7	529	0.0059	135,071	255	0.0059	0.059	2.6	0.68	1.4	348	44	8.0	135,076
2053	248,249	122,284	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,435	0.14	0.66	1.2	6.8	0.62	80	4,899	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.0059	135,740	255	0.006	0.06	2.7	0.68	1.4	190	24	4.4	135,145
2054	249,944	122,730	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,447	0.14	0.66	1.2	6.8	0.63	80	4,930	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.006	136,583	255	0.006	0.06	2.7	0.68	1.4	140	18	3.2	135,795
2055	252,972	123,320	3,174	4.3	0.45	0.32	0.29	145	0.0068	1,463	0.14	0.68	1.2	6.8	0.65	80	4,984	2.7	0.00068	8.5	2.3	51	4,543	8.0	529	0.0061	138,056	255	0.0061	0.061	2.7	0.68	1.5	145	18	3.3	136,601
2056	248,809	151,733	3,175	5.3	0.44	0.31	0.3	145	0.0069	1,018	0.14	0.67	1.4	6.9	0.63	80	5,234	2.7	0.00069	8.4	2.2	51	4,544	7.8	529	0.006	142,407	255	0.006	0.06	2.7	0.69	1.4	166	21	3.8	137,439
2057	238,664	196,137	3,175	7.1	0.42	0.3	0.32	145	0.0069	641	0.14	0.61	1.8	6.9	0.58	80	5,609	2.5	0.00069	8.0	2.1	51	4,544	7.2	530	0.0057	147,678	255	0.0057	0.057	2.5	0.69	1.4	192	24	4.4	137,940
2058	232,800	221,757	3,176	8.2	0.41	0.28	0.33	145	0.0069	518	0.14	0.58	2.0	6.9	0.54	80	5,859	2.3	0.00069	7.8	1.9	51	4,545	6.7	530	0.0056	150,409	255	0.0056	0.056	2.5	0.69	1.4	223	28	5.1	138,218
2059	231,450	230,578	3,176	8.6	0.41	0.28	0.34	145	0.0069	486	0.14	0.57	2.0	6.9	0.53	80	5,973	2.3	0.00069	7.8	1.9	51	4,545	6.6	530	0.0055	151,614	255	0.0056	0.056	2.5	0.69	1.4	259	33	5.9	138,460
2060	233,135	234,084	3,176	8.7	0.41	0.28	0.34	145	0.007	484	0.14	0.57	2.0	7.0	0.53	80	6,057	2.3	0.0007	7.8	1.9	51	4,545	6.7	530	0.0056	153,080	255	0.0056	0.056	2.5	0.7	1.4	301	38	6.9	139,518
2061	234,102	234,298	3,176	8.7	0.41	0.28	0.34	145	0.007	487	0.14	0.58	2.0	7.0	0.53	80	6,083	2.4	0.0007	7.9	1.9	51	4,545	6.9	530	0.0056	153,528	255	0.0056	0.056	2.5	0.7	1.4	348	44	8.0	139,838
2062	233,972	245,423	3,176	10.0	0.41	0.28	0.35	145	0.007	432	0.14	0.58	2.0	7.0	0.53	80	6,199	2.4	0.0007	7.9	1.9	51	4,546	6.9	530	0.0056	155,869	255	0.0056	0.056	2.5	0.7	1.4	400	51	9.2	140,676
2063	232,497	257,328	3,176	11	0.41	0.28	0.36	145	0.0071	394	0.14	0.57	2.0	7.1	0.51	80	6,343	2.3	0.00071	7.8	1.8	51	4,546	6.8	530	0.0056	157,664	255	0.0056	0.056	2.5	0.71	1.4	456	58	10	141,568
2064	233,675	261,461	3,176	11	0.41	0.28	0.36	145	0.0071	397	0.14	0.57	2.0	7.1	0.51	80	6,425	2.4	0.00071	7.9	1.8	51	4,546	6.6	530	0.0056	159,010	255	0.0056	0.056	2.5	0.71	1.4	517	65	12	142,789
2065	234,617	272,850	3,176	14	0.41	0.28	0.37	145	0.0072	336	0.14	0.57	2.0	7.2	0.5	80	6,577	2.4	0.00072	7.9	1.8	51	4,546	6.6	530	0.0056	161,866	255	0.0056	0.056	2.5	0.72	1.4	580	73	13	143,409
2066	232,662	287,614	3,176	16	0.41	0.28	0.38	145	0.0072	300	0.14	0.56	2.0	7.2	0.49	80	6,732	2.3	0.00072	7.8	1.8	51	4,546	6.6	530	0.0056	164,062	255	0.0056	0.056	2.5	0.72	1.4	647	82	15	144,573
2067	231,552	298,380	3,177	17	0.41	0.27	0.39	145	0.0073	285	0.15	0.56	2.0	7.3	0.49	80	6,866	2.3	0.00073	7.8	1.8	51	4,546	6.5	530	0.0055	165,759	255	0.0056	0.056	2.5	0.73	1.5	717	91	16	145,722
2068	233,135	305,923	3,177	17	0.41	0.28	0.39	145	0.0074	284	0.15	0.56	2.0	7.4	0.48	80	7,020	2.4	0.00074	7.8	1.7	51	4,546	6.6	530	0.0056	167,942	255	0.0056	0.056	2.5	0.74	1.5	788	100	18	147,284
2069	233,831	310,413	3,177	17	0.41	0.27	0.4	145	0.0074	285	0.15	0.56	2.0	7.4	0.48	80	7,125	2.4	0.00074	7.7	1.7	51	4,546	6.7	530	0.0056	169,122	255	0.0056	0.056	2.5	0.74	1.5	846	107	19	148,041
2070	236,506	313,306	3,177	16	0.42	0.28	0.4	145	0.0075	293	0.15	0.57	2.0	7.5	0.48	80	7,227	2.4	0.00075	8.0	1.8	51	4,547	6.8	530	0.0057	170,877	255	0.0057	0.057	2.5	0.75	1.5	872	110	20	149,328
2071	238,355	316,001	3,177	16	0.42	0.28	0.4	145	0.0075	301	0.15	0.57	2.0	7.5	0.49	80	7,318	2.4	0.00075	8.0	1.8	51	4,547	6.8	530	0.0057	172,193	255	0.0057	0.057	2.5	0.75	1.5	835	106	19	150,505
2072	242,928	319,691	3,177	17	0.43	0.28	0.41	145	0.0076	295	0.15	0.58	2.0	7.6	0.5	80	7,437	2.4	0.00076	8.2	1.8	51	4,547	7.0	530	0.0058	175,007	255	0.0058	0.058	2.6	0.76	1.5	760	96	17	151,916
2073	244,733	319,752	3,177	17	0.43	0.29	0.41	145	0.0076	301	0.15	0.59	2.1	7.6	0.51	80	7,478	2.5	0.00076	8.2	1.9	51	4,547	7.1	530	0.0059	175,806	255	0.0059	0.059	2.6	0.76	1.5	702	89	16	152,292
2074	247,278	320,249	3,177	16	0.44	0.29	0.41	145	0.0077	310	0.15	0.6	2.1	7.7	0.53	80	7,522	2.5	0.00077	8.3	1.9	51	4,547	7.2	530	0.0059	177,050	255	0.0059	0.059	2.6	0.77	1.5	688	87	16	153,237
2075	249,980	320,217	3,177	16	0.44	0.3	0.41	145	0.0077	319	0.15	0.62	2.1	7.7	0.54	80	7,568	2.6	0.00077	8.4	2.0	51	4,547	7.4	530	0.006	178,234	255	0.006	0.06	2.7	0.77	1.5	675	85	16	153,995
2076	255,619	323,744	3,177	18	0.45	0.31	0.41	145	0.0078	302	0.16	0.64	2.1	7.8	0.56	80	7,687	2.7	0.00078	8.6	2.0	51	4,547	7.7	530	0.0061	181,527	255	0.0062	0.061	2.7	0.78	1.6	698	88	16	155,005
2077	258,731	323,701	3,177	18	0.46	0.31	0.4	145	0.0078	306	0.16	0.66	2.2	7.8	0.58	80	7,735	2.8	0.00078	8.7	2.1	51	4,547	8.0	530	0.0062	182,917	255	0.0062	0.062	2.8	0.78	1.6	722	91	17	155,356
2078	262,398	324,502	3,177	17	0.46	0.32	0.4	145	0.0078	312	0.16	0.69	2.2	7.8	0.61	80	7,796	2.9	0.00078	8.8	2.2	51	4,547	8.4	530	0.0063	184,733	255	0.0063	0.063	2.8	0.78	1.6	763	96	18	156,236
2079	265,770	327,742	3,177	18	0.47	0.33	0.41	145	0.0079	312	0.16	0.72	2.2	7.9	0.63	80	7,886	3.0	0.00079	8.9	2.3	51	4,547	8.7	530	0.0064	186,924	255	0.0064	0.064	2.8	0.79	1.6	806	102	19	157,251
2080	269,002	332,121	3,177	18	0.47	0.34	0.41	145	0.0079	313	0.16	0.74	2.2	7.9	0.65	80	7,995	3.1	0.00079	9.1	2.4	51	4,547	9.0	530	0.0064	189,260	255	0.0065	0.065	2.9	0.79	1.6	850	108	20	158,470
2081	271,645	332,624	3,177	18	0.48	0.34	0.41	145	0.0079	318	0.16	0.77	2.3	7.9	0.67	80	8,050	3.2	0.00079	9.1	2.4	51	4,548	9.3	530	0.0065	190,543	255	0.0065	0.065	2.9	0.79	1.6	888	112	20	158,838
2082	272,418	340,563	3,177	19	0.48	0.35	0.41	145	0.008	307	0.16	0.78	2.3	8.0	0.68	80	8,165	3.3	0.0008	9.2	2.5	51	4,548	9.6	530	0.0065	192,527	255	0.0066	0.066	2.9	0.8	1.6	907	115	21	159,814
2083	271,705	348,063	3,178	19	0.48	0.35	0.42	145	0.008	297	0.16	0.79	2.3	8.0	0.69	80	8,265	3.3	0.0008	9.1	2.5	51	4,548	9.7	530	0.0065	193,727	255	0.0065	0.065	2.9	0.8	1.6	930	118	21	160,383
2084	274,395	353,193	3,178	19	0.48	0.36	0.42	145	0.0081	299	0.16	0.81	2.3	8.1	0.71	80	8,398	3.4	0.00081	9.2	2.6	51	4,548	9.9	530	0.0066	195,937	255	0.0066	0.066	2.9	0.81	1.6	915	116	21	161,637
2085	273,707	357,031	3,178	19	0.48	0.36	0.42	145	0.0081	297	0.16	0.81	2.3	8.1	0.71	80	8,471	3.4	0.00081	9.2	2.6	51	4,548	9.9	530	0.0066	196,356	255	0.0066	0.066	2.9	0.81	1.6	918	116	21	161,890
2086	275,893	360,180	3,178	19	0.49	0.37	0.43	145	0.0081	302	0.16	0.82	2.4	8.1	0.73	80	8,578	3.4	0.00081	9.3	2.6	51	4,548	10	530	0.0066	197,906	255	0.0066	0.066	2.9	0.81	1.7	864	109	20	162,778
2087	276,149	363,720	3,178	19	0.49	0.37	0.43	145	0.0082	304	0.16	0.82	2.4	8.2	0.72	80	8,669	3.4	0.00082	9.3	2.6	51	4,548	10.0	530	0.0066	198,681	255	0.0066	0.066	2.9	0.82	1.7	853	108	20	163,470
2088	279,900	368,389	3,178	20	0.49	0.37	0.43	145	0.0082	297	0.16	0.83	2.4	8.2	0.74	80	8,815	3.4	0.00082	9.4	2.7	51	4,548	10	530	0.0067	201,269	255	0.0067	0.067	3.0	0.82	1.7	779	98	18	164,570
2089	274,989	376,389	3,178	22	0.48	0.36	0.44	145	0.0082	273	0.16	0.78	2.4	8.2	0.7	80	8,863	3.2	0.00082	9.3	2.5	51	4,548	9.5	530	0.0066	200,693	255	0.0066	0.066	2.9	0.82	1.6	733	93	17	164,772
2090	275,131	383,442	3,178	23	0.49	0.36	0.44	145	0.0083	267	0.17	0.78	2.4	8.3	0.7	80	8,993	3.2	0.00083	9.3	2.5	51	4,548	9.4	530	0.0066	202,145	255	0.0066	0.066	2.9	0.83	1.7	692	87	16	165,462
2091	275,947	388,093	3,178	23	0.49	0.36	0.45	145	0.0083	267	0.17	0.78	2.4	8.3	0.7	80	9,115	3.2	0.00083	9.3	2.5	51	4,549	9.4	530	0.0066	203,383	255	0.0066	0.066	2.9	0.83	1.7	702	89	16	166,285
2092	278,346	393,814	3,178	23	0.49	0.36	0.45	145	0.0084	268	0.17	0.78	2.4	8.4	0.7	80	9,278	3.2	0.00084	9.4	2.5	51	4,549	9.4	530	0.0067	205,512	255	0.0067	0.067	3.0	0.84	1.7	695	88	16	167,587
2093	276,900	401,954	3,178	24	0.49	0.36	0.46	145	0.0084	259	0.17	0.78	2.4	8.4	0.69	80	9,401	3.2	0.00084	9.3	2.5	51	4,549	9.4	530

Table A6. Annual loads of the NAG backfill for the well graded cover system and no internal layer scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2135	294,182	594,578	3,182	43	0.52	0.42	0.59	145	0.0093	181	0.19	0.9	2.8	9.3	0.83	80	14,422	3.7	0.00093	9.9	3.0	51	4,554	11	531	0.007	249,536	256	0.0071	0.071	3.1	0.93	1.9	505	64	12	186,569
2136	295,407	597,572	3,182	43	0.52	0.42	0.59	145	0.0094	181	0.19	0.9	2.8	9.4	0.83	80	14,529	3.7	0.00094	9.9	3.0	51	4,554	11	531	0.0071	250,615	256	0.0071	0.071	3.2	0.94	1.9	502	63	12	187,180
2137	295,235	598,275	3,182	43	0.52	0.42	0.59	145	0.0093	180	0.19	0.89	2.8	9.3	0.83	80	14,606	3.6	0.00093	9.9	3.0	51	4,554	11	531	0.0071	250,535	256	0.0071	0.071	3.2	0.93	1.9	493	62	11	186,716
2138	293,260	603,891	3,182	45	0.52	0.41	0.59	145	0.0093	176	0.19	0.89	2.8	9.3	0.82	80	14,678	3.6	0.00093	9.9	2.9	51	4,554	10	531	0.007	250,747	256	0.007	0.071	3.1	0.93	1.9	492	62	11	186,790
2139	290,498	611,880	3,182	46	0.51	0.41	0.6	145	0.0094	172	0.19	0.88	2.8	9.4	0.81	80	14,802	3.6	0.00094	9.8	2.9	51	4,554	10	531	0.0069	251,030	256	0.007	0.07	3.1	0.94	1.9	491	62	11	187,056
2140	289,615	617,108	3,182	47	0.51	0.41	0.61	145	0.0094	171	0.19	0.87	2.8	9.4	0.8	80	14,924	3.5	0.00094	9.7	2.9	51	4,554	10	531	0.0069	251,587	256	0.007	0.07	3.1	0.94	1.9	492	62	11	187,514
2141	286,304	620,491	3,182	48	0.5	0.4	0.61	145	0.0093	167	0.19	0.86	2.8	9.3	0.79	80	14,988	3.5	0.00093	9.6	2.8	51	4,554	10	531	0.0068	250,645	256	0.0069	0.069	3.1	0.93	1.9	491	62	11	186,895
2142	285,021	623,285	3,182	48	0.5	0.4	0.61	145	0.0093	166	0.19	0.84	2.7	9.3	0.78	80	15,070	3.4	0.00093	9.6	2.8	51	4,554	10.0	531	0.0068	250,521	256	0.0068	0.069	3.0	0.93	1.9	492	62	11	186,886
2143	283,562	627,217	3,182	48	0.5	0.4	0.62	145	0.0094	165	0.19	0.84	2.7	9.4	0.77	80	15,161	3.4	0.00094	9.5	2.8	51	4,555	9.9	531	0.0068	250,550	256	0.0068	0.068	3.0	0.94	1.9	493	62	11	187,034
2144	283,033	631,952	3,182	49	0.5	0.39	0.62	145	0.0094	164	0.19	0.82	2.7	9.4	0.75	80	15,311	3.3	0.00094	9.5	2.7	51	4,555	9.7	531	0.0068	251,111	256	0.0068	0.068	3.0	0.94	1.9	494	63	11	187,551
2145	280,846	633,246	3,183	49	0.5	0.39	0.62	145	0.0094	163	0.19	0.81	2.7	9.4	0.74	80	15,352	3.3	0.00094	9.5	2.7	51	4,555	9.6	531	0.0067	250,287	256	0.0068	0.068	3.0	0.94	1.9	493	62	11	187,019
2146	279,836	635,870	3,182	49	0.49	0.38	0.63	145	0.0094	162	0.19	0.79	2.7	9.4	0.72	80	15,458	3.2	0.00094	9.4	2.6	51	4,555	9.3	531	0.0067	250,202	256	0.0067	0.067	3.0	0.94	1.9	492	62	11	187,081
2147	278,890	638,712	3,183	49	0.49	0.38	0.63	145	0.0094	161	0.19	0.78	2.7	9.4	0.72	80	15,545	3.2	0.00094	9.4	2.6	51	4,555	9.2	531	0.0067	250,228	256	0.0067	0.067	3.0	0.94	1.9	488	62	11	187,212
2148	278,629	642,514	3,183	50	0.49	0.37	0.64	145	0.0094	161	0.19	0.76	2.7	9.4	0.7	80	15,681	3.1	0.00094	9.4	2.5	51	4,555	9.0	531	0.0067	250,723	256	0.0067	0.067	3.0	0.94	1.9	485	61	11	187,667
2149	276,730	642,692	3,183	50	0.49	0.37	0.64	145	0.0094	160	0.19	0.75	2.7	9.4	0.69	80	15,708	3.0	0.00094	9.3	2.5	51	4,555	8.8	531	0.0066	249,797	256	0.0067	0.067	3.0	0.94	1.9	469	59	11	187,030
2150	275,915	644,238	3,183	50	0.49	0.36	0.64	145	0.0093	159	0.19	0.73	2.6	9.3	0.67	80	15,786	3.0	0.00093	9.3	2.4	51	4,555	8.6	531	0.0066	249,625	256	0.0066	0.066	2.9	0.93	1.9	458	58	11	186,985

Table A7. Source terms of the NAG backfill for the low nitrogen scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2023	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	24
2024	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	44
2025	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	80
2026	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	125
2027	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	158
2028	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	289
2029	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	270
2030	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	348
2031	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	2,236
2032	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	3,634
2033	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	620
2034	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	2,492
2035	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	7,085
2036	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	12,083
2037	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	13,464
2038	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	26,952
2039	8.3	1,301	139	29	0.021	0.0023	0.0013	0.0023	1.3	0.00005	31	0.001	0.0058	0.004	0.05	0.00032	0.72	23	0.034	0.000005	0.044	0.008	0.46	41	0.11	4.8	0.000031	606	2.3	0.000031	0.00031	0.014	0.005	0.01	40	5.0	0.91	45,912
2040	8.3	1,464	246	29	0.018	0.0026	0.0014	0.0022	1.3	0.00005	29	0.001	0.0057	0.004	0.05	0.00082	0.72	27	0.032	0.000005	0.049	0.009	0.46	41	0.1	4.8	0.000035	728	2.3	0.000035	0.00035	0.016	0.005	0.01	35	4.5	0.81	79,056
2041	8.4	1,507	382	29	0.028	0.0027	0.0015	0.0023	1.3	0.00005	13	0.001	0.0042	0.0081	0.05	0.0017	0.72	30	0.021	0.000005	0.051	0.0089	0.46	41	0.067	4.8	0.000036	823	2.3	0.000036	0.00036	0.016	0.005	0.01	18	2.3	0.42	110,907
2042	8.5	1,408	398	25	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.001	0.003	0.0082	0.05	0.002	0.62	28	0.014	0.000005	0.047	0.008	0.39	35	0.042	4.1	0.000034	788	2.0	0.000034	0.00034	0.015	0.005	0.01	7.3	0.93	0.17	128,839
2043	8.4	1,371	392	24	0.029	0.0024	0.0015	0.0024	1.1	0.00005	12	0.001	0.0026	0.0081	0.05	0.002	0.59	28	0.012	0.000005	0.046	0.0077	0.38	34	0.034	4.0	0.000033	769	1.9	0.000033	0.00033	0.015	0.005	0.01	4.3	0.55	0.099	133,866
2044	8.4	1,350	381	23	0.028	0.0024	0.0014	0.0024	1.1	0.00005	12	0.001	0.0026	0.008	0.05	0.002	0.58	27	0.011	0.000005	0.045	0.0075	0.37	33	0.033	3.9	0.000032	754	1.9	0.000032	0.00032	0.014	0.005	0.01	4.2	0.54	0.098	136,575
2045	8.5	1,399	396	24	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.001	0.0028	0.0082	0.05	0.002	0.59	28	0.012	0.000005	0.047	0.0079	0.38	34	0.037	4.0	0.000034	783	1.9	0.000034	0.00034	0.015	0.005	0.01	5.1	0.64	0.12	133,758
2046	8.5	1,450	402	25	0.03	0.0026	0.0016	0.0023	1.1	0.00005	12	0.001	0.003	0.0083	0.05	0.0023	0.62	29	0.013	0.000005	0.049	0.0089	0.39	35	0.04	4.1	0.000035	809	2.0	0.000035	0.00035	0.015	0.005	0.01	5.1	0.64	0.12	128,763
2047	8.5	1,577	414	25	0.03	0.0028	0.0017	0.0023	1.1	0.00005	11	0.001	0.0035	0.0084	0.05	0.0029	0.62	31	0.015	0.000005	0.053	0.011	0.4	35	0.043	4.1	0.000038	870	2.0	0.000038	0.00038	0.017	0.005	0.01	3.9	0.49	0.089	128,089
2048	8.5	1,714	432	24	0.031	0.003	0.0019	0.0022	1.1	0.00005	11	0.001	0.004	0.0087	0.05	0.0034	0.61	34	0.017	0.000005	0.058	0.013	0.39	35	0.05	4.1	0.000041	940	2.0	0.000041	0.00041	0.018	0.005	0.01	3.7	0.47	0.085	129,793
2049	8.5	1,775	447	24	0.031	0.0031	0.0021	0.0021	1.1	0.00005	11	0.001	0.0045	0.0089	0.05	0.0038	0.61	35	0.019	0.000005	0.06	0.014	0.39	35	0.056	4.0	0.000043	974	1.9	0.000043	0.00043	0.019	0.005	0.01	3.9	0.5	0.09	131,172
2050	8.5	1,803	451	24	0.032	0.0032	0.0022	0.0021	1.1	0.00005	11	0.001	0.0047	0.009	0.05	0.0042	0.6	36	0.02	0.000005	0.061	0.015	0.38	34	0.058	4.0	0.000043	989	1.9	0.000043	0.00043	0.019	0.005	0.01	3.4	0.43	0.079	132,811
2051	8.5	1,816	452	24	0.032	0.0032	0.0022	0.0021	1.1	0.00005	11	0.001	0.0048	0.009	0.05	0.0043	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.058	4.0	0.000044	995	1.9	0.000044	0.00044	0.019	0.005	0.01	2.7	0.34	0.062	133,964
2052	8.5	1,827	452	23	0.032	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0048	0.009	0.05	0.0045	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.057	3.9	0.000044	1,000	1.9	0.000044	0.00044	0.02	0.005	0.01	1.8	0.22	0.041	135,076
2053	8.5	1,837	453	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0049	0.009	0.05	0.0046	0.59	36	0.02	0.000005	0.062	0.016	0.38	34	0.057	3.9	0.000044	1,004	1.9	0.000044	0.00044	0.02	0.005	0.01	1.0	0.13	0.024	135,145
2054	8.5	1,841	452	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0049	0.009	0.05	0.0047	0.59	36	0.02	0.000005	0.062	0.016	0.37	33	0.057	3.9	0.000044	1,006	1.9	0.000044	0.00044	0.02	0.005	0.01	0.81	0.1	0.02	135,795
2055	8.5	1,852	452	23	0.031	0.0033	0.0023	0.0021	1.1	0.00005	11	0.001	0.005	0.009	0.05	0.0048	0.58	36	0.02	0.000005	0.062	0.017	0.37	33	0.058	3.9	0.000044	1,011	1.9	0.000045	0.00045	0.02	0.005	0.011	0.83	0.1	0.02	136,601
2056	8.6	1,808	551	23	0.039	0.0032	0.0023	0.0022	1.1	0.00005	7.4	0.001	0.0048	0.01	0.05	0.0046	0.58	38	0.02	0.000005	0.061	0.016	0.37	33	0.057	3.8	0.000043	1,036	1.9	0.000043	0.00043	0.019	0.005	0.01	0.92	0.12	0.021	137,639
2057	8.7	1,730	711	23	0.052	0.0031	0.0022	0.0023	1.1	0.00005	4.6	0.001	0.0044	0.013	0.05	0.0042	0.58	41	0.018	0.000005	0.058	0.015	0.37	33	0.052	3.8	0.000041	1,071	1.9	0.000042	0.00042	0.018	0.005	0.01	1.0	0.13	0.024	137,940
2058	8.7	1,684	803	23	0.059	0.003	0.0021	0.0024	1.1	0.00005	3.7	0.001	0.0042	0.015	0.05	0.0039	0.58	42	0.017	0.000005	0.057	0.014	0.37	33	0.049	3.8	0.00004	1,088	1.8	0.00004	0.00041	0.018	0.005	0.01	1.2	0.15	0.027	138,218
2059	8.7	1,672	833	23	0.063	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.37	33	0.048	3.8	0.00004	1,095	1.8	0.00004	0.0004	0.018	0.005	0.01	1.3	0.17	0.031	138,460
2060	8.7	1,671	840	23	0.063	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.36	33	0.048	3.8	0.00004	1,098	1.8	0.00004	0.0004	0.018	0.005	0.01	1.5	0.19	0.035	139,518
2061	8.7	1,674	839	23	0.063	0.003	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.014	0.36	33	0.049	3.8	0.00004	1,098	1.8	0.00004	0.0004	0.018	0.005	0.01	1.7	0.22	0.04	139,838
2062	8.8	1,663	873	23	0.073	0.0029	0.002	0.0025	1.0	0.00005	3.0	0.001	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.013	0.36	32	0.049	3.8	0.00004	1,108	1.8	0.00004	0.0004	0.018	0.005	0.01	1.9	0.25	0.045	140,676
2063	8.8	1,642	909	22	0.08	0.0029	0.002	0.0025	1.0	0.00005	2.7	0.001	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,114	1.8	0.000039	0.00039	0.018	0.005	0.01	2.2	0.28	0.05	141,568
2064	8.8	1,636	916	22	0.079	0.0029	0.002	0.0025	1.0	0.00005	2.7	0.001	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,114	1.8	0.000039	0.00039	0.017	0.005	0.01	2.4	0.31	0.056	142,789
2065	8.9	1,636	951	22	0.096	0.0029	0.0019	0.0026	1.0	0.00005	2.3	0.001	0.004	0.014	0.05	0.0035	0.56	46	0.016	0.000005	0.055	0.013	0.35	32	0.048	3.7	0.000039	1,129	1.8	0.000039	0.00039	0.017	0.005	0.01	2.7	0.34	0.062	143,409
2066	8.9	1,609	995	22	0.11	0.0028	0.0019	0.0026	1.0	0.00005	2.1	0.001	0.0039	0.014	0.05	0.0034	0.55	47	0.016	0.000005	0.054	0.012	0.35	31	0.048	3.7	0.000039	1,135	1.8	0.000039	0.00039	0.017	0.005	0.01	3.0	0.37	0.068	144,573
2067	8.9	1,588	1,024	22	0.12	0.0028	0.0019	0.0027	1.	0.00005	1.9	0.001	0.0039	0.013	0.05	0.0033	0.55	47	0.016	0.000005	0.053	0.012	0.35	31	0.047	3.6	0.000038	1,137	1.8	0.000038	0.00038	0.017	0.005	0.01	3.2	0.41	0.074	145,722
2068	9.0	1,582	1,039	22	0.12	0.0028	0.0019	0.0027	0.99	0.00005	1.9	0.001	0.0038	0.013	0.05	0.0033	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.047	3.6	0.000038	1,140	1.7	0.000038	0.00038	0.017	0.005	0.01	3.5	0.44	0.08	147,284
2069	8.9	1,579	1,049	21	0.12	0.0028	0.0019	0.0027	0.98	0.00005	1.9	0.001	0.0038	0.013	0.05	0.0032	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.047	3.6	0.000038	1,142	1.7	0.000038	0.00038	0.017	0.005	0.01	3.7	0.47	0.086	148,104
2070	8.9	1,583	1,050	21	0.11	0.0028	0.0019	0.0027	0.97	0.00005	1.9	0.001	0.0038	0.013	0.05	0.0032	0.53	48	0.016	0.000005	0.053	0.012	0.34	30	0.048	3.5	0.000038	1,144	1.7	0.000038	0.00038	0.017	0.005	0.01	3.8	0.48	0.088	149,328
2071	8.9	1,583	1,051	21	0.11	0.0028	0.0019	0.0027	0.96	0.00005	2.0	0.001	0.0038	0.013	0.05	0.0032	0.53	49	0.016	0.000005	0.053	0.012	0.34	30	0.047	3.5	0.000038	1,144	1.7	0.000038	0.00038	0.017	0.005	0.01	3.6	0.46	0.083	150,505
2072	8.9	1,599	1,053	21	0.11	0.0028	0.0019	0.0027	0.96	0.00005	1.9	0.001	0.0038	0.013	0.05	0.0033	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000038	1,152	1.7	0.000038	0.00038	0.017	0.005	0.01	3.3	0.42	0.076	151,916
2073	8.9	1,607	1,050	21	0.11	0.0028	0.0019	0.0027	0.95	0.00005	2.0	0.001	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000038	1,155	1.7	0.000039	0.00039	0.017	0.005	0.01	3.0	0.38	0.07	152,292
2074	8.9	1,613	1,046	21	0.11	0.0028	0.0019	0.0027	0.95	0.00005	2.0	0.001	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.013	0.33	30	0.048	3.5	0.000039	1,155	1.7	0.000039	0.00039	0.017	0.005	0.01	3.0	0.37	0.068	153,237
2075	8.9	1,623	1,040	21	0.11	0.0029	0.0019	0.0026	0.94	0.00005	2.0	0.001	0.004	0.014	0.05	0.0035	0.52	49	0.017	0.000005	0.055	0.013	0.33	30	0.049	3.4	0.000039	1,158	1.7	0.000039	0.00039	0.017	0.005	0.01	2.9	0.37	0.067	153,995
2076	8.9	1,649	1,044	20	0.11	0.0029	0.002	0.0026	0.94	0.00005	1.9	0.001	0.0041	0.014	0.05	0.0036	0.51	50	0.017	0.000005	0.055	0.013	0.33	29	0.05	3.4	0.000039	1,171	1.6	0.00004	0.0004	0.018	0.005	0.01	3.0	0.38	0.068	155,005
2077	8.9	1,665	1,042	20	0.11	0.0029	0.002	0.0026	0.93	0.00005	2.0	0.001	0.0043	0.014	0.05	0.0038	0.51	50	0.018	0.000005	0.056	0.014	0.33	29	0.052	3.4	0.00004	1,177	1.6	0.00004	0.0004	0.018	0.005	0.01	3.1	0.39	0.07	155,356
2078	8.9	1,678	1,039	20	0.11	0.003	0.0021	0.0026	0.93	0.00005	2.0	0.001	0.0044	0.014	0.05	0.0039	0.51	50	0.018	0.000005	0.056	0.014	0.32	29	0.054	3.4	0.00004	1,182	1.6	0.00004	0.0004	0.018	0.005	0.01	3.2	0.4	0.073	156,236
2079	8.9	1,688	1,042	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.001	0.0045	0.014	0.05	0.004	0.51	50	0.019	0.000005	0.057	0.015	0.32	29	0.055	3.4	0.00004	1,188	1.6	0.00004	0.00041	0.018	0.005	0.01	3.2	0.41	0.074	157,251
2080	8.9	1,694	1,048	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.001	0.0046	0.014	0.05	0.0041	0.5	50	0.019	0.000005	0.057	0.015	0.32	29	0.057	3.3	0.000041	1,193	1.6	0.00004	0.00041	0.018	0.005	0.01	3.2	0.41	0.074	158,470
2081	8.9	1,705	1,047	20	0.11	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.001	0.0045	0.014	0.05	0.0042	0.5	51	0.02	0.000005	0.057	0.015	0.32	29	0.058	3.3	0.000041	1,198	1.6	0.00004	0.00041	0.018	0.005	0.01	3.3	0.41	0.075	158,338
2082	9.0	1,698	1,066	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.001	0.0048	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.015	0.32	28	0.058	3.3	0.000041	1,202	1.6	0.00004	0.00041	0.018	0.005	0.01	3.2	0.4	0.073	159,814
2083	9.0	1,686	1,086	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.8	0.001	0.0048	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.016	0.32	28	0.059	3.3	0.000041	1,205	1.6	0.000041	0.00041	0.018	0.005	0.01	3.2	0.41	0.074	160,383
2084	9.0	1,688	1,093	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.8	0.001	0.0049	0.014	0.05	0.0044	0.49	52	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.000041	1,208	1.6	0.000041	0.00041	0.018	0.005	0.01	3.2	0.4	0.072	161,637
2085	9.0	1,681	1,104	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.8	0.001	0.0049	0.014	0.05	0.0044	0.49	52	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.00004	1,209	1.6	0.00004	0.0004	0.018	0.005	0.01	3.2	0.41	0.074	161,890
2086	9.0	1,685	1,107	20	0.12	0.003	0.0022	0.0026	0.89	0.00005	1.8	0.001	0.005	0.015	0.05	0.0044	0.49	53	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.000041	1,212	1.6	0.00004	0.00041	0.018	0.005	0.01	3.1	0.4	0.072	162,778
2087	9.0	1,679	1,114	19	0.12	0.003	0.0022	0.0026	0.89	0.00005	1.8	0.001	0.0049	0.015	0.05	0.0044	0.49	53	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.2	0.00004	1,211	1.6	0.00004	0.0004	0.018	0.005	0.01	3.1	0.4	0.072	163,470
2088	9.0	1,691	1,120	19	0.12	0.003	0.0023	0.0026	0.88	0.00005	1.8	0.001	0.0049	0.015	0.05	0.0044	0.48	53	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.2	0.000041	1,219	1.6

Table A7. Source terms of the NAG backfill for the low nitrogen scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2135	9.2	1,573	1,597	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.001	0.0048	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,337	1.4	0.000038	0.00038	0.017	0.005	0.01	1.8	0.23	0.042	186,569
2136	9.2	1,572	1,603	17	0.23	0.0028	0.0022	0.0032	0.78	0.00005	0.96	0.001	0.0047	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,338	1.4	0.000038	0.00038	0.017	0.005	0.01	1.8	0.23	0.041	187,180
2137	9.2	1,578	1,606	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.96	0.001	0.0048	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,341	1.4	0.000038	0.00038	0.017	0.005	0.01	1.8	0.23	0.041	186,716
2138	9.2	1,565	1,622	17	0.24	0.0028	0.0022	0.0032	0.78	0.00005	0.94	0.001	0.0047	0.015	0.05	0.0043	0.43	79	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,342	1.4	0.000038	0.00038	0.017	0.005	0.01	1.8	0.23	0.041	186,790
2139	9.2	1,549	1,640	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.92	0.001	0.0046	0.015	0.05	0.0043	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.055	2.8	0.000037	1,341	1.4	0.000037	0.00037	0.017	0.005	0.01	1.8	0.23	0.041	187,056
2140	9.2	1,541	1,650	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.91	0.001	0.0046	0.015	0.05	0.0042	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.054	2.8	0.000037	1,341	1.4	0.000037	0.00037	0.016	0.005	0.01	1.8	0.23	0.041	187,514
2141	9.2	1,529	1,664	17	0.26	0.0027	0.0022	0.0033	0.78	0.00005	0.89	0.001	0.0045	0.015	0.05	0.0042	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.054	2.8	0.000037	1,341	1.4	0.000037	0.00037	0.016	0.005	0.01	1.8	0.23	0.042	186,895
2142	9.2	1,523	1,670	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.89	0.001	0.0045	0.015	0.05	0.0041	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000036	1,340	1.4	0.000037	0.00037	0.016	0.005	0.01	1.8	0.23	0.042	186,886
2143	9.2	1,512	1,682	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.001	0.0044	0.015	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.052	2.8	0.000036	1,339	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.042	187,034
2144	9.2	1,507	1,687	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.87	0.001	0.0043	0.014	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.051	2.8	0.000036	1,338	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.042	187,551
2145	9.2	1,498	1,697	17	0.26	0.0026	0.0021	0.0034	0.78	0.00005	0.87	0.001	0.0042	0.014	0.05	0.0039	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.05	2.8	0.000036	1,338	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.042	187,019
2146	9.2	1,494	1,702	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.0042	0.014	0.05	0.0038	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.049	2.8	0.000036	1,337	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.042	187,081
2147	9.2	1,487	1,710	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.0041	0.014	0.05	0.0037	0.43	83	0.017	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000036	1,336	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.041	187,212
2148	9.2	1,483	1,714	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.004	0.014	0.05	0.0037	0.42	84	0.016	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000035	1,336	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.041	187,667
2149	9.2	1,477	1,721	17	0.27	0.0026	0.002	0.0034	0.78	0.00005	0.85	0.001	0.0039	0.014	0.05	0.0036	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000035	1,335	1.4	0.000036	0.00036	0.016	0.005	0.01	1.7	0.22	0.04	187,030
2150	9.2	1,474	1,724	17	0.27	0.0026	0.0019	0.0034	0.78	0.00005	0.85	0.001	0.0039	0.014	0.05	0.0035	0.43	85	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000035	1,335	1.4	0.000035	0.00035	0.016	0.005	0.01	1.7	0.21	0.039	186,985

Table A8. Annual loads of the NAG backfill for the low nitrogen scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2023	29	1.8	0.69	0.00041	0.000052	0.000029	0.000057	0.032	0.0000012	0.67	0.000024	0.00014	0.000097	0.0012	0.0000024	0.017	0.49	0.00081	0.00000012	0.00098	0.00018	0.011	0.99	0.0027	0.12	0.0000007	13	0.056	0.0000007	0.000007	0.00031	0.00012	0.00024	0.99	0.13	0.023	24
2024	53	3.2	1.3	0.00074	0.000094	0.000053	0.0001	0.057	0.0000022	1.2	0.000044	0.00025	0.00018	0.0022	0.0000044	0.031	0.89	0.0015	0.00000022	0.0018	0.00033	0.02	1.8	0.0048	0.21	0.0000013	24	0.1	0.0000013	0.000013	0.00057	0.00022	0.00044	1.8	0.23	0.041	44
2025	97	5.9	2.3	0.0014	0.00017	0.000097	0.00019	0.11	0.000004	2.2	0.00008	0.00046	0.00032	0.004	0.00000081	0.058	1.6	0.0027	0.000004	0.0033	0.0006	0.037	3.3	0.0089	0.38	0.0000023	43	0.18	0.0000023	0.000023	0.001	0.0004	0.0008	3.3	0.42	0.076	80
2026	152	9.1	3.6	0.0021	0.00027	0.00015	0.00029	0.16	0.0000063	3.5	0.00013	0.00072	0.0005	0.0063	0.000013	0.09	2.5	0.0042	0.00000063	0.0051	0.00093	0.057	5.1	0.014	0.6	0.0000036	68	0.29	0.0000036	0.000036	0.0016	0.00063	0.0013	5.1	0.65	0.12	125
2027	191	11	4.5	0.0027	0.00034	0.00019	0.00037	0.21	0.0000079	4.4	0.00016	0.0009	0.00063	0.0079	0.000016	0.11	3.2	0.0053	0.00000079	0.0064	0.0012	0.072	6.5	0.017	0.75	0.0000046	85	0.36	0.0000046	0.000046	0.002	0.00079	0.0016	6.5	0.82	0.15	158
2028	349	21	8.2	0.0048	0.00062	0.00035	0.00068	0.38	0.000014	8.0	0.00029	0.0017	0.0012	0.014	0.000029	0.21	5.8	0.0097	0.0000014	0.012	0.0021	0.13	12	0.032	1.4	0.0000084	156	0.66	0.0000084	0.000084	0.0037	0.0014	0.0029	12	1.5	0.27	289
2029	326	20	7.7	0.0045	0.00057	0.00032	0.00063	0.35	0.000013	7.5	0.00027	0.0015	0.0011	0.013	0.000027	0.19	5.5	0.0091	0.0000013	0.011	0.002	0.12	11	0.03	1.3	0.0000078	146	0.62	0.0000078	0.000078	0.0035	0.0013	0.0027	11	1.4	0.25	270
2030	421	25	9.9	0.0058	0.00074	0.00042	0.00081	0.45	0.000017	9.7	0.00035	0.002	0.0014	0.017	0.000035	0.25	7.0	0.012	0.0000017	0.014	0.0026	0.16	14	0.038	1.7	0.00001	188	0.8	0.00001	0.0001	0.0045	0.0017	0.0035	14	1.8	0.33	348
2031	2,705	163	64	0.038	0.0048	0.0027	0.0052	2.9	0.00011	62	0.0022	0.013	0.0089	0.11	0.00022	1.6	45	0.075	0.000011	0.091	0.017	1.0	91	0.25	11	0.000065	1,208	5.1	0.000065	0.00065	0.029	0.011	0.022	92	12	2.1	2,236
2032	4,396	264	104	0.061	0.0078	0.0044	0.0085	4.7	0.00018	101	0.0036	0.021	0.015	0.18	0.00036	2.6	73	0.12	0.000018	0.15	0.027	1.7	149	0.4	17	0.00011	1,962	8.3	0.00011	0.0011	0.047	0.018	0.036	149	19	3.4	3,634
2033	750	45	18	0.01	0.0013	0.00075	0.0015	0.81	0.0000031	17	0.00062	0.0035	0.0025	0.031	0.0000062	0.44	13	0.021	0.0000031	0.025	0.0046	0.28	25	0.068	3.0	0.000018	335	1.4	0.000018	0.00018	0.008	0.0031	0.0062	25	3.2	0.58	620
2034	3,015	181	71	0.042	0.0053	0.003	0.0058	3.3	0.00012	69	0.0025	0.014	0.01	0.12	0.00025	1.8	50	0.084	0.000012	0.1	0.019	1.1	102	0.28	12	0.000072	1,346	5.7	0.000072	0.00072	0.032	0.012	0.025	102	13	2.3	2,492
2035	8,570	516	202	0.12	0.015	0.0085	0.017	9.3	0.00035	197	0.0071	0.041	0.028	0.35	0.00071	5.1	143	0.24	0.000035	0.29	0.053	3.2	290	0.78	34	0.00021	3,825	16	0.00021	0.0021	0.092	0.035	0.071	290	37	6.7	7,085
2036	14,616	879	345	0.2	0.026	0.015	0.028	16	0.0006	336	0.012	0.069	0.048	0.6	0.0012	8.7	244	0.41	0.00006	0.49	0.09	5.5	494	1.3	58	0.00035	6,524	28	0.00035	0.0035	0.16	0.06	0.12	494	63	11	12,083
2037	16,287	980	385	0.23	0.029	0.016	0.032	18	0.00067	374	0.013	0.077	0.054	0.67	0.0014	9.6	272	0.45	0.000067	0.55	0.1	6.2	551	1.5	64	0.00039	7,270	31	0.00039	0.0039	0.17	0.067	0.13	551	70	13	13,464
2038	32,604	1,961	770	0.45	0.057	0.032	0.063	35	0.0013	749	0.027	0.15	0.11	1.3	0.0027	19	545	0.91	0.00013	1.1	0.2	12	1,102	3.0	128	0.00078	14,553	62	0.00078	0.0078	0.35	0.13	0.27	1,103	139	25	26,952
2039	59,745	6,372	1,312	0.94	0.11	0.058	0.11	60	0.0023	1,423	0.046	0.27	0.18	2.3	0.015	33	1,035	1.5	0.00023	2.0	0.37	21	1,878	5.0	219	0.0014	27,828	105	0.0014	0.014	0.64	0.23	0.46	1,824	231	42	45,912
2040	115,715	19,463	2,260	1.5	0.2	0.11	0.18	103	0.004	2,290	0.079	0.45	0.32	4.0	0.065	57	2,115	2.5	0.0004	3.9	0.71	36	3,235	8.2	377	0.0028	57,514	182	0.0028	0.028	1.2	0.4	0.79	2,790	353	64	79,056
2041	167,182	42,337	3,172	3.1	0.29	0.16	0.25	145	0.0055	1,440	0.11	0.46	0.9	5.5	0.18	79	3,299	2.4	0.00055	5.6	0.98	51	4,540	7.5	529	0.004	91,316	255	0.004	0.04	1.8	0.55	1.1	2,013	255	46	110,907
2042	181,431	51,233	3,172	3.8	0.32	0.19	0.31	145	0.0064	1,494	0.13	0.39	1.1	6.4	0.25	79	3,643	1.8	0.00064	6.1	1.0	51	4,539	5.4	529	0.0044	101,510	255	0.0044	0.044	1.9	0.64	1.3	946	120	22	128,839
2043	183,557	52,414	3,172	3.9	0.32	0.19	0.32	145	0.0067	1,574	0.13	0.35	1.1	6.7	0.27	79	3,688	1.5	0.00067	6.2	1.0	51	4,539	4.6	529	0.0044	102,890	255	0.0044	0.044	2.0	0.67	1.3	579	73	13	133,866
2044	184,376	52,092	3,171	3.9	0.33	0.2	0.33	145	0.0068	1,671	0.14	0.35	1.1	6.8	0.27	79	3,693	1.5	0.00068	6.2	1.0	51	4,539	4.6	529	0.0044	103,017	255	0.0044	0.044	2.0	0.68	1.4	579	73	13	136,575
2045	187,155	52,976	3,172	3.9	0.33	0.2	0.32	145	0.0067	1,557	0.13	0.37	1.1	6.7	0.27	79	3,757	1.6	0.00067	6.3	1.1	51	4,539	4.9	529	0.0045	104,762	255	0.0045	0.045	2.0	0.67	1.3	679	86	16	133,758
2046	186,745	51,799	3,172	3.8	0.33	0.2	0.3	145	0.0064	1,486	0.13	0.39	1.1	6.4	0.3	79	3,742	1.7	0.00064	6.3	1.1	51	4,540	5.1	529	0.0045	104,136	255	0.0045	0.045	2.0	0.64	1.3	655	83	15	128,763
2047	201,983	52,985	3,173	3.8	0.36	0.22	0.29	145	0.0064	1,470	0.13	0.44	1.1	6.4	0.37	80	4,015	1.9	0.00064	6.8	1.4	51	4,541	5.6	529	0.0048	111,476	255	0.0049	0.049	2.2	0.64	1.3	495	63	11	128,089
2048	222,414	56,058	3,173	4.0	0.39	0.25	0.28	145	0.0065	1,442	0.13	0.52	1.1	6.5	0.45	80	4,401	2.2	0.00065	7.5	1.6	51	4,542	6.5	529	0.0053	121,971	255	0.0054	0.053	2.4	0.65	1.3	479	61	11	129,793
2049	232,882	58,638	3,174	4.1	0.41	0.27	0.28	145	0.0066	1,397	0.13	0.59	1.2	6.6	0.5	80	4,615	2.5	0.00066	7.8	1.9	51	4,542	7.3	529	0.0056	127,814	255	0.0056	0.056	2.5	0.66	1.3	516	65	12	131,172
2050	239,485	59,886	3,174	4.2	0.42	0.29	0.28	145	0.0066	1,404	0.13	0.63	1.2	6.6	0.55	80	4,741	2.6	0.00066	8.1	2.0	51	4,543	7.7	529	0.0057	131,300	255	0.0058	0.058	2.6	0.66	1.3	454	57	10	132,811
2051	243,278	60,526	3,174	4.2	0.43	0.3	0.28	145	0.0067	1,417	0.13	0.65	1.2	6.7	0.58	80	4,811	2.7	0.00067	8.2	2.1	51	4,543	7.8	529	0.0058	133,263	255	0.0058	0.059	2.6	0.67	1.3	360	46	8.3	133,964
2052	246,757	61,084	3,174	4.3	0.44	0.3	0.28	145	0.0068	1,431	0.14	0.65	1.2	6.8	0.61	80	4,875	2.7	0.00068	8.3	2.2	51	4,543	7.7	529	0.0059	135,046	255	0.0059	0.059	2.6	0.68	1.4	239	30	5.5	135,076
2053	248,235	61,157	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,435	0.14	0.66	1.2	6.8	0.62	80	4,900	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.0059	135,740	255	0.006	0.06	2.7	0.68	1.4	141	18	3.2	135,145
2054	249,944	61,387	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,446	0.14	0.66	1.2	6.8	0.63	80	4,930	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.006	136,596	255	0.006	0.06	2.7	0.68	1.4	111	14	2.7	135,795
2055	252,972	61,688	3,174	4.3	0.45	0.32	0.29	145	0.0068	1,462	0.14	0.68	1.2	6.8	0.65	80	4,984	2.7	0.00068	8.5	2.3	51	4,543	8.0	529	0.0061	138,049	255	0.0061	0.061	2.7	0.68	1.5	113	14	2.7	136,601
2056	248,809	75,905	3,175	5.4	0.44	0.31	0.3	145	0.0069	1,017	0.14	0.67	1.4	6.9	0.63	80	5,234	2.7	0.00069	8.4	2.2	51	4,544	7.8	529	0.006	142,435	255	0.006	0.06	2.7	0.69	1.4	127	16	2.9	137,439
2057	238,664	98,121	3,176	7.1	0.42	0.3	0.32	145	0.0069	641	0.14	0.61	1.8	6.9	0.58	80	5,609	2.5	0.00069	8.0	2.1	51	4,544	7.2	530	0.0057	147,692	255	0.0057	0.057	2.5	0.69	1.4	143	18	3.3	137,940
2058	232,800	110,938	3,176	8.2	0.41	0.28	0.33	145	0.0069	518	0.14	0.58	2.0	6.9	0.54	80	5,859	2.3	0.00069	7.8	1.9	51	4,545	6.7	530	0.0056	150,436	255	0.0056	0.056	2.5	0.69	1.4	162	21	3.7	138,218
2059	231,450	115,350	3,176	8.7	0.41	0.28	0.34	145	0.0069	480	0.14	0.57	2.0	6.9	0.53	80	5,973	2.3	0.00069	7.8	1.9	51	4,545	6.6	530	0.0055	151,656	255	0.0056	0.056	2.5	0.69	1.4	185	23	4.2	138,460
2060	233,135	117,134	3,176	8.8	0.41	0.28	0.34	145	0.007	483	0.14	0.57	2.0	7.0	0.53	80	6,057	2.3	0.0007	7.8	1.9	51	4,545	6.7	530	0.0056	153,122	255	0.0056	0.056	2.5	0.7	1.4	212	27	4.9	139,518
2061	234,102	117,262	3,176	8.7	0.41	0.28	0.34	145	0.007	486	0.14	0.58	2.0	7.0	0.53	80	6,083	2.4	0.0007	7.9	1.9	51	4,545	6.9	530	0.0056	153,584	255	0.0056	0.056	2.5	0.7	1.4	240	30	5.5	139,838
2062	233,972	122,782	3,176	10	0.41	0.28	0.35	145	0.007	425	0.14	0.58	2.0	7.0	0.53	80	6,199	2.4	0.0007	7.9	1.9	51	4,546	6.9	530	0.0056	155,911	255	0.0056	0.056	2.5	0.7	1.4	273	35	6.3	140,676
2063	232,497	128,745	3,176	11	0.41	0.28	0.36	145	0.0071	387	0.14	0.57	2.0	7.1	0.51	80	6,343	2.3	0.00071	7.8	1.8	51	4,546	6.8	530	0.0056	157,707	255	0.0056	0.056	2.5	0.71	1.4	308	39	7.1	141,568
2064	233,632	130,824	3,176	11	0.41	0.28	0.36	145	0.0071	389	0.14	0.57	2.0	7.1	0.51	80	6,425	2.4	0.00071	7.9	1.8	51	4,546	6.9	530	0.0056	159,053	255	0.0056	0.056	2.5	0.71	1.4	346	44	8.0	142,789
2065	234,574	136,451	3,176	14	0.41	0.28	0.37	145	0.0072	335	0.14	0.57	2.0	7.2	0.5	80	6,576	2.4	0.00072	7.9	1.8	51	4,546	6.9	530	0.0056	161,851	255	0.0056	0.056	2.5	0.72	1.4	385	49	8.9	143,409
2066	232,619	143,839	3,176	16	0.41	0.28	0.38	145	0.0072	299	0.14	0.56	2.0	7.2	0.49	80	6,730	2.3	0.00072	7.8	1.8	51	4,546	6.9	530	0.0056	164,047	255	0.0056	0.056	2.5	0.72	1.4	427	54	9.8	144,573
2067	231,421	149,219	3,177	17	0.41	0.27	0.39	145	0.0073	283	0.15	0.56	2.0	7.3	0.49	80	6,867	2.3	0.00073	7.8	1.8	51	4,546	6.9	530	0.0055	165,715	255	0.0056	0.056	2.5	0.73	1.5	471	60	11	145,722
2068	232,988	153,013	3,177	17	0.41	0.28	0.4	145	0.0074	281	0.15	0.56	2.0	7.4	0.48	80	7,020	2.4	0.00074	7.8	1.8	51	4,546	7.0	530	0.0056	167,918	255	0.0056	0.056	2.5	0.74	1.5	516	65	12	147,284
2069	233,683	155,281	3,177	17	0.42	0.28	0.4	145	0.0074	282	0.15	0.56	2.0	7.4	0.48	80	7,126	2.4	0.00074	7.9	1.8	51	4,546	7.0	530	0.0056	169,093	255	0.0056	0.056	2.5	0.74	1.5	552	70	13	148,041
2070	236,372	156,735	3,177	17	0.42	0.28	0.4	145	0.0075	289	0.15	0.57	2.0	7.5	0.48	80	7,228	2.4	0.00075	8.0	1.8	51	4,547	7.1	530	0.0057	170,847	255	0.0057	0.057	2.5	0.75	1.5	569	72	13	149,328
2071	238,235	158,106	3,177	16	0.42	0.28	0.4	145	0.0075	296	0.15	0.57	2.0	7.5	0.49	80	7,319	2.4	0.00075	8.0	1.8	51	4,547	7.1	530	0.0057	172,193	255	0.0057	0.057	2.5	0.75	1.5	545	69	13	150,505
2072	242,837	159,906	3,177	17	0.43	0.29	0.41	145	0.0076	292	0.15	0.58	2.0	7.6	0.5	80	7,437	2.4	0.00076	8.2	1.8	51	4,547	7.1	530	0.0058	174,992	255	0.0058	0.058	2.6	0.76	1.5	499	63	11	151,916
2073	244,688	159,952	3,177	17	0.43	0.29	0.41	145	0.0076	297	0.15	0.59	2.1	7.6	0.51	80	7,477	2.5	0.00076	8.2	1.9	51	4,547	7.2	530	0.0059	175,821	255	0.0059	0.059	2.6	0.76	1.5	463	59	11	152,292
2074	247,186	160,209	3,177	17	0.44	0.29	0.41	145	0.0077	305	0.15	0.6	2.1	7.7	0.53	80	7,523	2.5	0.00077	8.3	1.9	51	4,547	7.3	530	0.0059	177,034	255	0.0059	0.059	2.6	0.77	1.5	454	57	10	153,237
2075	249,903	160,201	3,177	16	0.44	0.3	0.41	145	0.0077	314	0.15	0.62	2.1	7.7	0.54	80	7,568	2.6	0.00077	8.4	2.0	51	4,547	7.5	530	0.006	178,249	255	0.006	0.06	2.7	0.77	1.5	447	56	10	153,995
2076	255,542	161,888	3,177	18	0.45	0.31	0.41	145	0.0078	302	0.16	0.64	2.1	7.8	0.56	80	7,686	2.7	0.00078	8.6	2.0	51	4,547	7.8	530	0.0061	181,511	255	0.0062	0.061	2.7	0.78	1.6	461	58	11	155,005
2077	258,668	161,866	3,177	18	0.46	0.32	0.4	145	0.0078	305	0.16	0.66	2.2	7.8	0.58	80	7,734	2.8	0.00078	8.7	2.1	51	4,547	8.1	530	0.0062	182,886	255	0.0062	0.062	2.8	0.78	1.6	476	60	11	155,356
2078	262,211	162,267	3,177	18	0.46	0.32	0.4	145	0.0078	311	0.16	0.69	2.2	7.8	0.61	80	7,796	2.9	0.00078	8.8	2.2	51	4,547	8.4	530	0.0063	184,639	255	0.0063	0.063	2.8	0.78	1.6	496	63	11	156,236
2079	265,455	163,902	3,177	18	0.47	0.33	0.41	145	0.0079	311	0.16	0.71	2.2	7.9	0.63	80	7,884	3.0	0.00079	8.9	2.3	51	4,547	8.7	530	0.0064	186,782	255	0.0064	0.064	2.8	0.79	1.6	509	64	12	157,251
2080	268,416	166,108	3,177	18	0.47	0.34	0.41	145	0.0079	311	0.16	0.74	2.3	7.9	0.65	80	7,990	3.1	0.00079	9.0	2.4	51	4,547	9.0	530	0.0064	189,023	255	0.0064	0.065	2.9	0.79	1.6	510	64	12	158,470
2081	270,883	166,367	3,177	18	0.48	0.35	0.41	145	0.0079	316	0.16	0.76	2.3	7.9	0.67	80	8,041	3.1	0.00079	9.1	2.4	51	4,548	9.2	530	0.0065	190,209	255	0.0065	0.065	2.9	0.79	1.6	518	65	12	158,838
2082	271,299	170,361	3,177	19	0.48	0.35	0.41	145	0.008	304	0.16	0.77	2.3	8.0	0.68	80	8,150	3.2	0.0008	9.1	2.5	51	4,548	9.3	530	0.0065	192,048	255	0.0065	0.065	2.9	0.8	1.6	505	64	12	159,814
2083	270,406	174,128	3,178	20	0.48	0.35	0.42	145	0.008	294	0.16	0.78	2.3	8.0	0.69	80	8,248	3.2	0.0008	9.1	2.5	51	4,548	9.4	530	0.0065	193,181	255	0.0065	0.065	2.9	0.8	1.6	514	65	12	160,383
2084	272,860	176,718	3,178	20	0.48	0.36	0.42	145	0.0081	295	0.16	0.79	2.3	8.1	0.7	80	8,376	3.3	0.00081	9.2	2.6	51	4,548	9.6	530	0.0066	195,290	255	0.0066	0.066	2.9	0.81	1.6	510	64	12	161,637
2085	272,104	178,645	3,178	20	0.48	0.36	0.43	145	0.0081	293	0.16	0.79	2.3	8.1	0.7	80	8,448	3.3	0.00081	9.2	2.6	51	4,548	9.7	530	0.0066	195,692	255	0.0065	0.065	2.9	0.81	1.6	520	66	12	161,890
2086	274,233	180,244	3,178	20	0.48	0.37	0.43	145	0.0081	296	0.16	0.81	2.4	8.1	0.72	80	8,554	3.3	0.00081	9.2	2.6	51	4,548	9.8	530	0.0066	197,239	255	0.0066	0.066	2.9	0.81	1.6	510	64	12	162,778
2087	274,498	182,023	3,178	19	0.48	0.37	0.43	145	0.0082	298	0.16	0.8	2.4	8.2	0.72	80	8,645	3.3	0.00082	9.2	2.6	51	4,548	9.8	530	0.0066	198,011	255	0.0066	0.066	2.9	0.82	1.6	514	65	12	163,470
2088	278,287	184,335	3,178	20	0.49	0.37	0.43	145	0.0082	293	0.16	0.81	2.4	8.2	0.73	80	8,791	3.4	0.00082	9.4	2.6	51	4,548	9.9	530	0.0067	200,610	255	0.0067	0.067	3.0	0.82	1.7	488	62	11	164,570
2089	278,103	188,088	3,178	22	0.49	0.37	0.44	145	0.0082	274	0.16	0.81	2.4	8.2	0.72	80	8,913	3.3	0.00082	9.4	2.6	51	4,548	9.8	530	0.0066	202,044	255	0.0067	0.067	3.0	0.82	1.7	486	61	11	164,772
2090	277,811	191,638	3,178	23	0.49	0.37	0.44	145	0.0083	268	0.17	0.81	2.4	8.3	0.73	80	9,038	3.3	0.00083	9.4	2.6	51	4,549	9.7	530	0.0066	203,304	255	0.0067	0.067	3.0	0.83	1.7	459	58	11	165,462
2091	278,428	193,988	3,178	23	0.49	0.37	0.45	145	0.0083	267	0.17	0.81	2.4	8.3	0.72	80	9,159	3.3	0.00083	9.4	2.6	51	4,549	9.7	530	0.0066	204,448	255	0.0067	0.067	3.0	0.83	1.7	466	59	11	166,285
2092	280,491	196,915	3,178	23	0.49	0.37	0.45	145	0.0084	268	0.17	0.81	2.4	8.4	0.73	80	9,318	3.3	0.00084	9.4	2.6	51	4,549	9.8	530	0.0067	206,468	255	0.0068	0.067	3.0	0.84	1.7	462	58	11	167,587
2093	278,918	201,019	3,178	24	0.49	0.37	0.46	145	0.0084	258	0.17	0.8	2.4	8.4	0.72	80	9,439	3.3	0.00084	9.4	2.6	51	4,549	9.7

Table A8. Annual loads of the NAG backfill for the low nitrogen scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2135	293,473	298,007	3,182	43	0.52	0.42	0.59	145	0.0093	180	0.19	0.89	2.8	9.3	0.82	80	14,473	3.6	0.00093	9.9	2.9	51	4,554	11	531	0.007	249,424	256	0.0071	0.071	3.1	0.93	1.9	341	43	7.8	186,569
2136	294,228	300,087	3,182	44	0.52	0.42	0.59	145	0.0094	180	0.19	0.88	2.8	9.4	0.82	80	14,624	3.6	0.00094	9.9	2.9	51	4,554	10	531	0.0071	250,465	256	0.0071	0.071	3.1	0.94	1.9	338	43	7.8	187,180
2137	294,638	299,791	3,182	43	0.52	0.42	0.59	145	0.0093	180	0.19	0.89	2.8	9.3	0.82	80	14,657	3.6	0.00093	9.9	2.9	51	4,554	11	531	0.0071	250,461	256	0.0071	0.071	3.1	0.93	1.9	337	43	7.7	186,716
2138	292,401	302,917	3,182	45	0.52	0.41	0.59	145	0.0093	175	0.19	0.88	2.8	9.3	0.81	80	14,754	3.6	0.00093	9.8	2.9	51	4,554	10	531	0.007	250,635	256	0.007	0.07	3.1	0.93	1.9	337	43	7.7	186,790
2139	289,806	306,735	3,182	46	0.51	0.41	0.6	145	0.0094	171	0.19	0.87	2.8	9.4	0.8	80	14,872	3.5	0.00094	9.8	2.9	51	4,554	10	531	0.0069	250,917	256	0.007	0.07	3.1	0.94	1.9	337	43	7.7	187,056
2140	288,865	309,435	3,182	47	0.51	0.41	0.61	145	0.0094	170	0.19	0.86	2.8	9.4	0.79	80	15,001	3.5	0.00094	9.7	2.8	51	4,554	10	531	0.0069	251,475	256	0.0069	0.069	3.1	0.94	1.9	338	43	7.8	187,514
2141	285,669	310,955	3,182	48	0.5	0.4	0.61	145	0.0093	167	0.19	0.84	2.7	9.3	0.78	80	15,058	3.4	0.00093	9.6	2.8	51	4,554	10	531	0.0068	250,532	256	0.0069	0.069	3.0	0.93	1.9	338	43	7.8	186,895
2142	284,553	312,156	3,182	48	0.5	0.4	0.61	145	0.0093	166	0.19	0.84	2.7	9.3	0.77	80	15,121	3.4	0.00093	9.6	2.8	51	4,555	10	531	0.0068	250,428	256	0.0068	0.068	3.0	0.93	1.9	338	43	7.8	186,886
2143	282,757	314,534	3,182	48	0.5	0.39	0.62	145	0.0094	164	0.19	0.82	2.7	9.4	0.75	80	15,255	3.3	0.00094	9.5	2.7	51	4,555	10	531	0.0068	250,419	256	0.0068	0.068	3.0	0.94	1.9	339	43	7.8	187,034
2144	282,620	316,435	3,182	49	0.5	0.39	0.62	145	0.0094	164	0.19	0.81	2.7	9.4	0.75	80	15,360	3.3	0.00094	9.5	2.7	51	4,555	10	531	0.0068	251,018	256	0.0068	0.068	3.0	0.94	1.9	340	43	7.8	187,551
2145	280,136	317,427	3,183	49	0.49	0.38	0.63	145	0.0094	162	0.19	0.79	2.7	9.4	0.72	80	15,442	3.2	0.00094	9.4	2.6	51	4,555	9.4	531	0.0067	250,138	256	0.0067	0.067	3.0	0.94	1.9	339	43	7.8	187,019
2146	279,462	318,319	3,183	49	0.49	0.38	0.63	145	0.0094	162	0.19	0.78	2.7	9.4	0.72	80	15,504	3.2	0.00094	9.4	2.6	51	4,555	9.2	531	0.0067	250,109	256	0.0067	0.067	3.0	0.94	1.9	338	43	7.8	187,081
2147	278,291	320,039	3,183	49	0.49	0.38	0.63	145	0.0094	161	0.19	0.76	2.7	9.4	0.7	80	15,627	3.1	0.00094	9.4	2.5	51	4,555	9.0	531	0.0067	250,097	256	0.0067	0.067	3.0	0.94	1.9	336	42	7.7	187,212
2148	278,328	321,567	3,183	50	0.49	0.37	0.64	145	0.0094	161	0.19	0.75	2.7	9.4	0.69	80	15,722	3.1	0.00094	9.4	2.5	51	4,555	8.9	531	0.0067	250,648	256	0.0067	0.067	3.0	0.94	1.9	334	42	7.7	187,667
2149	276,244	321,860	3,183	50	0.49	0.37	0.64	145	0.0094	159	0.19	0.73	2.6	9.4	0.67	80	15,777	3.0	0.00094	9.3	2.4	51	4,555	8.7	531	0.0066	249,685	256	0.0066	0.066	2.9	0.94	1.9	324	41	7.5	187,030
2150	275,672	322,362	3,183	50	0.49	0.36	0.64	145	0.0093	159	0.19	0.72	2.6	9.3	0.66	80	15,820	2.9	0.00093	9.3	2.4	51	4,555	8.6	531	0.0066	249,550	256	0.0066	0.066	2.9	0.93	1.9	317	40	7.3	186,985

Table A9. Source terms of the NAG backfill for the high nitrogen scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2023	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	24
2024	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	44
2025	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	80
2026	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	125
2027	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	158
2028	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	289
2029	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	270
2030	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	348
2031	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	2,236
2032	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	3,634
2033	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	620
2034	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	2,492
2035	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	7,085
2036	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	12,083
2037	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	13,464
2038	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	26,952
2039	7.8	1,302	85	29	0.0094	0.0023	0.0013	0.0023	1.3	0.00005	31	0.001	0.0058	0.004	0.05	0.00032	0.72	23	0.034	0.000005	0.044	0.008	0.46	41	0.11	4.8	0.000031	581	2.3	0.000031	0.00031	0.014	0.005	0.01	99	13	2.3	45,912
2040	8.2	1,465	225	29	0.017	0.0026	0.0014	0.0022	1.3	0.00005	34	0.001	0.0057	0.004	0.05	0.00082	0.72	27	0.032	0.000005	0.049	0.009	0.46	41	0.1	4.8	0.000035	712	2.3	0.000035	0.00035	0.016	0.005	0.01	88	11	2.0	79,056
2041	8.4	1,508	378	29	0.028	0.0027	0.0015	0.0023	1.3	0.00005	13	0.001	0.0042	0.0081	0.05	0.0017	0.72	30	0.021	0.000005	0.051	0.0089	0.46	41	0.067	4.8	0.000036	821	2.3	0.000036	0.00036	0.016	0.005	0.01	45	5.7	1.0	110,907
2042	8.5	1,409	396	25	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.001	0.003	0.0082	0.05	0.002	0.62	28	0.014	0.000005	0.047	0.008	0.39	35	0.042	4.1	0.000034	787	2.0	0.000034	0.00034	0.015	0.005	0.01	17	2.1	0.38	128,839
2043	8.4	1,372	388	24	0.029	0.0024	0.0015	0.0024	1.1	0.00005	12	0.001	0.0026	0.0081	0.05	0.002	0.59	28	0.012	0.000005	0.046	0.0077	0.38	34	0.034	4.0	0.000033	767	1.9	0.000033	0.00033	0.015	0.005	0.01	9.1	1.1	0.21	133,866
2044	8.4	1,350	377	23	0.028	0.0024	0.0014	0.0024	1.1	0.00005	13	0.001	0.0026	0.008	0.05	0.002	0.58	27	0.011	0.000005	0.045	0.0075	0.37	33	0.033	3.9	0.000032	752	1.9	0.000032	0.00032	0.014	0.005	0.01	9.8	1.2	0.22	136,575
2045	8.5	1,399	394	24	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.001	0.0028	0.0082	0.05	0.002	0.59	28	0.012	0.000005	0.047	0.0079	0.38	34	0.037	4.0	0.000034	782	1.9	0.000034	0.00034	0.015	0.005	0.01	12	1.5	0.28	133,758
2046	8.5	1,450	399	25	0.029	0.0026	0.0016	0.0023	1.1	0.00005	12	0.001	0.003	0.0082	0.05	0.0023	0.62	29	0.013	0.000005	0.049	0.0089	0.39	35	0.04	4.1	0.000035	807	2.0	0.000035	0.00035	0.015	0.005	0.01	12	1.5	0.28	128,763
2047	8.5	1,577	410	25	0.03	0.0028	0.0017	0.0022	1.1	0.00005	12	0.001	0.0035	0.0084	0.05	0.0029	0.62	31	0.015	0.000005	0.053	0.011	0.4	35	0.043	4.1	0.000038	868	2.0	0.000038	0.00038	0.017	0.005	0.01	9.0	1.1	0.21	128,089
2048	8.5	1,714	430	24	0.03	0.003	0.0019	0.0022	1.1	0.00005	11	0.001	0.004	0.0087	0.05	0.0034	0.61	34	0.017	0.000005	0.058	0.013	0.39	35	0.05	4.1	0.000041	939	2.0	0.000041	0.00041	0.018	0.005	0.01	8.6	1.1	0.2	129,793
2049	8.5	1,776	447	24	0.031	0.0031	0.0021	0.0021	1.1	0.00005	11	0.001	0.0045	0.0089	0.05	0.0038	0.61	35	0.019	0.000005	0.06	0.014	0.39	35	0.056	4.0	0.000043	974	1.9	0.000043	0.00043	0.019	0.005	0.01	9.2	1.2	0.21	131,172
2050	8.5	1,803	451	24	0.031	0.0032	0.0022	0.0021	1.1	0.00005	11	0.001	0.0047	0.009	0.05	0.0042	0.6	36	0.02	0.000005	0.061	0.015	0.38	34	0.058	4.0	0.000043	988	1.9	0.000043	0.00043	0.019	0.005	0.01	7.9	1.0	0.18	132,811
2051	8.5	1,816	452	24	0.031	0.0032	0.0022	0.0021	1.1	0.00005	11	0.001	0.0048	0.009	0.05	0.0043	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.058	4.0	0.000044	995	1.9	0.000044	0.00044	0.019	0.005	0.01	6.1	0.77	0.14	133,964
2052	8.5	1,827	452	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0048	0.009	0.05	0.0045	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.057	3.9	0.000044	1,000	1.9	0.000044	0.00044	0.02	0.005	0.01	3.8	0.48	0.087	135,076
2053	8.5	1,837	452	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0049	0.009	0.05	0.0046	0.59	36	0.02	0.000005	0.062	0.016	0.38	34	0.057	3.9	0.000044	1,004	1.9	0.000044	0.00044	0.02	0.005	0.01	1.9	0.25	0.045	135,145
2054	8.5	1,841	452	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0049	0.009	0.05	0.0047	0.59	36	0.02	0.000005	0.062	0.016	0.37	33	0.057	3.9	0.000044	1,006	1.9	0.000044	0.00044	0.02	0.005	0.01	1.4	0.17	0.031	135,795
2055	8.5	1,852	451	23	0.031	0.0033	0.0023	0.0021	1.1	0.00005	11	0.001	0.005	0.009	0.05	0.0048	0.58	36	0.02	0.000005	0.062	0.017	0.37	33	0.058	3.9	0.000044	1,010	1.9	0.000045	0.00045	0.02	0.005	0.011	1.4	0.18	0.032	136,601
2056	8.6	1,808	551	23	0.039	0.0032	0.0023	0.0022	1.1	0.00005	7.4	0.001	0.0048	0.01	0.05	0.0046	0.58	38	0.02	0.000005	0.061	0.016	0.37	33	0.057	3.8	0.000043	1,036	1.9	0.000043	0.00043	0.019	0.005	0.01	1.6	0.21	0.037	137,639
2057	8.7	1,730	710	23	0.052	0.0031	0.0022	0.0023	1.1	0.00005	4.7	0.001	0.0044	0.013	0.05	0.0042	0.58	41	0.018	0.000005	0.058	0.015	0.37	33	0.052	3.8	0.000041	1,070	1.9	0.000042	0.00042	0.018	0.005	0.01	1.9	0.24	0.044	137,940
2058	8.7	1,684	801	23	0.059	0.003	0.0021	0.0024	1.1	0.00005	3.8	0.001	0.0042	0.015	0.05	0.0039	0.58	42	0.017	0.000005	0.057	0.014	0.37	33	0.049	3.8	0.00004	1,088	1.8	0.00004	0.00041	0.018	0.005	0.01	2.3	0.29	0.052	138,218
2059	8.7	1,672	832	23	0.062	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.37	33	0.048	3.8	0.00004	1,095	1.8	0.00004	0.0004	0.018	0.005	0.01	2.7	0.34	0.061	138,460
2060	8.7	1,671	838	23	0.062	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.36	33	0.048	3.8	0.00004	1,097	1.8	0.00004	0.0004	0.018	0.005	0.01	3.1	0.4	0.072	139,518
2061	8.7	1,674	837	23	0.062	0.003	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.014	0.36	33	0.049	3.8	0.00004	1,097	1.8	0.00004	0.0004	0.018	0.005	0.01	3.6	0.46	0.084	139,838
2062	8.8	1,663	872	23	0.065	0.0029	0.002	0.0025	1.0	0.00005	3.3	0.001	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.013	0.36	32	0.049	3.8	0.00004	1,108	1.8	0.00004	0.0004	0.018	0.005	0.01	4.2	0.53	0.096	140,676
2063	8.8	1,642	908	22	0.07	0.0029	0.002	0.0025	1.0	0.00005	3.0	0.001	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,113	1.8	0.000039	0.00039	0.018	0.005	0.01	4.8	0.61	0.11	141,568
2064	8.8	1,636	915	22	0.069	0.0029	0.002	0.0025	1.0	0.00005	3.0	0.001	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,113	1.8	0.000039	0.00039	0.017	0.005	0.01	5.4	0.68	0.12	142,789
2065	8.9	1,636	951	22	0.092	0.0029	0.0019	0.0026	1.0	0.00005	2.4	0.001	0.004	0.014	0.05	0.0035	0.56	46	0.016	0.000005	0.055	0.013	0.35	32	0.048	3.7	0.000039	1,128	1.8	0.000039	0.00039	0.017	0.005	0.01	6.1	0.77	0.14	143,409
2066	8.9	1,609	994	22	0.1	0.0028	0.0019	0.0026	1.0	0.00005	2.1	0.001	0.0039	0.014	0.05	0.0034	0.55	47	0.016	0.000005	0.054	0.012	0.35	31	0.048	3.7	0.000039	1,134	1.8	0.000039	0.00039	0.017	0.005	0.01	6.8	0.85	0.16	144,573
2067	8.9	1,588	1,023	22	0.11	0.0028	0.0019	0.0027	1.	0.00005	2.0	0.001	0.0039	0.013	0.05	0.0033	0.55	47	0.016	0.000005	0.053	0.012	0.35	31	0.047	3.6	0.000038	1,137	1.8	0.000038	0.00038	0.017	0.005	0.01	7.5	0.94	0.17	145,722
2068	8.9	1,582	1,038	22	0.11	0.0028	0.0019	0.0027	0.99	0.00005	2.0	0.001	0.0038	0.013	0.05	0.0033	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.047	3.6	0.000038	1,139	1.7	0.000038	0.00038	0.017	0.005	0.01	8.1	1.0	0.19	147,284
2069	8.9	1,578	1,048	21	0.1	0.0028	0.0019	0.0027	0.98	0.00005	2.0	0.001	0.0038	0.013	0.05	0.0032	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.047	3.6	0.000038	1,141	1.7	0.000038	0.00038	0.017	0.005	0.01	8.7	1.1	0.2	148,201
2070	8.9	1,583	1,048	21	0.1	0.0028	0.0019	0.0027	0.97	0.00005	2.1	0.001	0.0038	0.013	0.05	0.0032	0.53	48	0.016	0.000005	0.053	0.012	0.34	30	0.048	3.5	0.000038	1,143	1.7	0.000038	0.00038	0.017	0.005	0.01	8.9	1.1	0.2	149,328
2071	8.9	1,583	1,049	21	0.095	0.0028	0.0019	0.0027	0.96	0.00005	2.1	0.001	0.0038	0.013	0.05	0.0032	0.53	49	0.016	0.000005	0.053	0.012	0.34	30	0.047	3.5	0.000038	1,143	1.7	0.000038	0.00038	0.017	0.005	0.01	8.4	1.1	0.19	150,505
2072	8.9	1,598	1,052	21	0.1	0.0028	0.0019	0.0027	0.96	0.00005	2.0	0.001	0.0038	0.013	0.05	0.0033	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000038	1,151	1.7	0.000038	0.00038	0.017	0.005	0.01	7.6	0.96	0.17	151,916
2073	8.9	1,607	1,049	21	0.1	0.0028	0.0019	0.0027	0.95	0.00005	2.1	0.001	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000038	1,154	1.7	0.000039	0.00039	0.017	0.005	0.01	7.0	0.88	0.16	152,292
2074	8.9	1,613	1,044	21	0.097	0.0028	0.0019	0.0026	0.95	0.00005	2.1	0.001	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.013	0.33	30	0.048	3.5	0.000039	1,155	1.7	0.000039	0.00039	0.017	0.005	0.01	6.8	0.86	0.16	153,237
2075	8.9	1,623	1,039	21	0.093	0.0029	0.0019	0.0026	0.94	0.00005	2.2	0.001	0.004	0.014	0.05	0.0035	0.52	49	0.017	0.000005	0.055	0.013	0.33	30	0.049	3.4	0.000039	1,157	1.7	0.000039	0.00039	0.017	0.005	0.01	6.6	0.84	0.15	153,995
2076	8.9	1,649	1,044	20	0.11	0.0029	0.002	0.0026	0.94	0.00005	2.0	0.001	0.0041	0.014	0.05	0.0036	0.51	50	0.017	0.000005	0.055	0.013	0.33	29	0.05	3.4	0.000039	1,171	1.6	0.00004	0.0004	0.018	0.005	0.01	6.8	0.86	0.16	155,005
2077	8.9	1,665	1,042	20	0.11	0.0029	0.002	0.0026	0.93	0.00005	2.0	0.001	0.0043	0.014	0.05	0.0038	0.51	50	0.018	0.000005	0.056	0.014	0.33	29	0.052	3.4	0.00004	1,177	1.6	0.00004	0.0004	0.018	0.005	0.01	7.0	0.89	0.16	155,356
2078	8.9	1,678	1,038	20	0.11	0.003	0.0021	0.0026	0.93	0.00005	2.0	0.001	0.0044	0.014	0.05	0.0039	0.51	50	0.018	0.000005	0.056	0.014	0.32	29	0.054	3.4	0.00004	1,182	1.6	0.00004	0.0004	0.018	0.005	0.01	7.3	0.92	0.17	156,236
2079	8.9	1,688	1,042	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.001	0.0045	0.014	0.05	0.004	0.51	50	0.019	0.000005	0.057	0.015	0.32	29	0.055	3.4	0.00004	1,187	1.6	0.00004	0.00041	0.018	0.005	0.01	7.5	0.94	0.17	157,251
2080	8.9	1,694	1,048	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.001	0.0046	0.014	0.05	0.0041	0.5	50	0.019	0.000005	0.057	0.015	0.32	29	0.057	3.3	0.00004	1,192	1.6	0.00004	0.00041	0.018	0.005	0.01	7.4	0.94	0.17	158,470
2081	8.9	1,705	1,047	20	0.11	0.003	0.0022	0.0026	0.91	0.00005	2.0	0.001	0.0048	0.014	0.05	0.0042	0.5	51	0.02	0.000005	0.057	0.015	0.32	29	0.058	3.3	0.00004	1,197	1.6	0.00004	0.00041	0.018	0.005	0.01	7.5	0.95	0.17	158,338
2082	8.9	1,697	1,065	20	0.11	0.003	0.0022	0.0026	0.91	0.00005	2.0	0.001	0.0048	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.015	0.32	28	0.058	3.3	0.00004	1,201	1.6	0.00004	0.00041	0.018	0.005	0.01	7.3	0.92	0.17	159,814
2083	8.9	1,686	1,085	20	0.11	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.001	0.0048	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.016	0.32	28	0.059	3.3	0.00004	1,204	1.6	0.00004	0.00041	0.018	0.005	0.01	7.4	0.93	0.17	160,383
2084	8.9	1,688	1,092	20	0.11	0.003	0.0022	0.0026	0.9	0.00005	1.9	0.001	0.0049	0.014	0.05	0.0044	0.49	52	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.00004	1,207	1.6	0.00004	0.00041	0.018	0.005	0.01	7.2	0.92	0.17	161,637
2085	8.9	1,680	1,102	20	0.11	0.003	0.0022	0.0026	0.9	0.00005	1.9	0.001	0.0049	0.014	0.05	0.0044	0.49	52	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.00004	1,208	1.6	0.00004	0.0004	0.018	0.005	0.01	7.4	0.94	0.17	161,890
2086	8.9	1,684	1,106	20	0.11	0.003	0.0022	0.0026	0.89	0.00005	1.9	0.001	0.005	0.015	0.05	0.0044	0.49	53	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.00004	1,211	1.6	0.00004	0.00041	0.018	0.005	0.01	7.2	0.91	0.17	162,778
2087	8.9	1,679	1,112	19	0.1	0.003	0.0022	0.0026	0.89	0.00005	2.0	0.001	0.0049	0.015	0.05	0.0044	0.49	53	0.02	0.000005	0.056	0.016	0.31	28	0.06	3.2	0.00004	1,210	1.6	0.00004	0.0004	0.018	0.005	0.01	7.2	0.91	0.17	163,470
2088	8.9	1,691	1,119	19	0.11	0.003	0.0023	0.0026	0.88	0.00005	1.9	0.001	0.0049	0.015	0.05	0.0044	0.48	53	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.2	0.00004	1,218	1.6	0.00004	0.

Table A9. Source terms of the NAG backfill for the high nitrogen scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2135	9.2	1,573	1,597	17	0.23	0.0028	0.0022	0.0032	0.78	0.00005	0.97	0.001	0.0048	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,337	1.4	0.000038	0.00038	0.017	0.005	0.01	3.9	0.49	0.09	186,569
2136	9.2	1,571	1,603	17	0.23	0.0028	0.0022	0.0032	0.78	0.00005	0.96	0.001	0.0047	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,338	1.4	0.000038	0.00038	0.017	0.005	0.01	3.8	0.49	0.088	187,180
2137	9.2	1,577	1,606	17	0.23	0.0028	0.0022	0.0032	0.78	0.00005	0.96	0.001	0.0048	0.015	0.05	0.0044	0.43	79	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,341	1.4	0.000038	0.00038	0.017	0.005	0.01	3.9	0.49	0.089	186,716
2138	9.2	1,565	1,622	17	0.24	0.0028	0.0022	0.0032	0.78	0.00005	0.94	0.001	0.0047	0.015	0.05	0.0043	0.43	79	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,342	1.4	0.000038	0.00038	0.017	0.005	0.01	3.8	0.49	0.088	186,790
2139	9.2	1,549	1,640	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.92	0.001	0.0046	0.015	0.05	0.0043	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.055	2.8	0.000037	1,341	1.4	0.000037	0.00037	0.017	0.005	0.01	3.8	0.49	0.088	187,056
2140	9.2	1,540	1,650	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.91	0.001	0.0046	0.015	0.05	0.0042	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.054	2.8	0.000037	1,341	1.4	0.000037	0.00037	0.016	0.005	0.01	3.8	0.49	0.088	187,514
2141	9.2	1,528	1,664	17	0.26	0.0027	0.0022	0.0033	0.78	0.00005	0.89	0.001	0.0045	0.015	0.05	0.0042	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.054	2.8	0.000037	1,340	1.4	0.000037	0.00037	0.016	0.005	0.01	3.9	0.49	0.089	186,895
2142	9.2	1,522	1,670	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.89	0.001	0.0045	0.015	0.05	0.0041	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000037	1,340	1.4	0.000037	0.00037	0.016	0.005	0.01	3.9	0.49	0.089	186,886
2143	9.2	1,512	1,682	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.001	0.0044	0.015	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.052	2.8	0.000036	1,339	1.4	0.000036	0.00036	0.016	0.005	0.01	3.9	0.49	0.089	187,034
2144	9.2	1,507	1,687	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.87	0.001	0.0043	0.014	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.051	2.8	0.000036	1,338	1.4	0.000036	0.00036	0.016	0.005	0.01	3.9	0.49	0.089	187,551
2145	9.2	1,498	1,697	17	0.26	0.0026	0.0021	0.0034	0.78	0.00005	0.87	0.001	0.0042	0.014	0.05	0.0039	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.05	2.8	0.000036	1,337	1.4	0.000036	0.00036	0.016	0.005	0.01	3.9	0.49	0.089	187,019
2146	9.2	1,494	1,701	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.0042	0.014	0.05	0.0038	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.049	2.8	0.000036	1,337	1.4	0.000036	0.00036	0.016	0.005	0.01	3.9	0.49	0.089	187,081
2147	9.2	1,486	1,709	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.0041	0.014	0.05	0.0037	0.43	83	0.017	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000036	1,336	1.4	0.000036	0.00036	0.016	0.005	0.01	3.8	0.48	0.088	187,212
2148	9.2	1,483	1,714	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.004	0.014	0.05	0.0037	0.42	84	0.016	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000036	1,335	1.4	0.000036	0.00036	0.016	0.005	0.01	3.8	0.48	0.087	187,667
2149	9.2	1,477	1,721	17	0.27	0.0026	0.002	0.0034	0.78	0.00005	0.85	0.001	0.0039	0.014	0.05	0.0036	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000036	1,335	1.4	0.000036	0.00036	0.016	0.005	0.01	3.7	0.46	0.084	187,030
2150	9.2	1,474	1,724	17	0.27	0.0026	0.0019	0.0034	0.78	0.00005	0.85	0.001	0.0039	0.014	0.05	0.0035	0.43	85	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000035	1,335	1.4	0.000035	0.00035	0.016	0.005	0.01	3.6	0.45	0.082	186,985

Table A10. Annual loads of the NAG backfill for the high nitrogen scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m³/year
2023	29	0.2	0.69	0.0037	0.000052	0.000029	0.000055	0.032	0.0000012	0.67	0.000024	0.00014	0.000097	0.0012	0.0000024	0.017	0.49	0.00081	0.00000012	0.00098	0.00018	0.011	0.99	0.0027	0.12	0.0000007	12	0.056	0.0000007	0.000007	0.00031	0.00012	0.00024	2.5	0.31	0.057	24
2024	53	0.37	1.3	0.0067	0.000094	0.000053	0.0001	0.057	0.0000022	1.2	0.000044	0.00025	0.00018	0.0022	0.0000044	0.031	0.89	0.0015	0.00000022	0.0018	0.00033	0.02	1.8	0.0048	0.21	0.0000013	22	0.1	0.0000013	0.000013	0.00057	0.00022	0.00044	4.5	0.57	0.1	44
2025	97	0.68	2.3	0.012	0.00017	0.000097	0.00018	0.11	0.000004	2.2	0.00008	0.00046	0.00032	0.004	0.0000081	0.058	1.6	0.0027	0.000004	0.0033	0.0006	0.037	3.3	0.0089	0.38	0.0000023	41	0.18	0.0000023	0.000023	0.001	0.0004	0.0008	8.2	1.0	0.19	80
2026	152	1.1	3.6	0.019	0.00027	0.00015	0.00029	0.16	0.0000063	3.5	0.00013	0.00072	0.0005	0.0063	0.0000013	0.09	2.5	0.0042	0.00000063	0.0051	0.00093	0.057	5.1	0.014	0.6	0.0000036	64	0.29	0.0000036	0.000036	0.0016	0.00063	0.0013	13	1.6	0.3	125
2027	191	1.3	4.5	0.024	0.00034	0.00019	0.00036	0.21	0.0000079	4.4	0.00016	0.0009	0.00063	0.0079	0.0000016	0.11	3.2	0.0053	0.00000079	0.0064	0.0012	0.072	6.5	0.017	0.75	0.0000046	81	0.36	0.0000046	0.000046	0.002	0.00079	0.0016	16	2.0	0.37	158
2028	349	2.4	8.2	0.044	0.00062	0.00035	0.00066	0.38	0.0000014	8.0	0.00029	0.0017	0.0012	0.014	0.000029	0.21	5.8	0.0097	0.0000014	0.012	0.0021	0.13	12	0.032	1.4	0.0000084	147	0.66	0.0000084	0.000084	0.0037	0.0014	0.0029	30	3.7	0.68	289
2029	326	2.3	7.7	0.041	0.00057	0.00032	0.00062	0.35	0.0000013	7.5	0.00027	0.0015	0.0011	0.013	0.0000027	0.19	5.5	0.0091	0.0000013	0.011	0.002	0.12	11	0.03	1.3	0.0000078	138	0.62	0.0000078	0.000078	0.0035	0.0013	0.0027	28	3.5	0.63	270
2030	421	2.9	9.9	0.053	0.00074	0.00042	0.0008	0.45	0.0000017	9.7	0.00035	0.002	0.0014	0.017	0.000035	0.25	7.0	0.012	0.0000017	0.014	0.0026	0.16	14	0.038	1.7	0.00001	178	0.8	0.00001	0.0001	0.0045	0.0017	0.0035	36	4.5	0.82	348
2031	2,706	19	64	0.34	0.0048	0.0027	0.0051	2.9	0.00011	62	0.0022	0.013	0.0089	0.11	0.00022	1.6	45	0.075	0.000011	0.091	0.017	1.0	91	0.25	11	0.000065	1,141	5.1	0.000065	0.00065	0.029	0.011	0.022	229	29	5.3	2,236
2032	4,396	31	104	0.56	0.0078	0.0044	0.0083	4.7	0.00018	101	0.0036	0.021	0.015	0.18	0.00036	2.6	73	0.12	0.000018	0.15	0.027	1.7	149	0.4	17	0.0011	1,854	8.3	0.00011	0.0011	0.047	0.018	0.036	372	47	8.5	3,634
2033	750	5.2	18	0.095	0.0013	0.00075	0.0014	0.81	0.0000031	17	0.00062	0.0035	0.0025	0.031	0.0000062	0.44	13	0.021	0.0000031	0.025	0.0046	0.28	25	0.068	3.0	0.000018	316	1.4	0.000018	0.00018	0.008	0.0031	0.0062	63	8.0	1.5	620
2034	3,015	21	71	0.38	0.0053	0.003	0.0057	3.3	0.00012	69	0.0025	0.014	0.01	0.12	0.000025	1.8	50	0.084	0.000012	0.1	0.019	1.1	102	0.28	12	0.000072	1,271	5.7	0.000072	0.00072	0.032	0.012	0.025	255	32	5.9	2,492
2035	8,571	60	202	1.1	0.015	0.0085	0.016	9.3	0.00035	197	0.0071	0.041	0.028	0.35	0.00071	5.1	143	0.24	0.000035	0.29	0.053	3.2	290	0.78	34	0.00021	3,614	16	0.00021	0.0021	0.092	0.035	0.071	725	92	17	7,085
2036	14,618	102	345	1.9	0.026	0.015	0.028	16	0.0006	336	0.012	0.069	0.048	0.6	0.0012	8.7	244	0.41	0.00006	0.49	0.09	5.5	494	1.3	58	0.00035	6,163	28	0.00035	0.0035	0.16	0.06	0.12	1,236	156	28	12,083
2037	16,289	113	385	2.1	0.029	0.016	0.031	18	0.00067	374	0.013	0.077	0.054	0.67	0.0014	9.6	272	0.45	0.000067	0.55	0.1	6.2	551	1.5	64	0.00039	6,868	31	0.00039	0.0039	0.17	0.067	0.13	1,377	174	32	13,464
2038	32,606	227	770	4.1	0.057	0.032	0.062	35	0.0013	749	0.027	0.15	0.11	1.3	0.0027	19	545	0.91	0.00013	1.1	0.2	12	1,102	3.0	128	0.00078	13,748	62	0.00078	0.0078	0.35	0.13	0.27	2,757	349	63	26,952
2039	59,768	3,889	1,312	0.43	0.11	0.058	0.1	60	0.0023	1,430	0.046	0.27	0.18	2.3	0.015	33	1,040	1.5	0.00023	2.0	0.37	21	1,878	5.0	219	0.0014	26,682	105	0.0014	0.014	0.64	0.23	0.46	4,560	577	105	45,912
2040	115,810	17,792	2,260	1.3	0.2	0.11	0.18	103	0.004	2,717	0.079	0.45	0.32	4.0	0.065	57	2,136	2.5	0.0004	3.9	0.71	36	3,235	8.2	377	0.0028	56,264	182	0.0028	0.028	1.2	0.4	0.79	6,967	881	160	79,056
2041	167,259	41,951	3,172	3.1	0.29	0.16	0.25	145	0.0055	1,465	0.11	0.46	0.89	5.5	0.18	79	3,331	2.4	0.00055	5.6	0.98	51	4,540	7.5	529	0.004	91,088	255	0.004	0.04	1.8	0.55	1.1	4,991	631	115	110,907
2042	181,534	50,979	3,172	3.8	0.32	0.19	0.31	145	0.0064	1,508	0.13	0.39	1.1	6.4	0.25	79	3,653	1.8	0.00064	6.1	1.0	51	4,539	5.4	529	0.0044	101,408	255	0.0044	0.044	1.9	0.64	1.3	2,152	272	49	128,839
2043	183,623	51,985	3,171	3.9	0.32	0.19	0.32	145	0.0067	1,598	0.13	0.35	1.1	6.7	0.27	79	3,688	1.5	0.00067	6.2	1.0	51	4,539	4.6	529	0.0044	102,699	255	0.0044	0.044	2.0	0.67	1.3	1,212	153	28	133,866
2044	184,376	51,422	3,171	3.8	0.33	0.2	0.33	145	0.0068	1,711	0.14	0.35	1.1	6.8	0.27	79	3,693	1.5	0.00068	6.2	1.0	51	4,539	4.6	529	0.0044	102,665	255	0.0044	0.044	2.0	0.68	1.4	1,333	169	31	136,575
2045	187,181	52,658	3,172	3.9	0.33	0.2	0.32	145	0.0067	1,574	0.13	0.37	1.1	6.7	0.27	79	3,765	1.6	0.00067	6.3	1.1	51	4,539	4.9	529	0.0045	104,596	255	0.0045	0.045	2.0	0.67	1.3	1,614	204	37	133,758
2046	186,758	51,405	3,172	3.8	0.33	0.2	0.3	145	0.0064	1,506	0.13	0.39	1.1	6.4	0.3	79	3,749	1.7	0.00064	6.3	1.1	51	4,540	5.1	529	0.0045	103,927	255	0.0045	0.045	2.0	0.64	1.3	1,560	197	36	128,763
2047	201,983	52,505	3,173	3.8	0.36	0.22	0.29	145	0.0064	1,495	0.13	0.44	1.1	6.4	0.37	80	4,017	1.9	0.00064	6.8	1.4	51	4,541	5.6	529	0.0048	111,227	255	0.0049	0.049	2.2	0.64	1.3	1,157	146	27	128,089
2048	222,440	55,777	3,173	3.9	0.39	0.25	0.28	145	0.0065	1,455	0.13	0.52	1.1	6.5	0.45	80	4,406	2.2	0.00065	7.5	1.6	51	4,542	6.5	529	0.0053	121,828	255	0.0054	0.053	2.4	0.65	1.3	1,115	141	26	129,793
2049	232,908	58,594	3,174	4.1	0.41	0.27	0.28	145	0.0066	1,399	0.13	0.59	1.2	6.6	0.5	80	4,623	2.5	0.00066	7.8	1.9	51	4,542	7.3	529	0.0056	127,787	255	0.0056	0.056	2.5	0.66	1.3	1,209	153	28	131,172
2050	239,498	59,850	3,174	4.2	0.42	0.29	0.28	145	0.0066	1,406	0.13	0.63	1.2	6.6	0.55	80	4,749	2.6	0.00066	8.1	2.0	51	4,543	7.7	529	0.0057	131,275	255	0.0058	0.058	2.6	0.66	1.3	1,052	133	24	132,811
2051	243,292	60,490	3,174	4.2	0.43	0.3	0.28	145	0.0067	1,419	0.13	0.64	1.2	6.7	0.58	80	4,816	2.7	0.00067	8.2	2.1	51	4,543	7.8	529	0.0058	133,239	255	0.0058	0.059	2.6	0.67	1.3	814	103	19	133,964
2052	246,757	61,046	3,174	4.3	0.44	0.3	0.28	145	0.0068	1,433	0.14	0.65	1.2	6.8	0.61	80	4,878	2.7	0.00068	8.3	2.2	51	4,543	7.7	529	0.0059	135,022	255	0.0059	0.059	2.6	0.68	1.4	510	64	12	135,076
2053	248,235	61,113	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,436	0.14	0.66	1.2	6.8	0.62	80	4,900	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.0059	135,713	255	0.006	0.06	2.7	0.68	1.4	262	33	6.0	135,145
2054	249,944	61,330	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,448	0.14	0.66	1.2	6.8	0.63	80	4,930	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.006	136,555	255	0.006	0.06	2.7	0.68	1.4	185	23	4.2	135,795
2055	252,972	61,615	3,174	4.3	0.45	0.32	0.29	145	0.0068	1,465	0.14	0.68	1.2	6.8	0.65	80	4,984	2.7	0.00068	8.5	2.3	51	4,543	8.0	529	0.0061	138,022	255	0.0061	0.061	2.7	0.68	1.5	191	24	4.4	136,601
2056	248,809	75,807	3,175	5.3	0.44	0.31	0.3	145	0.0069	1,019	0.14	0.67	1.4	6.9	0.63	80	5,234	2.7	0.00069	8.4	2.2	51	4,544	7.8	529	0.006	142,580	255	0.006	0.06	2.7	0.69	1.4	224	28	5.2	137,439
2057	238,664	97,994	3,175	7.1	0.42	0.3	0.32	145	0.0069	642	0.14	0.61	1.8	6.9	0.58	80	5,609	2.5	0.00069	8.0	2.1	51	4,544	7.2	530	0.0057	147,637	255	0.0057	0.057	2.5	0.69	1.4	265	34	6.1	137,940
2058	232,800	110,780	3,176	8.2	0.41	0.28	0.33	145	0.0069	519	0.14	0.58	2.0	6.9	0.54	80	5,859	2.3	0.00069	7.8	1.9	51	4,545	6.7	530	0.0056	150,367	255	0.0056	0.056	2.5	0.69	1.4	314	40	7.2	138,218
2059	231,450	115,170	3,176	8.6	0.41	0.28	0.34	145	0.0069	487	0.14	0.57	2.0	6.9	0.53	80	5,973	2.3	0.00069	7.8	1.9	51	4,545	6.6	530	0.0055	151,559	255	0.0056	0.056	2.5	0.69	1.4	370	47	8.5	138,460
2060	233,135	116,900	3,176	8.7	0.41	0.28	0.34	145	0.007	485	0.14	0.57	2.0	7.0	0.53	80	6,057	2.3	0.0007	7.8	1.9	51	4,545	6.7	530	0.0056	153,010	255	0.0056	0.056	2.5	0.7	1.4	436	55	10	139,518
2061	234,102	116,981	3,176	8.7	0.41	0.28	0.34	145	0.007	488	0.14	0.58	2.0	7.0	0.53	80	6,083	2.4	0.0007	7.9	1.9	51	4,545	6.9	530	0.0056	153,444	255	0.0056	0.056	2.5	0.7	1.4	509	64	12	139,838
2062	233,986	122,647	3,176	9.2	0.41	0.28	0.35	145	0.007	457	0.14	0.58	2.0	7.0	0.53	80	6,200	2.4	0.0007	7.9	1.9	51	4,546	6.9	530	0.0056	155,812	255	0.0056	0.056	2.5	0.7	1.4	590	75	14	140,676
2063	232,497	128,575	3,176	9.9	0.41	0.28	0.36	145	0.0071	422	0.14	0.57	2.0	7.1	0.51	80	6,344	2.3	0.00071	7.8	1.8	51	4,546	6.8	530	0.0056	157,594	255	0.0056	0.056	2.5	0.71	1.4	678	86	16	141,568
2064	233,632	130,611	3,176	9.9	0.41	0.28	0.36	145	0.0071	426	0.14	0.57	2.0	7.1	0.51	80	6,427	2.4	0.00071	7.9	1.8	51	4,546	6.9	530	0.0056	158,910	255	0.0056	0.056	2.5	0.71	1.4	773	98	18	142,789
2065	234,589	136,385	3,176	13	0.41	0.28	0.37	145	0.0072	343	0.14	0.57	2.0	7.2	0.5	80	6,581	2.4	0.00072	7.9	1.8	51	4,546	6.9	530	0.0056	161,808	255	0.0056	0.056	2.5	0.72	1.4	871	110	20	143,409
2066	232,604	143,755	3,176	15	0.41	0.28	0.38	145	0.0072	307	0.14	0.56	2.0	7.2	0.49	80	6,736	2.3	0.00072	7.8	1.8	51	4,546	6.9	530	0.0056	163,990	255	0.0056	0.056	2.5	0.72	1.4	976	123	22	144,573
2067	231,421	149,117	3,177	16	0.41	0.27	0.39	145	0.0073	293	0.15	0.56	2.0	7.3	0.49	80	6,873	2.3	0.00073	7.8	1.8	51	4,546	6.9	530	0.0055	165,642	255	0.0056	0.056	2.5	0.73	1.5	1,086	137	25	145,722
2068	232,959	152,880	3,177	16	0.41	0.28	0.39	145	0.0074	294	0.15	0.56	2.0	7.4	0.48	80	7,026	2.4	0.00074	7.8	1.8	51	4,546	7.0	530	0.0056	167,815	255	0.0056	0.056	2.5	0.74	1.5	1,196	151	27	147,284
2069	233,639	155,103	3,177	16	0.41	0.27	0.4	145	0.0074	299	0.15	0.56	2.0	7.4	0.48	80	7,131	2.4	0.00074	7.8	1.8	51	4,546	7.0	530	0.0056	168,960	255	0.0056	0.056	2.5	0.74	1.5	1,287	163	30	148,041
2070	236,312	156,526	3,177	15	0.42	0.28	0.4	145	0.0075	311	0.15	0.57	2.0	7.5	0.48	80	7,234	2.4	0.00075	8.0	1.8	51	4,547	7.1	530	0.0057	170,682	255	0.0057	0.057	2.5	0.75	1.5	1,328	168	31	149,328
2071	238,190	157,850	3,177	14	0.42	0.28	0.4	145	0.0075	323	0.15	0.57	2.0	7.5	0.49	80	7,324	2.4	0.00075	8.0	1.8	51	4,547	7.1	530	0.0057	172,012	255	0.0057	0.057	2.5	0.75	1.5	1,269	160	29	150,505
2072	242,807	159,755	3,177	16	0.43	0.29	0.41	145	0.0076	307	0.15	0.58	2.0	7.6	0.5	80	7,442	2.4	0.00076	8.2	1.8	51	4,547	7.1	530	0.0058	174,885	255	0.0058	0.058	2.6	0.76	1.5	1,151	146	26	151,916
2073	244,657	159,770	3,177	15	0.43	0.29	0.4	145	0.0076	315	0.15	0.59	2.1	7.6	0.51	80	7,481	2.5	0.00076	8.2	1.9	51	4,547	7.2	530	0.0059	175,699	255	0.0059	0.059	2.6	0.76	1.5	1,061	134	24	152,292
2074	247,171	160,010	3,177	15	0.44	0.29	0.41	145	0.0077	327	0.15	0.6	2.1	7.7	0.53	80	7,527	2.5	0.00077	8.3	1.9	51	4,547	7.3	530	0.0059	176,912	255	0.0059	0.059	2.6	0.77	1.5	1,038	131	24	153,237
2075	249,872	159,970	3,177	14	0.44	0.3	0.4	145	0.0077	340	0.15	0.62	2.1	7.7	0.54	80	7,572	2.6	0.00077	8.4	2.0	51	4,547	7.5	530	0.006	178,095	255	0.006	0.06	2.7	0.77	1.5	1,018	129	23	153,995
2076	255,542	161,841	3,177	17	0.45	0.31	0.41	145	0.0078	305	0.16	0.64	2.1	7.8	0.56	80	7,693	2.7	0.00078	8.6	2.0	51	4,547	7.8	530	0.0061	181,465	255	0.0062	0.061	2.7	0.78	1.6	1,053	133	24	155,005
2077	258,637	161,819	3,177	17	0.46	0.32	0.4	145	0.0078	309	0.16	0.66	2.2	7.8	0.58	80	7,740	2.8	0.00078	8.7	2.1	51	4,547	8.1	530	0.0062	182,839	255	0.0062	0.062	2.8	0.78	1.6	1,091	138	25	155,356
2078	262,179	162,204	3,177	17	0.46	0.32	0.4	145	0.0078	316	0.16	0.69	2.2	7.8	0.61	80	7,803	2.9	0.00078	8.8	2.2	51	4,547	8.4	530	0.0062	184,593	255	0.0063	0.063	2.8	0.78	1.6	1,141	144	26	156,236
2079	265,408	163,840	3,177	17	0.47	0.33	0.41	145	0.0079	317	0.16	0.71	2.2	7.9	0.63	80	7,891	3.0	0.00079	8.9	2.3	51	4,547	8.7	530	0.0063	186,720	255	0.0064	0.064	2.8	0.79	1.6	1,172	148	27	157,251
2080	268,368	166,029	3,177	17	0.47	0.34	0.41	145	0.0079	319	0.16	0.74	2.3	7.9	0.65	80	7,996	3.1	0.00079	9.0	2.4	51	4,547	9.0	530	0.0064	188,943	255	0.0064	0.065	2.9	0.79	1.6	1,173	148	27	158,470
2081	270,820	166,272	3,177	17	0.48	0.35	0.41	145	0.0079	325	0.16	0.76	2.3	7.9	0.67	80	8,048	3.1	0.00079	9.1	2.4	51	4,548	9.2	530	0.0064	190,130	255	0.0065	0.065	2.9	0.79	1.6	1,193	151	27	158,838
2082	271,220	170,249	3,177	18	0.48	0.35	0.41	145	0.008	314	0.16	0.77	2.3	8.0	0.68	80	8,156	3.2	0.0008	9.1	2.5	51	4,548	9.3	530	0.0064	191,952	255	0.0065	0.065	2.9	0.8	1.6	1,162	147	27	159,814
2083	270,326	173,983	3,178	18	0.48	0.35	0.42	145	0.008	306	0.16	0.78	2.3	8.0	0.69	80	8,253	3.2	0.0008	9.1	2.5	51	4,548	9.4	530	0.0064	193,053	255	0.0065	0.065	2.9	0.8	1.6	1,183	150	27	160,383
2084	272,779	176,556	3,178	18	0.48	0.36	0.42	145	0.0081	310	0.16	0.79	2.3	8.1	0.7	80	8,381	3.3	0.00081	9.2	2.6	51	4,548	9.6	530	0.0065	195,161	255	0.0066	0.066	2.9	0.81	1.6	1,171	148	27	161,637
2085	272,007	178,451	3,178	18	0.48	0.36	0.42	145	0.0081	310	0.16	0.79	2.3	8.1	0.7	80	8,453	3.3	0.00081	9.2	2.6	51	4,548	9.7	530	0.0064	195,547	255	0.0065	0.065	2.9	0.81	1.6	1,198	151	28	161,890
2086	274,151	180,017	3,178	18	0.48	0.37	0.43	145	0.0081	317	0.16	0.81	2.4	8.1	0.72	80	8,558	3.3	0.00081	9.2	2.6	51	4,548	9.8	530	0.0065	197,076	255	0.0066	0.066	2.9	0.81	1.6	1,170	148	27	162,778
2087	274,417	181,762	3,178	17	0.48	0.37	0.43	145	0.0082	322	0.16	0.8	2.4	8.2	0.72	80	8,648	3.3	0.00082	9.2	2.6	51	4,548	9.8	530	0.0065	197,831	255	0.0066	0.066	2.9	0.82	1.6	1,182	149	27	163,470
2088	278,238	184,154	3,178	19	0.49	0.37	0.43	145	0.0082	308	0.16	0.81	2.4	8.2	0.73	80	8,795	3.4	0.00082	9.4	2.6	51	4,548	9.9	530	0.0066	200,479	255	0.0067	0.067	3.0	0.82	1.7	1,114	141	26	164,570
2089	278,070	188,038	3,178	22	0.49	0.37	0.44	145	0.0082	278	0.16	0.81	2.4	8.2	0.72	80	8,919	3.3	0.00082	9.4	2.6	51	4,548	9.8	530	0.0066	201,978	255	0.0067	0.067	3.0	0.82	1.7	1,110	140	26	164,772
2090	277,778	191,572	3,178	22	0.49	0.37	0.44	145	0.0083	272	0.17	0.81	2.4	8.3	0.73	80	9,044	3.3	0.00083	9.3	2.6	51	4,549	9.7	530	0.0066	203,237	255	0.0067	0.067	3.0	0.83	1.7	1,042	132	24	165,462
2091	278,395	193,905	3,178	22	0.49	0.37	0.45	145	0.0083	273	0.17	0.81	2.4	8.3	0.72	80	9,165	3.3	0.00083	9.4	2.6	51	4,549	9.7	530	0.0066	204,381	255	0.0067	0.067	3.0	0.83	1.7	1,058	134	24	166,285
2092	280,457	196,798	3,178	22	0.49	0.37	0.45	145	0.0084	275	0.17	0.81	2.4	8.4	0.73	80	9,323	3.3	0.00084	9.4	2.6	51	4,549	9.8	530	0.0067	206,401	255	0.0067	0.067	3.0	0.84	1.7	1,046	132	24	167,587
2093	278,867	200,885	3,178	23	0.49	0.37	0.46	145	0.0084	266	0.17	0.8	2.4	8.4

Table A10. Annual loads of the NAG backfill for the high nitrogen scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2135	293,380	298,007	3,182	43	0.52	0.42	0.59	145	0.0093	180	0.19	0.89	2.8	9.3	0.82	80	14,476	3.6	0.00093	9.9	2.9	51	4,554	11	531	0.0071	249,369	256	0.0071	0.071	3.1	0.93	1.9	729	92	17	186,569
2136	294,116	300,087	3,182	44	0.52	0.42	0.59	145	0.0094	180	0.19	0.88	2.8	9.4	0.82	80	14,627	3.6	0.00094	9.9	2.9	51	4,554	10	531	0.0071	250,409	256	0.0071	0.071	3.1	0.94	1.9	720	91	17	187,180
2137	294,526	299,791	3,182	43	0.52	0.42	0.59	145	0.0093	180	0.19	0.89	2.8	9.3	0.82	80	14,660	3.6	0.00093	9.9	2.9	51	4,554	11	531	0.0071	250,386	256	0.0071	0.071	3.1	0.93	1.9	719	91	17	186,716
2138	292,307	302,917	3,182	45	0.52	0.41	0.59	145	0.0093	175	0.19	0.88	2.8	9.3	0.81	80	14,758	3.6	0.00093	9.8	2.9	51	4,554	10	531	0.007	250,579	256	0.007	0.07	3.1	0.93	1.9	718	91	17	186,790
2139	289,713	306,716	3,182	46	0.51	0.41	0.6	145	0.0094	171	0.19	0.87	2.8	9.4	0.8	80	14,875	3.5	0.00094	9.7	2.9	51	4,554	10	531	0.007	250,880	256	0.007	0.07	3.1	0.94	1.9	719	91	17	187,056
2140	288,790	309,416	3,182	47	0.51	0.41	0.61	145	0.0094	170	0.19	0.86	2.8	9.4	0.79	80	15,004	3.5	0.00094	9.7	2.8	51	4,554	10	531	0.007	251,418	256	0.0069	0.069	3.1	0.94	1.9	722	91	17	187,514
2141	285,594	310,955	3,182	48	0.5	0.4	0.61	145	0.0093	167	0.19	0.84	2.7	9.3	0.78	80	15,062	3.4	0.00093	9.6	2.8	51	4,554	10	531	0.0069	250,495	256	0.0069	0.069	3.0	0.93	1.9	721	91	17	186,895
2142	284,497	312,138	3,182	48	0.5	0.4	0.61	145	0.0093	166	0.19	0.84	2.7	9.3	0.77	80	15,125	3.4	0.00093	9.6	2.8	51	4,555	10	531	0.0068	250,391	256	0.0068	0.068	3.0	0.93	1.9	722	91	17	186,886
2143	282,701	314,516	3,182	48	0.5	0.39	0.62	145	0.0094	164	0.19	0.82	2.7	9.4	0.75	80	15,260	3.3	0.00094	9.5	2.7	51	4,555	10	531	0.0068	250,382	256	0.0068	0.068	3.0	0.94	1.9	724	91	17	187,034
2144	282,564	316,417	3,182	49	0.5	0.39	0.62	145	0.0094	164	0.19	0.81	2.7	9.4	0.75	80	15,365	3.3	0.00094	9.5	2.7	51	4,555	10	531	0.0068	250,980	256	0.0068	0.068	3.0	0.94	1.9	726	92	17	187,551
2145	280,098	317,409	3,183	49	0.49	0.38	0.63	145	0.0094	162	0.19	0.79	2.7	9.4	0.72	80	15,447	3.2	0.00094	9.4	2.6	51	4,555	9	531	0.0067	250,100	256	0.0067	0.067	3.0	0.94	1.9	724	91	17	187,019
2146	279,425	318,300	3,183	49	0.49	0.38	0.63	145	0.0094	162	0.19	0.78	2.7	9.4	0.72	80	15,509	3.2	0.00094	9.4	2.6	51	4,555	9.2	531	0.0067	250,071	256	0.0067	0.067	3.0	0.94	1.9	723	91	17	187,081
2147	278,254	320,021	3,183	49	0.49	0.38	0.63	145	0.0094	161	0.19	0.76	2.7	9.4	0.7	80	15,631	3.1	0.00094	9.4	2.5	51	4,555	9.0	531	0.0067	250,059	256	0.0067	0.067	3.0	0.94	1.9	716	91	16	187,212
2148	278,291	321,567	3,183	50	0.49	0.37	0.64	145	0.0094	161	0.19	0.75	2.7	9.4	0.69	80	15,727	3.1	0.00094	9.4	2.5	51	4,555	8.9	531	0.0067	250,610	256	0.0067	0.067	3.0	0.94	1.9	712	90	16	187,667
2149	276,225	321,860	3,183	50	0.49	0.37	0.64	145	0.0094	159	0.19	0.73	2.6	9.4	0.67	80	15,781	3.0	0.00094	9.3	2.4	51	4,555	8.7	531	0.0066	249,667	256	0.0066	0.066	2.9	0.94	1.9	687	87	16	187,030
2150	275,653	322,343	3,183	50	0.49	0.36	0.64	145	0.0093	159	0.19	0.72	2.6	9.3	0.66	80	15,824	2.9	0.00093	9.3	2.4	51	4,555	8.6	531	0.0066	249,532	256	0.0066	0.066	2.9	0.93	1.9	669	85	15	186,985

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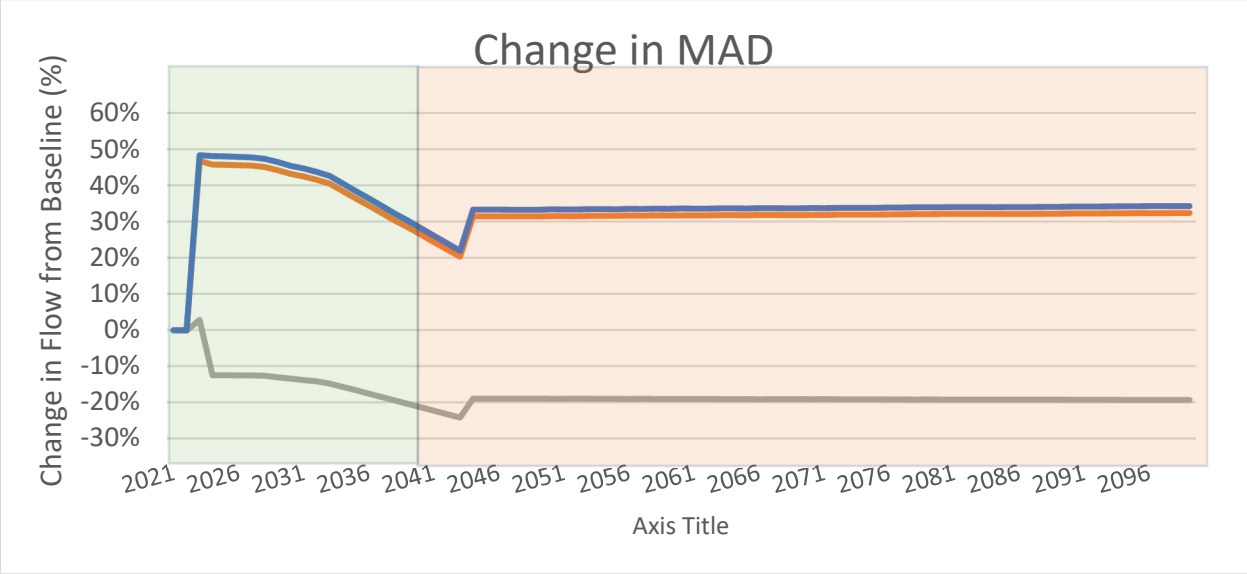
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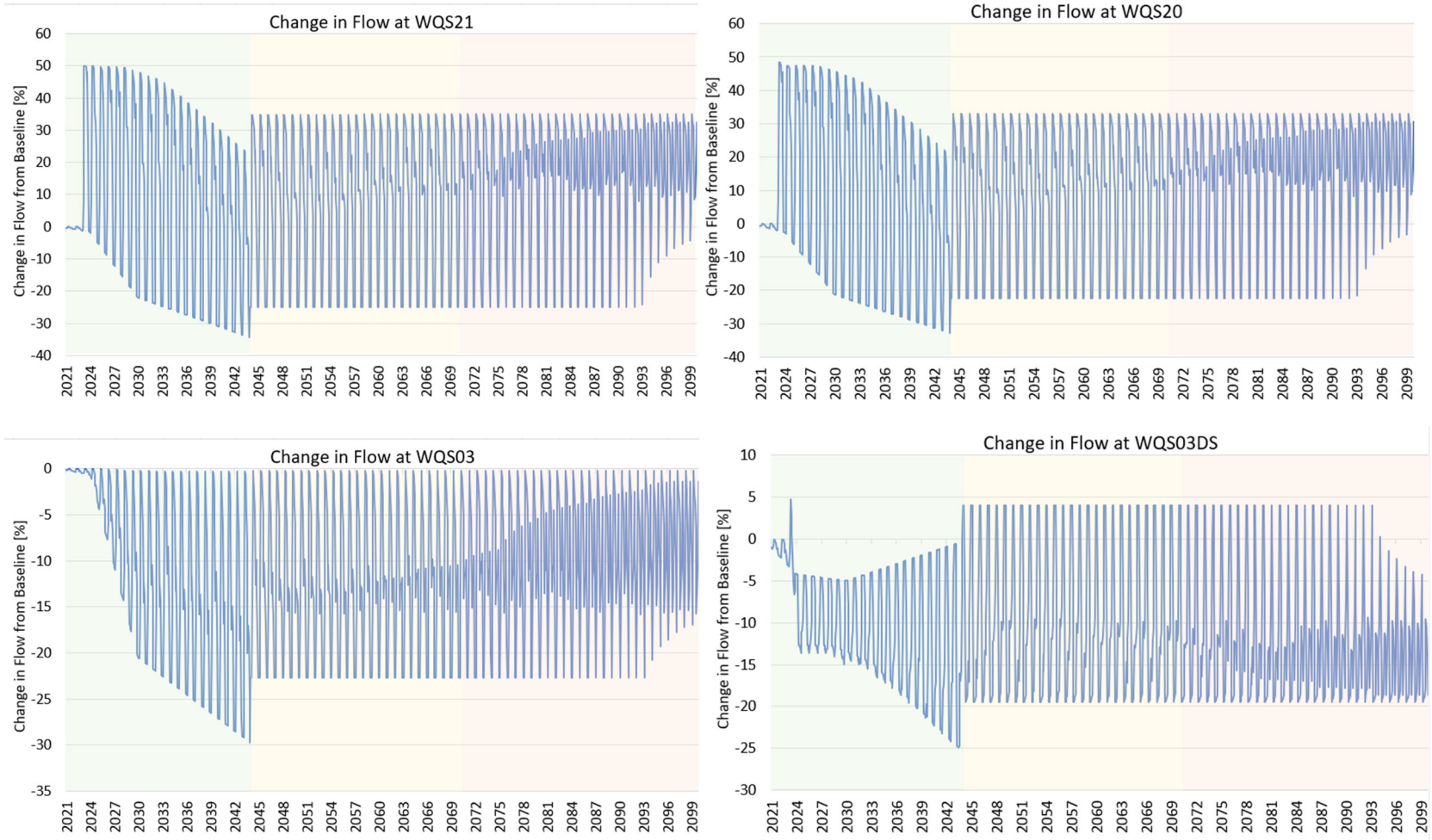
Appendix F Water Quantity Results for Project Case and Alternative Cases

Figure F-1. Four Creek Streamflow Effect to Mean Annual Discharge relative to Base Case Conditions



Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_ChangetoMAD_20250722_CCM.xlsx?web=1

Figure F-2: Four Creek Streamflow Effect to Monthly Average Discharge relative to Base Case Conditions in the Project Case



Source:

*https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/*WaterQuantity_Results_20250725_CCM.xlsm?web=1

Table F-1: Tenas Creek Project Case Streamflow Effect as Monthly Change over Base Case Conditions

Scenario		Tenas Creek Monthly % Change											
		WQS01			WQS02			WQS22			WQS04		
Period	Month	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease
Construction	January	-	0.0	-	-	-0.3	-	-	-0.3	-	-	-0.2	-
	February	-	0.0	-	-	-0.3	-	-	-0.3	-	-	-0.3	-
	March	-	0.0	-	-	-0.3	-	-	-0.2	-	-	-0.2	-
	April	-	0.0	-	-	0.0	-	-	0.0	-	-	0.0	-
	May	-	0.0	-	-	0.0	-	-	0.0	-	-	0.0	-
	June	-	0.0	-	-	0.0	-	-	0.0	-	-	0.0	-
	July	-	0.0	-	-	0.0	-	-	0.0	-	-	0.0	-
	August	-	0.0	-	-	0.0	-	-	0.0	-	-	0.0	-
	September	-	0.0	-	-	-0.1	-	-	-0.1	-	-	-0.1	-
	October	-	0.0	-	-	-0.1	-	-	-0.1	-	-	-0.1	-
	November	-	0.0	-	-	-0.5	-	-	-0.5	-	-	-0.4	-
	December	-	0.0	-	-	-0.6	-	-	-0.5	-	-	-0.5	-
Operations	January	-	-0.2	-0.4	1.3	-1.5	-3.9	2.8	-1.8	-5.9	2.7	-1.7	-5.5
	February	-	-0.2	-0.4	1.4	-1.5	-3.9	2.8	-1.8	-5.8	2.7	-1.7	-5.5
	March	-	-0.2	-0.4	1.0	-1.5	-3.9	-	-4.8	-8.5	-	-4.7	-8.3
	April	-	0.0	-	0.0	-1.4	-1.6	0.0	-7.6	-10.4	-	-8.4	-11.0
	May	-	0.0	-	0.0	-1.4	-1.5	0.0	-6.3	-7.2	-	-7.2	-8.1
	June	-	0.0	-	0.0	-1.4	-1.5	0.0	-4.9	-5.5	-	-6.0	-6.8
	July	-	0.0	-	0.0	-1.4	-1.7	0.0	-5.0	-6.0	-	-6.1	-7.2
	August	-	0.0	-	0.0	-1.5	-1.8	0.0	-5.3	-6.8	-	-6.4	-7.8
	September	-	0.0	-0.1	-	-1.5	-2.0	-	-5.4	-7.2	-	-6.5	-8.2
	October	-	0.0	-0.1	-	-1.6	-2.1	-	-6.1	-7.4	-	-7.1	-8.4
	November	-	-0.2	-0.4	0.9	-1.7	-4.0	-	-3.7	-7.3	-	-3.8	-7.3
	December	-	-0.2	-0.4	1.7	-1.4	-3.9	3.4	-1.7	-5.9	3.3	-1.5	-5.5
Post-Closure	January	-	-0.2	-0.3	1.9	0.4	-1.3	3.1	-2.6	-6.8	3.0	-2.7	-6.8
	February	-	-0.3	-0.3	1.9	1.3	-0.9	3.1	1.2	-5.2	3.0	1.1	-5.4
	March	-	-0.2	-0.2	0.8	0.6	0.3	-	-1.5	-2.1	-	-1.6	-2.2
	April	-	0.0	-	-	-1.5	-1.5	-	-6.3	-6.5	-	-6.5	-6.6
	May	-	0.0	-	-	-1.5	-1.5	-	-5.6	-5.9	-	-5.8	-6.1
	June	-	0.0	-	-	-1.4	-1.4	-	-4.2	-4.8	-	-4.5	-5.1
	July	-	0.0	-	-	-1.3	-1.4	-	-4.9	-5.5	-	-5.2	-5.7
	August	-	0.0	-	-	-1.3	-1.4	-	-5.2	-6.0	-	-5.4	-6.2
	September	-	0.0	-	-	-1.2	-1.3	-	-5.0	-6.1	-	-5.3	-6.2
	October	-	0.0	-	-	-1.3	-1.3	-	-5.6	-6.0	-	-5.8	-6.2
	November	-	0.0	-	-	-1.3	-1.4	-	-7.6	-8.2	-	-7.7	-8.2
	December	-	0.0	-0.2	-	-1.2	-1.4	-	-7.2	-9.2	-	-7.3	-9.2

Source:

https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_MonthlyChange_07222025_CCM.xlsm

Table F-2: Goathorn Creek Project Case Streamflow Effect as Monthly Change over Base Case Conditions

Scenario		Goathorn Creek Monthly % Change											
		WQS06US			WQS06			WQSEA1			WQS05		
Period	Month	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease
Construction	January	-	0.00	-	-	-2.58	-	-	-0.08	-	-	-0.12	-
	February	-	0.00	-	-	-2.58	-	-	-0.08	-	-	-0.13	-
	March	-	-0.01	-	-	-2.58	-	-	-0.08	-	-	-0.13	-
	April	-	0.00	-	-	-2.52	-	-	-0.02	-	-	-0.02	-
	May	-	0.00	-	-	-2.50	-	-	0.00	-	-	-0.01	-
	June	-	0.00	-	-	-2.50	-	-	0.00	-	-	-0.01	-
	July	-	0.00	-	-	-2.50	-	-	0.00	-	-	-0.01	-
	August	-	0.00	-	-	-2.51	-	-	0.00	-	-	-0.03	-
	September	-	0.00	-	-	-2.52	-	-	-0.02	-	-	-0.08	-
	October	-	0.00	-	-	-2.54	-	-	-0.04	-	-	-0.10	-
	November	-	-0.01	-	-	-2.64	-	-	-0.14	-	-	-0.22	-
	December	-	-0.01	-	-	-2.65	-	-	-0.15	-	-	-0.23	-
Operations	January	-	-0.1	-0.2	-	-2.8	-3.0	-	-0.3	-0.5	0.6	-0.7	-1.9
	February	-	-0.1	-0.2	-	-2.8	-3.0	-	-0.3	-0.5	0.7	-0.7	-1.9
	March	-	-0.1	-0.2	-	-6.3	-10.0	0.5	-3.8	-7.6	-	-3.6	-4.9
	April	-	0.0	0.0	-	-5.1	-6.8	1.6	-2.6	-4.3	0.0	-5.4	-7.7
	May	-	0.0	0.0	3.8	1.2	-2.5	6.4	3.8	-	0.0	-1.3	-2.1
	June	-	0.0	0.0	1.1	0.3	-2.5	3.7	2.8	-	2.4	0.1	-1.9
	July	-	0.0	0.0	0.7	-0.9	-2.5	3.2	1.6	-	1.8	0.5	-0.9
	August	-	0.0	0.0	-	-2.1	-2.8	1.2	0.5	-0.3	0.0	-1.1	-1.7
	September	-	0.0	-0.1	0.6	-2.2	-3.1	3.2	0.3	-0.6	0.9	-1.8	-3.3
	October	-	0.0	-0.1	3.4	-0.7	-3.0	6.0	1.8	-0.5	2.3	-0.8	-2.2
	November	-	-0.1	-0.2	-	-2.8	-3.0	-	-0.3	-0.5	0.7	-0.7	-1.9
	December	-	-0.1	-0.2	-	-2.8	-3.0	-	-0.3	-0.5	0.8	-0.6	-1.9
Post-Closure	January	-	0.0	-	2.8	-1.4	-2.4	5.4	1.1	-	1.4	0.7	-0.7
	February	-	0.0	-	-	-2.0	-2.2	1.4	0.5	-	1.1	1.0	-
	March	-	0.0	-	2.3	0.9	-0.6	4.8	3.4	-	1.5	0.6	-
	April	-	0.0	-	1.1	0.1	-2.0	3.7	2.6	-	-	-1.6	-2.6
	May	-	0.0	-	-	-2.6	-2.7	0.0	-0.1	-0.2	-	-2.6	-2.8
	June	-	0.0	-	-	-1.9	-2.1	1.0	0.7	-	-	-1.0	-1.2
	July	-	0.0	-	-	-2.4	-2.4	0.2	0.1	-	-	-0.5	-0.6
	August	-	0.0	-	-	-2.1	-2.2	0.5	0.4	-	-	-0.9	-1.1
	September	-	0.0	-	-	-1.8	-2.0	0.9	0.7	-	-	-1.0	-1.3
	October	-	0.0	-	1.7	1.0	-	4.3	3.6	-	1.7	1.3	-
	November	-	0.0	-	8.7	5.1	-	11.3	7.7	-	1.2	-0.6	-2.2
	December	-	0.0	-	5.7	-0.3	-2.2	8.3	2.2	-	0.3	-1.3	-2.0

Source:

https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_MonthlyChange_07222025_CCM.xlsm

Table F-3: Telkwa and Bulkley River Project Case Streamflow Effect as Monthly Change over Base Case Conditions

Scenario		Telkwa River Monthly % Change			Bulkley River Monthly % Change					
		WQS09			WQS11			WQS12		
Period	Month	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease
Construction	January		-0.1			0.0			0.0	
	February		-0.1			0.0			0.0	
	March		-0.1			0.0			0.0	
	April		-0.1			0.0			0.0	
	May		0.0			0.0			0.0	
	June		0.0			0.0			0.0	
	July		0.0			0.0			0.0	
	August		0.0			0.0			0.0	
	September		-0.1			0.0			0.0	
	October		-0.1			0.0			0.0	
	November		-0.2			0.0			0.0	
	December		-0.2			0.0			0.0	
Operations	January	0.6	-0.6	-1.6	0.0	0.0		0.0	0.0	
	February	0.6	-0.6	-1.6	0.0	0.0		0.0	0.0	
	March	0.6	-0.6	-1.6	0.0	0.0		0.0	0.0	-0.1
	April	-	-1.2	-1.7	0.0	0.0		0.0	-0.2	-0.2
	May	0.0	-0.2	-0.3	0.0	0.0		0.0	0.0	
	June	0.2	0.0	-0.2	0.0	0.0		0.0	0.0	
	July	0.2	0.0	-0.2	0.0	0.0		0.0	0.0	
	August	0.0	-0.2	-0.4	0.0	0.0		0.0	0.0	
	September	0.1	-0.3	-0.8	0.0	0.0		0.0	0.0	
	October	0.1	-0.3	-0.8	0.0	0.0		0.0	0.0	
	November	0.7	-0.6	-1.6	0.0	0.0		0.0	0.0	
	December	0.7	-0.5	-1.6	0.0	0.0		0.0	0.0	
Post-Closure	January	1.0	0.8	0.4	0.0	0.0		0.0	0.0	
	February	1.0	0.9	0.8	0.0	0.0		0.0	0.0	
	March	0.7	0.6	0.5	0.0	0.0		0.0	0.0	
	April	-	-0.2	-0.4	0.0	0.0		0.0	0.0	-0.1
	May	-	-0.2	-0.2	0.0	0.0		0.0	0.0	-0.1
	June	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
	July	0.1	0.1	0.1	0.0	0.0		0.0	0.0	
	August	0.2	0.1	0.1	0.0	0.0		0.0	0.0	
	September	0.4	0.4	0.3	0.0	0.0		0.0	0.0	
	October	0.4	0.4	0.3	0.0	0.0		0.0	0.0	
	November	0.7	0.4	0.0	0.0	0.0		0.0	0.0	
	December	1.0	0.5	0.1	0.0	0.0		0.0	0.0	

Source:

https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_MonthlyChange_07222025_CCM.xlsm

Table F-4: Goathorn Creek and Telkwa River Streamflow Effect as Monthly Change for Alternative Case 4 (3 consecutive wet years) over baseline conditions

Project Case		Goathorn Creek		Telkwa River
		WQSEA1	WQS05	WQS09
Period	Month	Maximum Percent Increase over Baseline Conditions [%]	Maximum Percent Increase over Baseline Conditions [%]	Maximum Percent Increase over Baseline Conditions [%]
Operations	January	-	0.6	0.6
	February	-	0.7	0.6
	March	0.5	-	0.6
	April	13.3	0.7	-
	May	6.4	0.0	0.0
	June	3.7	2.4	0.2
	July	3.2	1.8	0.2
	August	1.2	0.0	0.0
	September	3.2	0.9	0.1
	October	5.9	2.3	0.1
	November	-	0.7	0.7
	December	-	0.8	0.7

Source:
https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_MonthlyChange_07222025_CCM.xlsm

Table F-5: Goathorn Creek Project Case Streamflow Effect as Monthly Change over Alternative Case 5 (low flow)

Stream	Node	Baseline 7Q10 [m3/s]	Modelled 7Q10 with Ratio [m3/s]			% Change to 7Q10 over Baseline		
			Construction	Operation	Closure and Post-Closure	Construction	Operation	Closure and Post-Closure
Tenas Creek	WQS01	0.003	0.00	0.00	0.00	-1%	-1%	-1%
	WQS02	0.004	0.00	0.00	0.00	-1%	-4%	1%
	WQS22	0.006	0.01	0.01	0.01	-1%	-7%	2%
	WQ04	0.006	0.01	0.01	0.01	-1%	-6%	2%
Four Creek	WQS03	0.000	0.00	0.00	0.00	-30%	-50%	-46%
	WQS21	0.000	0.00	0.00	0.00	-30%	-54%	-47%
	WQS20	0.000	0.00	0.00	0.00	-30%	-52%	-45%
	WQS03_DS	0.001	0.00	0.00	0.00	-30%	-33%	-26%
Goathorn Creek	WQS13	0.174	0.17	0.17	0.17	0%	0%	0%
	WQS06_US	0.191	0.19	0.19	0.19	0%	0%	0%
	WQSEA1	0.220	0.22	0.22	0.22	0%	0%	0%
	WQS06	0.220	0.22	0.22	0.22	0%	0%	0%
	WQS05	0.348	0.35	0.34	0.35	0%	-2%	1%
Telkwa River	WQS09	4.216	4.21	4.15	4.26	0%	-2%	1%
Bulkley River	WQS11	16.503	16.50	16.50	16.50	0%	0%	0%
	WQS12	19.563	19.56	19.56	19.56	0%	0%	0%

Source:
https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_LowFlow_FEAC2025_20250725.xlsm

Table F-6: Percent Change in Mean Annual Discharge for Alternative Assessment Case 1: High Groundwater Seepage Conditions Relative to Base Case Conditions, including Maximum Increase, Maximum Decrease and Average Change, over each Project Stage

Stream	Node	% Change in Mean Annual Discharge relative to Base Case Conditions								
		Construction			Operation			Post-Closure		
		Maximum Increase	Average Change	Maximum Decrease	Maximum Increase	Average Change	Maximum Decrease	Maximum Increase	Average Change	Maximum Decrease
Tenas Creek	WQS01	n.a	0.0%	0.0%	n.a	0.0%	0.0%	n.a	0.0%	0.0%
	WQS02	n.a	0.0%	0.0%	n.a	-1.4%	-1.7%	n.a	-1.2%	-1.3%
	WQS22	n.a	0.0%	0.0%	n.a	-6.1%	-7.0%	n.a	-5.2%	-5.3%
	WQS04	0.0%	0.0%	0.0%	n.a	-7.0%	-8.0%	n.a	-5.5%	-5.6%
Four Creek	WQS03	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	n.a	0.0%	0.0%
	WQS21	n.a	-0.8%	-0.8%	47.1%	33.9%	-1.0%	32.2%	31.0%	n.a
	WQS20	n.a	-0.8%	-0.8%	45.6%	31.9%	-1.0%	30.2%	29.0%	n.a
	WQS03_DS	n.a	-0.6%	-0.6%	2.1%	-13.8%	-19.8%	n.a	-14.8%	-16.2%
Goathorn Creek	WQS13	n.a	0.0%	0.0%	n.a	0.0%	-0.1%	n.a	-0.1%	-0.1%
	WQS06_US	n.a	0.0%	0.0%	n.a	0.0%	0.0%	n.a	0.0%	0.0%
	WQSEA1	n.a	0.0%	0.0%	2.7%	1.4%	n.a	0.7%	0.5%	n.a
	WQS06	n.a	0.0%	0.0%	0.8%	-1.4%	-1.8%	n.a	-1.5%	-2.0%
	WQS05	n.a	0.0%	0.0%	0.7%	0.1%	-0.4%	0.7%	0.6%	n.a
Telkwa River	WQS09	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Bulkley River	WQS11	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	n.a	0.0%	0.0%
	WQS12	n.a	0.0%	0.0%	n.a	0.0%	0.0%	n.a	0.0%	0.0%

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_ChangetoMAD_20250722_CCM.xlsx?web=1

Note: n.a. (not applicable) values represent nodes which do not experience a net increase or net decrease over Pre-Mining conditions

Table F-7: Tenas Creek Project Case Streamflow Effect as Monthly Change over Base Case Conditions for Alternative Case 1: High Groundwater Seepage

Scenario		Tenas Creek Monthly % Change											
		WQS01			WQS02			WQS22			WQS04		
Period	Month	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease
Construction	January		-0.03			-0.42			-0.04			-0.01	
	February		-0.03			-0.46			-0.05			-0.01	
	March		-0.03			-0.47			-0.04			-0.01	
	April		0.00			-0.01			0.00			0.00	
	May		0.00			-0.01			0.00			0.00	
	June		0.00			-0.02			0.00			0.00	
	July		0.00			-0.06			-0.01			0.00	
	August		0.00			-0.06			-0.01			0.00	
	September		-0.01			-0.11			-0.01			0.00	
	October		-0.01			-0.17			-0.02			0.00	
	November		-0.05			-0.75			-0.08			-0.01	
	December		-0.05			-0.80			-0.08			-0.01	
Operations	January		-0.4	-0.5	9.7	-0.1	-6.5	33.1	5.0	-12.2	29.1	4.5	-10.5
	February		-0.4	-0.5	9.8	-0.1	-6.4	33.4	5.1	-11.9	29.3	4.6	-10.2
	March		-0.4	-0.5	8.6	-0.3	-6.3	19.5	0.3	-13.4	16.6	0.0	-11.9
	April		0.0		0.0	-1.4	-1.8	0.0	-7.6	-10.4	0.0	-8.3	-11.0
	May		0.0		0.0	-1.4	-1.5	0.0	-6.2	-7.2	0.0	-7.1	-8.1
	June		0.0		0.0	-1.3	-1.6	0.0	-4.7	-5.5	0.0	-5.9	-6.8
	July		0.0		0.0	-1.3	-1.9	0.0	-4.4	-6.0	0.0	-5.6	-7.2
	August		0.0		-	-1.3	-2.0	0.0	-4.7	-6.9	0.0	-5.8	-7.9
	September		-0.1	-0.1	0.0	-1.3	-2.4	0.0	-4.4	-7.4	0.0	-5.6	-8.4
	October		-0.1	-0.1	-	-1.4	-2.5	0.0	-5.2	-8.3	0.0	-6.2	-9.2
	November		-0.4	-0.5	8.8	-0.2	-6.3	24.0	2.9	-12.9	20.4	2.2	-11.7
	December		-0.4	-0.5	10.9	0.4	-6.5	36.3	6.4	-12.3	31.8	5.7	-10.5
Post-Closure	January		-0.2	-0.3	11.6	6.5	-0.4	35.1	16.0	-3.0	30.8	13.5	-3.6
	February		-0.3	-0.3	11.6	9.8	-	35.1	28.9		30.8	25.1	
	March		-0.2	-0.2	7.5	6.5	-	19.1	17.6		16.3	15.0	
	April		0.0			-1.4	-1.4		-6.2	-6.3		-6.3	-6.5
	May		0.0			-1.4	-1.4		-5.4	-5.7		-5.6	-5.9
	June		0.0			-1.2	-1.3		-3.4	-3.6		-3.8	-4.1
	July		0.0			-0.6	-0.7		-2.4	-2.9		-3.0	-3.5
	August		0.0			-0.5	-0.7		-2.5	-3.3		-3.1	-3.8
	September		0.0		0.4	0.0	-0.4	0.6	-0.9	-1.8		-1.7	-2.5
	October		0.0		-	-0.5	-0.7		-3.2	-3.7		-3.7	-4.1
	November		0.0		0.3	-0.4	-1.0		-5.5	-6.6		-5.8	-6.8
	December		0.0	-0.2	5.1	0.4	-1.1	1.1	-3.5	-5.4	0.1	-4.1	-5.7

Source:

https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_MonthlyChange_07222025_CCM.xlsm

Table F-8: Four Creek Project Case Streamflow Effect as Monthly Change over Base Case Conditions for Alternative Case 1: High Groundwater Seepage

Scenario		Four Creek Monthly % Change											
		WQS03			WQS21			WQS20			WQS03DS		
Period	Month	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease
Construction	January	-	0.00	-	-	-5.27	-	-	-5.27	-	-	-3.87	-
	February	-	0.00	-	-	-6.45	-	-	-6.45	-	-	-4.73	-
	March	-	0.00	-	-	-5.11	-	-	-5.11	-	-	-3.75	-
	April	-	0.00	-	-	-0.13	-	-	-0.13	-	-	-0.09	-
	May	-	0.00	-	-	-0.74	-	-	-0.74	-	-	-0.54	-
	June	-	0.00	-	-	-1.70	-	-	-1.70	-	-	-1.24	-
	July	-	0.00	-	-	-2.50	-	-	-2.50	-	-	-1.83	-
	August	-	0.00	-	-	-6.58	-	-	-6.58	-	-	-4.82	-
	September	-	0.00	-	-	-5.97	-	-	-5.97	-	-	-4.37	-
	October	-	0.00	-	-	-7.49	-	-	-7.49	-	-	-5.49	-
	November	-	0.00	-	-	-10.76	-	-	-10.76	-	-	-7.88	-
	December	-	0.00	-	-	-11.23	-	-	-11.23	-	-	-8.24	-
Operations	January	-	0.0	-	-5.3	-76.9	-100.0	-	-76.9	-100.0	85.0	16.8	-16.8
	February	-	0.0	-	-6.5	-77.2	-100.0	-	-77.2	-100.0	85.6	17.1	-16.8
	March	-	0.0	-	-5.1	-42.4	-57.5	-	-42.9	-58.2	47.2	6.4	-16.0
	April	-	0.0	-	49.7	37.0	-0.2	48.2	35.1	-0.2	4.6	-14.2	-23.9
	May	-	0.0	-	49.5	36.2	-0.7	47.9	34.3	-0.7	2.5	-14.2	-23.1
	June	-	0.0	-	48.3	27.9	-1.7	46.6	26.0	-1.7	-	-12.1	-15.2
	July	-	0.0	-	45.4	19.0	-3.1	43.6	17.1	-4.1	-	-10.3	-17.0
	August	-	0.0	-	33.1	-16.1	-50.0	31.4	-17.8	-51.4	44.8	0.5	-19.8
	September	-	0.0	-	38.0	-8.0	-41.1	36.1	-9.7	-42.3	35.0	-1.7	-19.0
	October	-	0.0	-	12.5	-27.9	-46.8	11.4	-29.2	-47.9	40.5	3.1	-17.9
	November	-	0.0	-	-10.8	-78.9	-100.0	-	-78.9	-100.0	76.2	19.0	-16.3
	December	-	0.0	-	-11.2	-80.7	-100.0	-	-80.7	-100.0	91.9	20.6	-16.6
Post-Closure	January	-	0.0	-	-19.4	-75.6	-100.0	-	-76.0	-100.0	121.3	96.4	-
	February	-	0.0	-	-60.3	-93.9	-100.0	-	-94.0	-100.0	121.3	115.5	-
	March	-	0.0	-	-35.0	-40.6	-47.9	-	-41.5	-48.7	67.0	59.5	-
	April	-	0.0	-	34.5	34.5	-	32.5	32.5	-	-	-18.8	-18.9
	May	-	0.0	-	31.3	28.5	-	29.3	26.5	-	-	-11.6	-14.9
	June	-	0.0	-	25.4	21.4	-	23.4	19.4	-	3.4	-2.9	-7.8
	July	-	0.0	-	16.2	11.6	-	14.1	9.6	-	15.9	9.1	-
	August	-	0.0	-	-19.1	-35.0	-44.3	-	-36.7	-45.9	72.1	63.7	-
	September	-	0.0	-	-4.0	-23.3	-35.3	-	-25.0	-36.8	59.5	48.7	-
	October	-	0.0	-	-17.1	-20.5	-25.2	-	-22.1	-26.7	48.7	43.9	-
	November	-	0.0	-	28.1	12.1	-16.8	26.1	10.3	-18.3	38.3	6.1	-11.8
	December	-	0.0	-	1.2	-33.9	-100.0	-	-35.1	-100.0	121.3	56.1	-

Source:

https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_MonthlyChange_07222025_CCM.xlsm

Table F-9: Goathorn Creek Project Case Streamflow Effect as Monthly Change over Base Case Conditions for Alternative Case 1: High Groundwater Seepage

Scenario		Goathorn Creek Monthly % Change											
		WQS06US			WQS06			WQSEA1			WQS05		
Period	Month	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease
Construction	January	-	-0.01	-	-	-2.57	-	-	-0.07	-	-	-0.06	-
	February	-	-0.01	-	-	-2.58	-	-	-0.08	-	-	-0.06	-
	March	-	-0.01	-	-	-2.58	-	-	-0.08	-	-	-0.06	-
	April	-	0.00	-	-	-2.52	-	-	-0.01	-	-	-0.01	-
	May	-	0.00	-	-	-2.50	-	-	0.00	-	-	0.00	-
	June	-	0.00	-	-	-2.50	-	-	0.00	-	-	0.00	-
	July	-	0.00	-	-	-2.50	-	-	0.00	-	-	0.00	-
	August	-	0.00	-	-	-2.50	-	-	0.00	-	-	-0.01	-
	September	-	-0.01	-	-	-2.52	-	-	-0.01	-	-	-0.02	-
	October	-	-0.01	-	-	-2.53	-	-	-0.03	-	-	-0.04	-
	November	-	-0.02	-	-	-2.63	-	-	-0.13	-	-	-0.11	-
	December	-	-0.02	-	-	-2.63	-	-	-0.13	-	-	-0.11	-
Operations	January	-	-0.1	-0.2	-	-2.2	-2.8	1.7	0.3	-0.3	6.4	1.0	-2.1
	February	-	-0.1	-0.2	-	-2.2	-2.8	1.7	0.3	-0.3	6.5	1.1	-2.0
	March	-	-0.1	-0.2	-	-5.7	-8.4	0.5	-3.2	-6.0	0.4	-2.1	-4.7
	April	-	0.0	-	-	-5.0	-6.7	1.6	-2.5	-4.2	0.0	-5.3	-7.6
	May	-	0.0	-	3.8	0.9	-2.5	6.4	3.5	-	0.0	-1.4	-1.9
	June	-	0.0	-	1.2	0.3	-2.5	3.8	2.8	-	2.4	0.1	-1.9
	July	-	0.0	-	0.8	-1.3	-2.5	3.4	1.2	-	1.7	0.3	-0.7
	August	-	0.0	-	-	-2.1	-2.7	1.6	0.4	-0.2	0.1	-0.9	-1.7
	September	-	0.0	-0.1	0.6	-2.2	-2.8	3.2	0.3	-0.3	1.0	-1.2	-3.2
	October	-	0.0	-0.1	3.6	-0.6	-2.6	6.2	1.9	-0.1	2.3	-0.2	-1.9
	November	-	-0.1	-0.2	-	-2.1	-2.8	1.8	0.4	-0.3	6.9	1.3	-2.1
	December	-	-0.1	-0.2	-	-2.1	-2.8	1.9	0.4	-0.3	7.0	1.3	-2.1
Post-Closure	January	-	-0.3	-0.3	-	-0.8	-2.2	1.7	0.3	-0.3	7.1	5.3	-
	February	-	-0.3	-0.3	-	-0.3	-0.9	1.7	0.3	-0.3	7.1	6.8	-
	March	-	-0.2	-0.3	-	-3.0	-4.7	0.5	-3.2	-6.0	3.1	2.0	-
	April	-	0.0	-	0.1	-0.5	-2.2	1.6	-2.5	-4.2	-	-1.7	-2.6
	May	-	0.0	-	-	-2.7	-2.8	6.4	3.5	-	-	-2.5	-2.7
	June	-	0.0	-	-	-2.3	-2.4	3.8	2.8	-	-	-0.9	-1.1
	July	-	0.0	-	-	-2.2	-2.3	3.4	1.2	-	0.3	0.1	-
	August	-	0.0	-0.1	-	-1.8	-2.0	1.6	0.4	-0.2	0.4	0.1	-
	September	-	-0.1	-0.1	-	-1.2	-1.5	3.2	0.3	-0.3	2.1	1.4	-
	October	-	0.0	-0.1	-	-1.5	-1.6	6.2	1.9	-0.1	0.5	0.3	-
	November	-	-0.2	-0.3	-	-3.4	-5.3	1.8	0.4	-0.3	-	-3.1	-5.0
	December	-	-0.2	-0.3	-	-1.4	-2.2	1.9	0.4	-0.3	5.8	0.6	-2.3

Source:

https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_MonthlyChange_07222025_CCM.xlsm

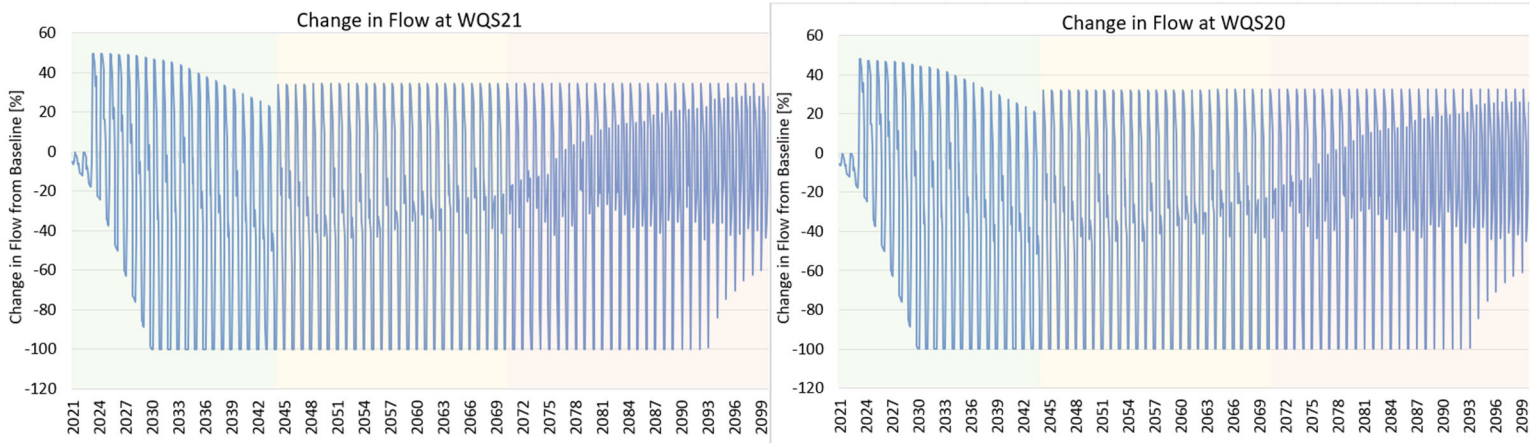
Table F-10: Telkwa and Bulkley River Project Case Streamflow Effect as Monthly Change over Base Case Conditions for Alternative Case 1: High Groundwater Seepage

Scenario		Telkwa River Monthly % Change			Bulkley River Monthly % Change					
		WQS09			WQS11			WQS12		
Period	Month	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease	Maximum Increase	Average	Maximum Decrease
Construction	January	-	-0.04	-	-	0.00	-	-	0.00	-
	February	-	-0.04	-	-	0.00	-	-	0.00	-
	March	-	-0.05	-	-	0.00	-	-	0.00	-
	April	-	-0.02	-	-	0.00	-	-	0.00	-
	May	-	-0.01	-	-	0.00	-	-	0.00	-
	June	-	-0.01	-	-	0.00	-	-	0.00	-
	July	-	-0.01	-	-	0.00	-	-	0.00	-
	August	-	-0.02	-	-	0.00	-	-	0.00	-
	September	-	-0.04	-	-	0.00	-	-	0.00	-
	October	-	-0.04	-	-	0.00	-	-	0.00	-
	November	-	-0.07	-	-	0.00	-	-	0.00	-
	December	-	-0.08	-	-	0.00	-	-	0.00	-
Operations	January	4.8	0.8	-1.5	-	0.0	-	0.1	0.0	-
	February	4.8	0.8	-1.5	-	0.0	-	0.1	0.0	-
	March	4.9	0.8	-1.4	-	0.0	-	0.0	0.0	-
	April	0.0	-0.8	-1.6	-	0.0	-	0.0	-0.2	-0.2
	May	0.1	-0.1	-0.3	-	0.0	-	0.0	0.0	-
	June	0.3	0.0	-0.2	-	0.0	-	0.0	0.0	-
	July	0.5	0.1	-0.2	-	0.0	-	0.0	0.0	-
	August	0.8	0.1	-0.3	-	0.0	-	0.0	0.0	-
	September	2.0	0.3	-0.7	-	0.0	-	0.0	0.0	-
	October	1.9	0.3	-0.7	-	0.0	-	0.0	0.0	-
	November	5.2	1.0	-1.5	-	0.0	-	0.1	0.0	-
	December	5.2	1.0	-1.5	-	0.0	-	0.1	0.0	-
Post-Closure	January	5.3	4.9	-	-	0.0	-	0.1	0.0	-
	February	5.3	5.3	-	-	0.0	-	0.1	0.1	-
	March	3.7	3.5	-	-	0.0	-	0.0	0.0	-
	April	0.1	0.0	-0.2	-	0.0	-	0.0	-0.1	-0.1
	May	0.0	-0.1	-0.1	-	0.0	-	0.0	0.0	-
	June	0.5	0.3	-	-	0.0	-	0.0	0.0	-
	July	0.9	0.7	-	-	0.0	-	0.0	0.0	-
	August	1.3	1.1	-	-	0.0	-	0.0	0.0	-
	September	2.9	2.4	-	-	0.0	-	0.0	0.0	-
	October	1.5	1.4	-	-	0.0	-	0.0	0.0	-
	November	4.5	2.5	-	-	0.0	-	0.0	0.0	-0.1
	December	5.3	3.8	-	-	0.0	-	0.0	0.0	-

Source:

https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/Results_Streams_MonthlyChange_07222025_CCM.xlsm

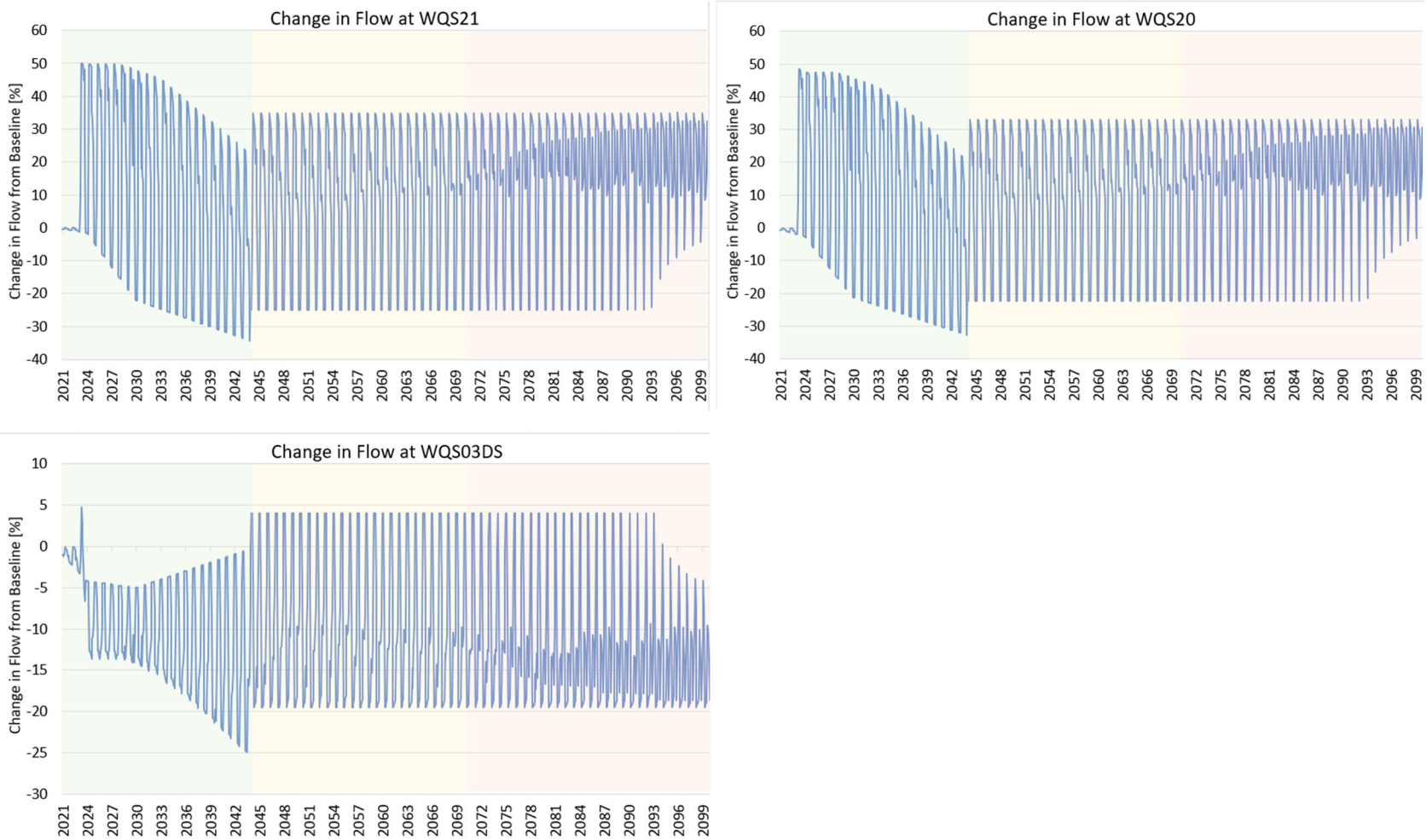
Figure F-3 : Streamflow Effect to Monthly Average Discharge relative to Base Case Conditions in Alternative Case 1



Source:

*https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/*WaterQuantity_Results_20250725_CCM.xlsm?web=1

Figure F-4: Streamflow Effect to Monthly Average Discharge relative to Base Case Conditions in Alternative Case 4

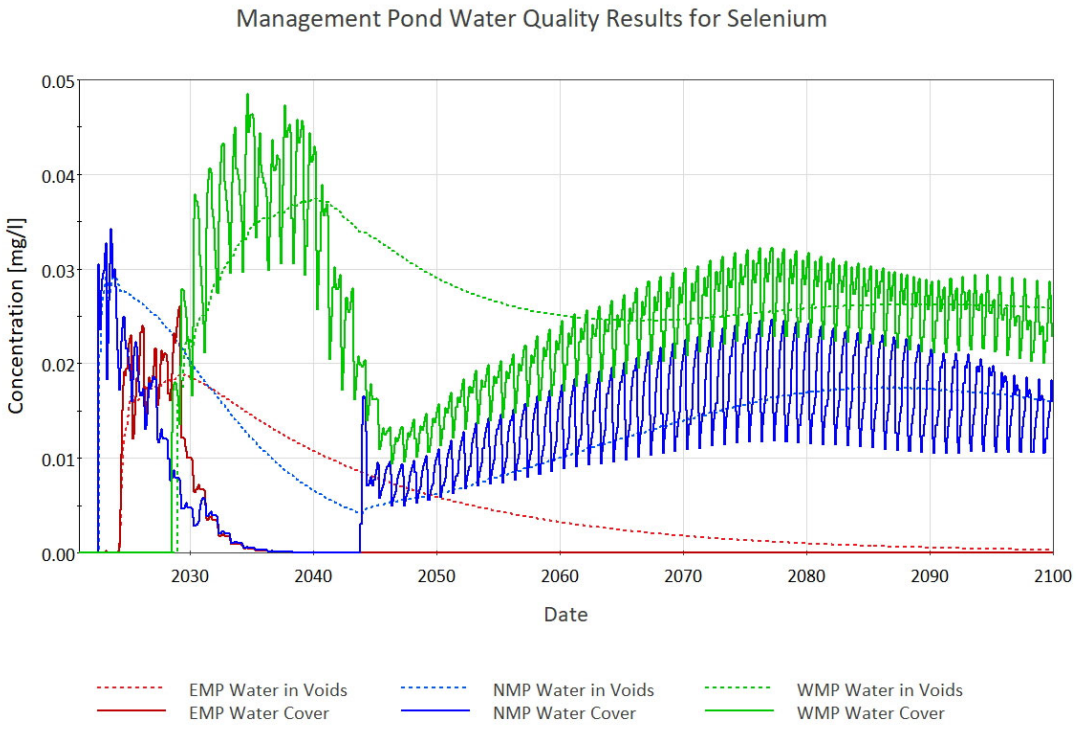


Source:

https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water%20Balance%20Modelling/Results/20250403_FEAC_2024/WaterQuantity_Results_20250725_CCM.xlsm?web=1

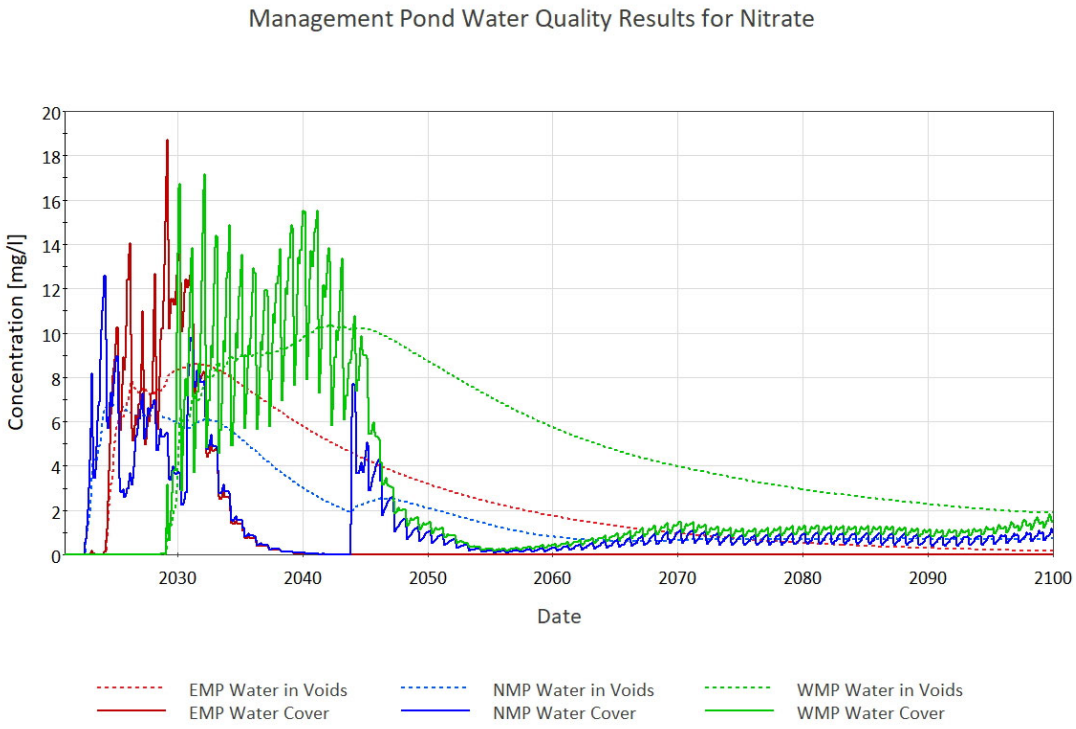
Appendix G Water Quality Results for Project Case and Alternative Cases

Figure G-1. Management Pond Water Quality Results for Total Selenium with Alternative Assessment Case 2: High Geochemical Source Terms



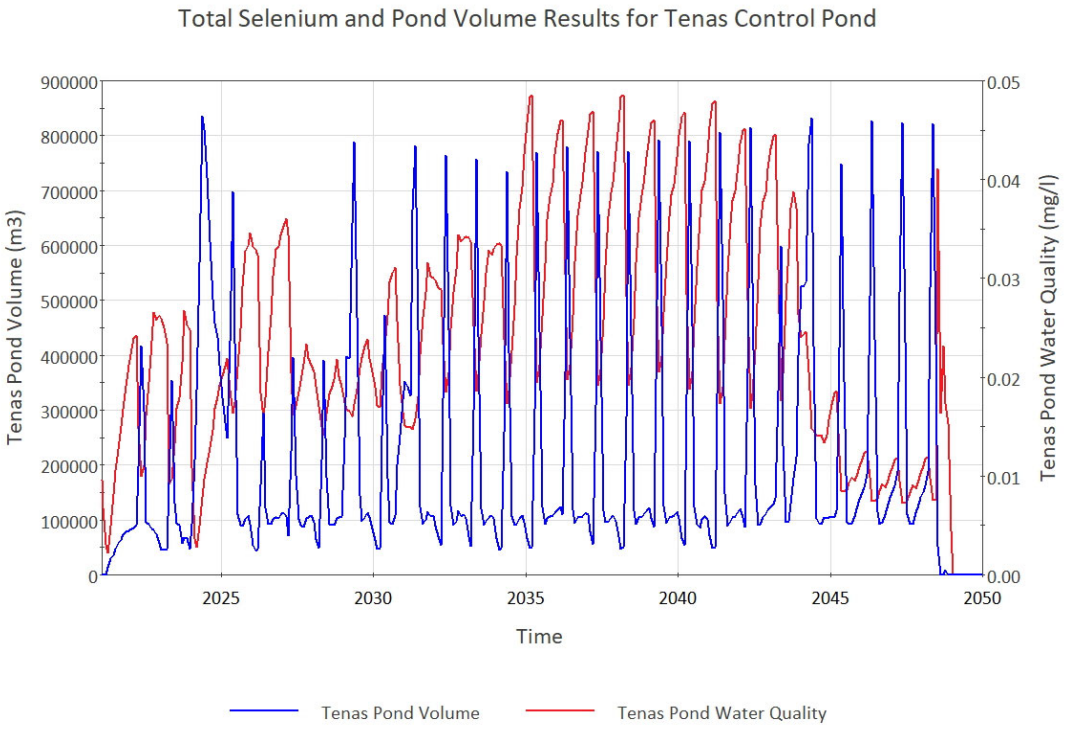
Source:
https://srk.sharepoint.com/:f:/s/NACAPR002055/EkLJcHcXDu9NuwX6KxLFsosB_kp2a5ZgyGSMlxQBw_mxXA?e=YWEg8e

Figure G-2. Management Pond Water Quality Results for Nitrate-nitrogen with Alternative Assessment Case 2: High Geochemical Source Terms



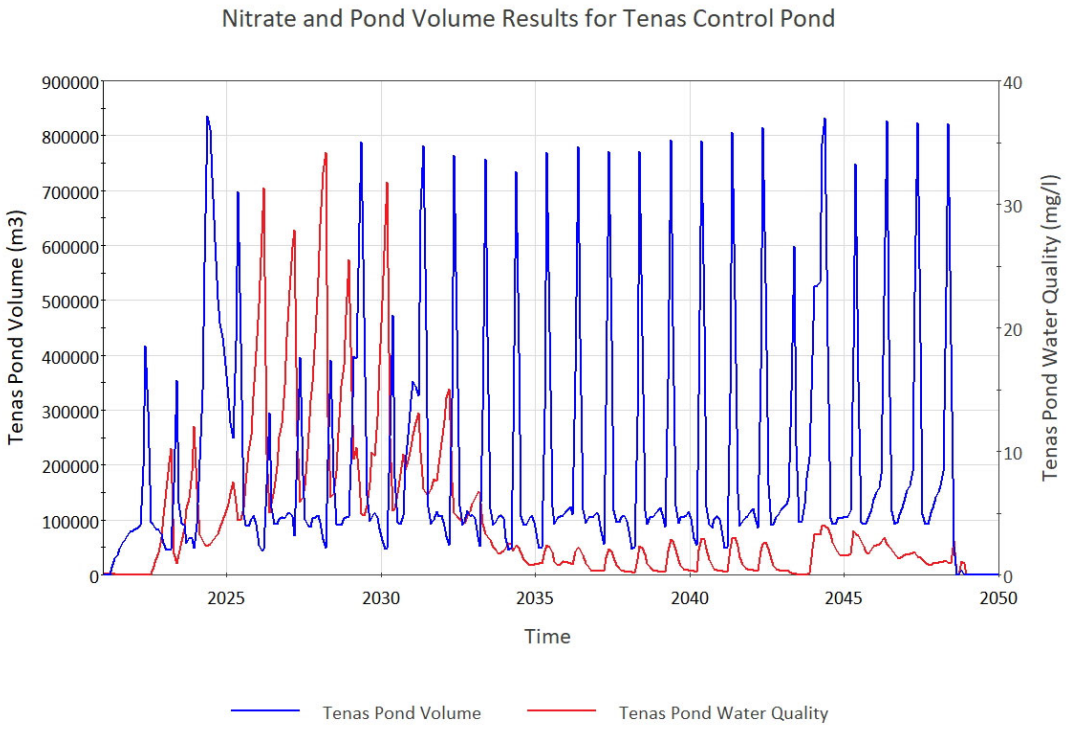
Source:
https://srk.sharepoint.com/:f:/s/NACAPR002055/EkLJcHcXDu9NuwX6KxLFsosB_kp2a5ZgyGSMlxQBw_mxXA?e=YWEg8e

Figure G-3. Tenas Control Pond Water Quality Results for Total Selenium with Alternative Assessment Case 2: High Geochemical Source Terms



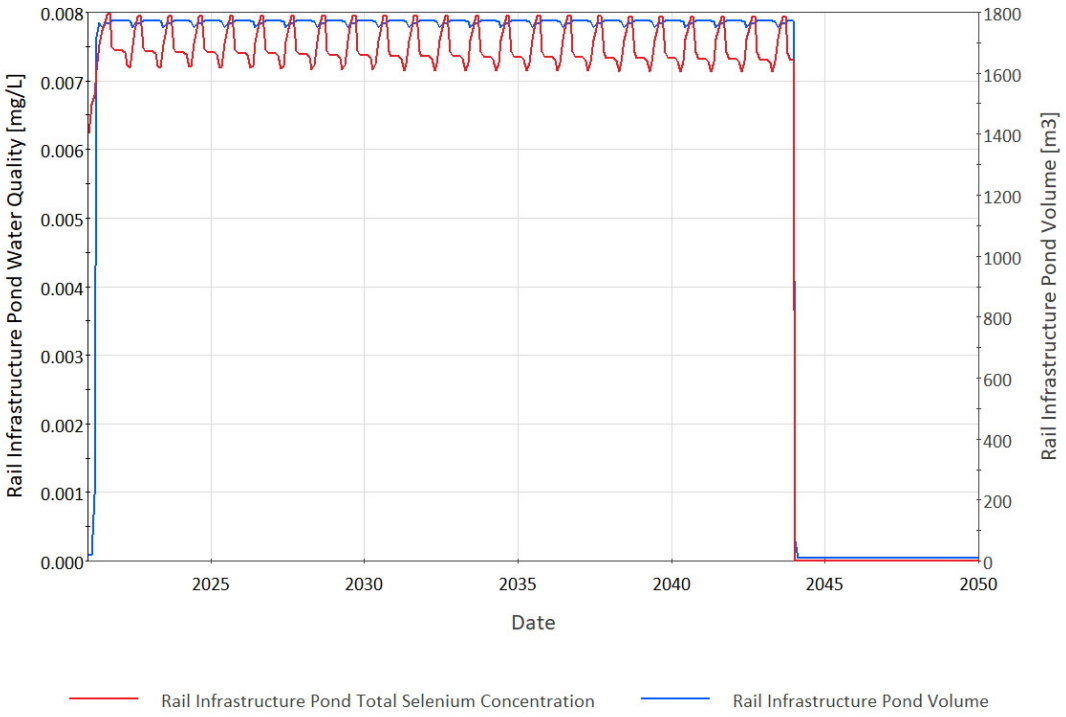
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https://srk.sharepoint.com/:f:/s/NACAPR002055/EkLJcHcXDu9NuwX6KxLFsosB_kp2a5ZgyGSMlxQBw_mxXA?e=YWEg8e

Figure G-4. Tenas Control Pond Water Quality Results for Total Selenium with Alternative Assessment Case 2: High Geochemical Source Terms



Source:
https://srk.sharepoint.com/:f:/s/NACAPR002055/EkLJcHcXDu9NuwX6KxLFsosB_kp2a5ZgyGSMlxQBw_mxXA?e=YWEg8e

Figure G-5. Rail Infrastructure Sedimentation Pond Water Quality Results for Total Selenium with Alternative Assessment Case 2: High Geochemical Source Terms



Source:
https://srk.sharepoint.com/:f:/s/NACAPR002055/EkLJcHcXDu9NuwX6KxLFsosB_kp2a5ZgyGSMlxQBw_mxXA?e=YWEg8e

Table G-1

Parameter	Units	Goathorn WQG	North Management Pond																	
			Baseline in Goathorn Creek		Operations								Closure							
					Final EAC Project Case (2024)				High Source terms (Alternative Case 2)				Final EAC Project Case (2024)				High Source terms (Alternative Case 2)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	154	92	13	13	327	224	54	51	52	57	37	44	85	95	58	75
Alkalinity, total	mg CaCO3/L		54	85	280	240	28	35	720	630	120	130	310	360	180	240	540	620	280	380
Chloride	mg/L	150	0.25	0.50	2.8	3.3	0.31	0.43	11	9.4	1.8	1.9	2.3	3.0	1.8	2.5	2.6	3.4	2.0	2.7
Fluoride	mg/L	1.19	0.032	0.041	0.067	0.057	0.0047	0.0056	0.067	0.057	0.0047	0.0056	0.025	0.030	0.021	0.026	0.025	0.030	0.021	0.026
Ammonia, total	mg-N/L	1.56	0.0025	0.0070	0.27	0.41	0.078	0.11	1.1	1.6	0.31	0.42	0.071	0.12	0.035	0.049	0.18	0.34	0.072	0.10
Nitrate	mg/L	3	0.043	0.084	2.1	3.2	0.62	0.84	8.6	13	2.5	3.3	0.51	0.87	0.23	0.33	1.4	2.6	0.53	0.75
Nitrite	mg/L	0.02	0.00050	0.0020	0.049	0.073	0.014	0.019	0.20	0.29	0.057	0.077	0.012	0.020	0.0055	0.0077	0.032	0.060	0.012	0.017
Sulfate	mg/L	218	25	38	270	430	32	45	1300	1200	200	220	180	220	130	190	490	620	350	490
Aluminum, total	mg/L	0.27	0.034	0.66	0.38	0.38	0.30	0.30	0.39	0.39	0.30	0.30	0.39	0.39	0.38	0.38	0.39	0.39	0.38	0.38
Antimony, total	mg/L	0.074	0.000055	0.00013	0.00036	0.00034	0.000039	0.000051	0.0011	0.00097	0.00020	0.00021	0.00035	0.00043	0.00026	0.00036	0.00089	0.0011	0.00065	0.00090
Arsenic, total	mg/L	0.005	0.00020	0.00060	0.0012	0.00081	0.00051	0.00052	0.0020	0.0016	0.00071	0.00071	0.00084	0.00090	0.00075	0.00083	0.0013	0.0015	0.0011	0.0013
Barium, total	mg/L	1	0.059	0.071	0.086	0.062	0.012	0.012	0.099	0.076	0.014	0.015	0.024	0.025	0.022	0.023	0.024	0.026	0.022	0.024
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000093	0.000047	0.0000057	0.0000054	0.000093	0.000047	0.0000057	0.0000054	0.000014	0.000015	0.000013	0.000014	0.000014	0.000015	0.000013	0.000014
Boron, total	mg/L	1.2	0.0050	0.050	0.054	0.088	0.0066	0.0093	0.19	0.17	0.032	0.034	0.10	0.14	0.081	0.11	0.11	0.14	0.086	0.12
Cadmium, dissolved	mg/L	0.00016	0.0000075	0.000033	0.000087	0.00015	0.0000071	0.000012	0.00025	0.00033	0.000028	0.000035	0.0000039	0.0000051	0.0000030	0.0000040	0.000013	0.000016	0.0000098	0.000013
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.0012	0.0014	0.00100	0.0010	0.0016	0.0016	0.0011	0.0011	0.0013	0.0013	0.0013	0.0013	0.0014	0.0015	0.0014	0.0014
Cobalt, dissolved	mg/L	0.00045	0.000050	0.00010	0.0044	0.0076	0.00049	0.00070	0.027	0.021	0.0041	0.0041	0.00057	0.00069	0.00038	0.00052	0.0017	0.0021	0.0011	0.0016
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0024	0.0017	0.00020	0.00022	0.0028	0.0027	0.00036	0.00041	0.0018	0.0022	0.0013	0.0017	0.0044	0.0050	0.0025	0.0034
Iron, total	mg/L	1	0.040	0.70	1.5	1.5	1.2	1.2	1.5	1.5	1.2	1.2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Iron, dissolved	mg/L	0.35	0.015	0.12	0.11	0.19	0.011	0.017	0.23	0.37	0.023	0.034	0.0062	0.0079	0.0052	0.0057	0.032	0.039	0.025	0.033
Lead, dissolved	mg/L	0.0026	0.000025	0.000050	0.00049	0.00054	0.000057	0.000077	0.0018	0.0016	0.00031	0.00033	0.00050	0.00061	0.00033	0.00046	0.0015	0.0018	0.00097	0.0013
Manganese, total	mg/L	0.913	0.0036	0.029	0.088	0.16	0.029	0.033	0.41	0.39	0.077	0.080	0.029	0.029	0.028	0.029	0.033	0.035	0.031	0.033
Mercury, total	mg/L	0.00002	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.015	0.014	0.0017	0.0023	0.058	0.049	0.010	0.010	0.0062	0.0076	0.0045	0.0063	0.018	0.022	0.013	0.018
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.0071	0.012	0.00078	0.0011	0.039	0.032	0.0058	0.0059	0.0018	0.0022	0.0012	0.0017	0.0055	0.0067	0.0036	0.0049
Selenium, total	mg/L	0.002	0.000084	0.00020	0.0090	0.011	0.00098	0.0013	0.034	0.033	0.0060	0.0063	0.0065	0.0080	0.0042	0.0059	0.020	0.025	0.013	0.018
Strontium, total	mg/L	2.5	0.080	0.11	0.26	0.36	0.031	0.040	0.81	0.83	0.13	0.14	0.20	0.25	0.16	0.21	0.21	0.26	0.16	0.22
Silver, total	mg/L	0.00005	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00003	0.0000050	0.000010	0.00011	0.00019	0.0000088	0.000014	0.00027	0.00039	0.000029	0.000039	0.000013	0.000016	0.000010	0.000014	0.000021	0.000026	0.000016	0.000022
Uranium, total	mg/L	0.0085	0.000056	0.00014	0.0019	0.0019	0.00022	0.00029	0.0068	0.0059	0.0012	0.0013	0.0020	0.0024	0.0015	0.0020	0.0053	0.0067	0.0038	0.0053
Zinc, dissolved	mg/L	0.0074	0.0013	0.0021	0.0099	0.017	0.0011	0.0015	0.045	0.041	0.0066	0.0068	0.0016	0.0018	0.0011	0.0015	0.0040	0.0048	0.0027	0.0036

Red highlights indicate value above WQG calculated for the receiving stream
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_MMPs_WaterQuality_EAModel_41_20250717.xlsm

Table G-2

Parameter	Units	East Management Pond																		
			Baseline in Four Creek		Operations								Closure							
					Final EAC Project Case (2024)				High Source terms (Alternative Case 2)				Final EAC Project Case (2024)				High Source terms (Alternative Case 2)			
		Four Creek WQG	P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	58	328	14	20	178	340	40	47	12	11	11	10	12	11	11	10
Alkalinity, total	mg CaCO3/L		54	85	150	320	28	40	400	470	89	110	9.2	7.7	7.8	7.3	9.2	7.7	7.8	7.3
Chloride	mg/L	150	0.25	0.50	1.9	2.4	0.36	0.48	6.4	7.3	1.4	1.6	0.031	0.027	0.027	0.025	0.031	0.027	0.027	0.025
Fluoride	mg/L	1.19	0.032	0.041	0.030	0.15	0.0058	0.0094	0.030	0.15	0.0058	0.0094	0.0046	0.0039	0.0039	0.0037	0.0046	0.0039	0.0039	0.0037
Ammonia, total	mg-N/L	1.56	0.0025	0.0070	0.39	0.59	0.099	0.13	1.6	2.4	0.39	0.53	0.00037	0.00034	0.00032	0.00030	0.00040	0.00041	0.00032	0.00031
Nitrate	mg/L	3	0.043	0.084	3.1	4.7	0.78	1.0	12	19	3.1	4.2	0.0043	0.0034	0.0035	0.0032	0.0043	0.0038	0.0035	0.0033
Nitrite	mg/L	0.02	0.00050	0.0020	0.071	0.11	0.018	0.024	0.29	0.43	0.071	0.096	0.00012	0.00011	0.00011	0.00010	0.00013	0.00012	0.00011	0.00010
Sulfate	mg/L	218	25	38	230	310	47	62	890	1000	180	210	0.82	0.68	0.69	0.64	0.82	0.68	0.69	0.64
Aluminum, total	mg/L	0.27	0.034	0.66	0.38	0.39	0.27	0.26	0.39	0.40	0.27	0.27	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Antimony, total	mg/L	0.074	0.000055	0.00013	0.00022	0.00027	0.000039	0.000053	0.00063	0.00070	0.00014	0.00016	0.0000081	0.0000073	0.0000073	0.0000070	0.0000081	0.0000073	0.0000073	0.0000070
Arsenic, total	mg/L	0.005	0.00020	0.00060	0.00066	0.0013	0.00047	0.00050	0.0013	0.0014	0.00060	0.00064	0.00055	0.00055	0.00055	0.00054	0.00055	0.00055	0.00055	0.00054
Barium, total	mg/L	1	0.059	0.071	0.039	0.23	0.012	0.017	0.048	0.23	0.015	0.019	0.013	0.012	0.012	0.012	0.013	0.012	0.012	0.012
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000033	0.00019	0.0000065	0.0000099	0.000033	0.00019	0.0000065	0.0000099	0.0000062	0.0000054	0.0000054	0.0000050	0.0000062	0.0000054	0.0000054	0.0000050
Boron, total	mg/L	1.2	0.0050	0.050	0.038	0.049	0.0072	0.0100	0.11	0.12	0.024	0.029	0.0016	0.0014	0.0014	0.0013	0.0016	0.0014	0.0014	0.0013
Cadmium, dissolved	mg/L	0.00016	0.0000075	0.000033	0.000064	0.000078	0.000013	0.000016	0.00016	0.00020	0.000034	0.000041	0.00000052	0.00000047	0.00000043	0.00000041	0.00000052	0.00000047	0.00000043	0.00000041
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.0013	0.0014	0.00089	0.00090	0.0017	0.0018	0.00097	0.00099	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012
Cobalt, dissolved	mg/L	0.00045	0.000050	0.00010	0.0043	0.0064	0.00090	0.0011	0.019	0.022	0.0036	0.0040	0.000012	0.000011	0.000011	0.000010	0.000012	0.000011	0.000011	0.000010
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0012	0.0038	0.00023	0.00033	0.0018	0.0038	0.00038	0.00049	0.00014	0.00012	0.00012	0.00011	0.00014	0.00012	0.00012	0.00011
Iron, total	mg/L	1	0.040	0.70	1.5	1.6	1.1	1.1	1.6	1.7	1.1	1.1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Iron, dissolved	mg/L	0.35	0.015	0.12	0.088	0.10	0.018	0.024	0.17	0.21	0.035	0.045	0.0025	0.0022	0.0021	0.0020	0.0025	0.0022	0.0021	0.0020
Lead, dissolved	mg/L	0.0026	0.000025	0.000050	0.00033	0.00042	0.000056	0.000076	0.00099	0.0011	0.00022	0.00026	0.0000037	0.0000032	0.0000032	0.0000030	0.0000037	0.0000032	0.0000032	0.0000030
Manganese, total	mg/L	0.913	0.0036	0.029	0.097	0.13	0.034	0.038	0.30	0.36	0.073	0.081	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
Mercury, total	mg/L	0.00002	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.0093	0.012	0.0016	0.0021	0.031	0.035	0.0069	0.0078	0.000061	0.000055	0.000056	0.000054	0.000061	0.000055	0.000056	0.000054
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.0060	0.0087	0.0013	0.0017	0.025	0.029	0.0050	0.0056	0.000037	0.000032	0.000032	0.000030	0.000037	0.000032	0.000032	0.000030
Selenium, total	mg/L	0.002	0.000084	0.00020	0.0060	0.0080	0.0012	0.0016	0.023	0.026	0.0048	0.0056	0.000013	0.000012	0.000012	0.000011	0.000013	0.000012	0.000012	0.000011
Strontium, total	mg/L	2.5	0.080	0.11	0.20	0.38	0.044	0.059	0.54	0.63	0.12	0.14	0.016	0.014	0.014	0.013	0.016	0.014	0.014	0.013
Silver, total	mg/L	0.00005	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00003	0.0000050	0.000010	0.000080	0.000094	0.000016	0.000021	0.00018	0.00023	0.000039	0.000048	0.0000012	0.0000011	0.0000011	0.0000010	0.0000012	0.0000011	0.0000011	0.0000010
Uranium, total	mg/L	0.0085	0.000056	0.00014	0.0012	0.0015	0.00021	0.00029	0.0038	0.0044	0.00085	0.00099	0.000024	0.000022	0.000022	0.000021	0.000024	0.000022	0.000022	0.000021
Zinc, dissolved	mg/L	0.0074	0.0013	0.0021	0.0083	0.011	0.0017	0.0023	0.029	0.035	0.0059	0.0069	0.00019	0.00016	0.00016	0.00015	0.00019	0.00016	0.00016	0.00015

Red highlights indicate value above WQG calculated for the receiving stream
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_MMPs_WaterQuality_EAModel_41_20250717.xlsm

Table G-3

Parameter	Units	West Management Pond																		
		Tenas WQG	Baseline in Tenas Creek		Operations								Closure							
					Final EAC Project Case (2024)				High Source terms (Alternative Case 2)				Final EAC Project Case (2024)				High Source terms (Alternative Case 2)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	63	65	20	23	268	186	62	60	82	72	58	56	144	125	93	95
Alkalinity, total	mg CaCO3/L		54	85	210	250	59	77	1100	980	520	450	560	480	310	330	970	830	510	530
Chloride	mg/L	150	0.25	0.50	3.9	4.7	1.1	1.5	14	12	6.6	6.0	4.0	4.3	3.2	3.5	4.4	4.7	3.6	3.8
Fluoride	mg/L	1.19	0.032	0.041	0.044	0.051	0.014	0.019	0.044	0.051	0.014	0.019	0.040	0.040	0.034	0.034	0.040	0.040	0.034	0.034
Ammonia, total	mg-N/L	1.56	0.0025	0.0070	0.54	0.61	0.18	0.27	1.7	2.2	0.65	0.97	0.11	0.15	0.063	0.068	0.28	0.40	0.13	0.14
Nitrate	mg/L	3	0.043	0.084	4.2	4.7	1.4	2.1	14	17	5.1	7.6	0.79	1.1	0.42	0.45	2.1	3.1	0.95	1.0
Nitrite	mg/L	0.02	0.00050	0.0020	0.097	0.11	0.033	0.048	0.32	0.39	0.12	0.18	0.019	0.025	0.0099	0.011	0.049	0.071	0.022	0.024
Sulfate	mg/L	218	25	38	300	370	120	160	1300	1200	620	620	330	310	240	260	810	820	640	690
Aluminum, total	mg/L	0.27	0.034	0.66	0.39	0.39	0.053	0.054	0.40	0.41	0.057	0.059	0.40	0.40	0.39	0.39	0.41	0.40	0.39	0.39
Antimony, total	mg/L	0.074	0.000055	0.00013	0.00042	0.00051	0.00011	0.00015	0.0017	0.0015	0.00084	0.00075	0.00063	0.00058	0.00046	0.00050	0.0015	0.0015	0.0012	0.0012
Arsenic, total	mg/L	0.005	0.00020	0.00060	0.00097	0.0010	0.00031	0.00035	0.0019	0.0017	0.0010	0.00095	0.0011	0.00100	0.00093	0.00094	0.0018	0.0017	0.0015	0.0015
Barium, total	mg/L	1	0.059	0.071	0.042	0.039	0.014	0.016	0.050	0.049	0.024	0.025	0.031	0.028	0.029	0.026	0.032	0.029	0.030	0.027
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000030	0.000026	0.0000099	0.000010	0.000030	0.000026	0.0000099	0.000010	0.000020	0.000017	0.000019	0.000016	0.000020	0.000017	0.000019	0.000016
Boron, total	mg/L	1.2	0.0050	0.050	0.14	0.17	0.034	0.043	0.28	0.27	0.14	0.13	0.18	0.20	0.15	0.16	0.19	0.20	0.15	0.16
Cadmium, dissolved	mg/L	0.00016	0.0000075	0.000033	0.000055	0.00010	0.000026	0.000039	0.00018	0.00023	0.000074	0.000094	0.0000067	0.0000064	0.0000052	0.0000054	0.000023	0.000020	0.000017	0.000018
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.0014	0.0015	0.00026	0.00029	0.0018	0.0019	0.00072	0.00067	0.0014	0.0014	0.0014	0.0014	0.0016	0.0015	0.0015	0.0015
Cobalt, dissolved	mg/L	0.00045	0.000050	0.00010	0.0045	0.0067	0.0016	0.0023	0.023	0.022	0.0064	0.0070	0.00097	0.00091	0.00068	0.00073	0.0027	0.0028	0.0020	0.0022
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0017	0.0019	0.00043	0.00051	0.0036	0.0041	0.0012	0.0013	0.0032	0.0028	0.0022	0.0023	0.0078	0.0067	0.0044	0.0047
Iron, total	mg/L	1	0.040	0.70	1.5	1.5	0.34	0.35	1.6	1.7	0.37	0.40	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Iron, dissolved	mg/L	0.35	0.015	0.12	0.073	0.12	0.033	0.047	0.16	0.24	0.069	0.098	0.0087	0.0086	0.0077	0.0067	0.056	0.050	0.043	0.045
Lead, dissolved	mg/L	0.0026	0.000025	0.000050	0.00044	0.00058	0.00012	0.00017	0.0030	0.0026	0.0013	0.0011	0.00083	0.00082	0.00059	0.00064	0.0024	0.0024	0.0017	0.0019
Manganese, total	mg/L	0.913	0.0036	0.029	0.084	0.13	0.035	0.049	0.34	0.34	0.083	0.11	0.031	0.031	0.030	0.030	0.038	0.038	0.035	0.036
Mercury, total	mg/L	0.00002	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.011	0.015	0.0034	0.0046	0.095	0.083	0.042	0.036	0.011	0.010	0.0082	0.0089	0.029	0.029	0.023	0.025
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.0059	0.0091	0.0024	0.0034	0.030	0.029	0.011	0.012	0.0031	0.0029	0.0022	0.0023	0.0087	0.0088	0.0064	0.0068
Selenium, total	mg/L	0.002	0.000084	0.00020	0.013	0.015	0.0038	0.0053	0.048	0.046	0.023	0.022	0.011	0.011	0.0076	0.0082	0.031	0.032	0.023	0.024
Strontium, total	mg/L	2.5	0.080	0.11	0.34	0.38	0.11	0.14	0.62	0.64	0.32	0.34	0.34	0.35	0.27	0.29	0.35	0.36	0.28	0.30
Silver, total	mg/L	0.00005	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00003	0.0000050	0.000010	0.000077	0.00013	0.000034	0.000051	0.00020	0.00028	0.000084	0.00011	0.000023	0.000022	0.000018	0.000019	0.000035	0.000033	0.000028	0.000030
Uranium, total	mg/L	0.0085	0.000056	0.00014	0.0023	0.0030	0.00064	0.00084	0.011	0.0096	0.0053	0.0048	0.0036	0.0033	0.0026	0.0029	0.0087	0.0088	0.0069	0.0074
Zinc, dissolved	mg/L	0.0074	0.0013	0.0021	0.0073	0.012	0.0032	0.0046	0.035	0.034	0.012	0.014	0.0026	0.0023	0.0019	0.0020	0.0062	0.0061	0.0048	0.0049

Red highlights indicate value above WQG calculated for the receiving stream
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_MMPs_WaterQuality_EAModel_41_20250717.xlsm

Table G-4

Parameter	Units	Tenas Control Pond																		
		Goathorn WQG	Baseline in Goathorn Creek		Operations								Closure							
					Final EAC Project Case (2024)				High Source terms (Alternative Case 2)				Final EAC Project Case (2024)				High Source terms (Alternative Case 2)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	138	163	90	111	236	291	152	197	66	3274	5	15	91	4721	6	21
Alkalinity, total	mg CaCO3/L		54	85	500	560	270	350	820	1000	530	650	120	7200	4.2	27	230	14000	8.3	55
Chloride	mg/L	150	0.25	0.50	6.0	6.7	3.1	4.0	10	13	6.6	8.1	2.1	120	0.072	0.46	2.7	170	0.095	0.64
Fluoride	mg/L	1.19	0.032	0.041	0.071	0.15	0.046	0.082	0.071	0.15	0.046	0.082	0.028	1.6	0.0010	0.0061	0.028	1.6	0.0010	0.0061
Ammonia, total	mg-N/L	1.56	0.0025	0.0070	0.56	1.1	0.13	0.24	2.2	4.4	0.48	0.88	0.071	2.3	0.0018	0.0093	0.19	5.3	0.0046	0.022
Nitrate	mg/L	3	0.043	0.084	4.3	8.6	0.96	1.7	17	34	3.7	6.8	0.51	16	0.013	0.065	1.5	40	0.035	0.17
Nitrite	mg/L	0.02	0.00050	0.0020	0.099	0.20	0.023	0.040	0.39	0.79	0.086	0.16	0.012	0.39	0.00031	0.0016	0.034	0.94	0.00082	0.0040
Sulfate	mg/L	218	25	38	410	420	220	260	770	850	520	590	130	7700	4.3	29	290	17000	10.0	66
Aluminum, total	mg/L	0.27	0.034	0.66	0.39	0.39	0.38	0.38	0.39	0.39	0.38	0.38	0.38	1.0	0.37	0.37	0.38	1.1	0.37	0.37
Antimony, total	mg/L	0.074	0.000055	0.00013	0.00073	0.00080	0.00038	0.00049	0.0012	0.0014	0.00079	0.00094	0.00025	0.015	0.000010	0.000058	0.00054	0.031	0.000020	0.00012
Arsenic, total	mg/L	0.005	0.00020	0.00060	0.0018	0.0018	0.0013	0.0014	0.0025	0.0027	0.0018	0.0020	0.00092	0.023	0.00052	0.00059	0.0011	0.036	0.00053	0.00064
Barium, total	mg/L	1	0.059	0.071	0.072	0.080	0.050	0.062	0.075	0.095	0.058	0.072	0.038	1.6	0.0076	0.013	0.041	1.7	0.0077	0.013
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000056	0.000061	0.000038	0.000044	0.000056	0.000061	0.000038	0.000044	0.000034	0.0016	0.0000010	0.0000060	0.000034	0.0016	0.0000010	0.0000060
Boron, total	mg/L	1.2	0.0050	0.050	0.11	0.13	0.063	0.080	0.19	0.23	0.13	0.15	0.090	4.5	0.0031	0.018	0.097	5.3	0.0035	0.021
Cadmium, dissolved	mg/L	0.00016	0.0000075	0.000033	0.000034	0.000030	0.000022	0.000022	0.00011	0.00010	0.000063	0.000062	0.0000070	0.00036	0.0000021	0.0000013	0.000013	0.00075	0.0000048	0.0000029
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.0018	0.0020	0.0016	0.0017	0.0022	0.0024	0.0018	0.0020	0.0014	0.012	0.0012	0.0012	0.0015	0.018	0.0012	0.0012
Cobalt, dissolved	mg/L	0.00045	0.000050	0.00010	0.0029	0.0029	0.0019	0.0021	0.012	0.011	0.0050	0.0050	0.00045	0.028	0.000015	0.00011	0.00095	0.059	0.000032	0.00022
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0015	0.0015	0.0011	0.0012	0.0019	0.0019	0.0015	0.0015	0.0012	0.069	0.000042	0.00026	0.0019	0.11	0.000068	0.00041
Iron, total	mg/L	1	0.040	0.70	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.1	1.5	1.5	1.5	2.9	1.5	1.5
Iron, dissolved	mg/L	0.35	0.015	0.12	0.038	0.036	0.026	0.026	0.066	0.059	0.039	0.036	0.014	0.67	0.00043	0.0025	0.026	1.5	0.00094	0.0056
Lead, dissolved	mg/L	0.0026	0.000025	0.000050	0.0011	0.0012	0.00057	0.00072	0.0020	0.0022	0.0012	0.0015	0.00026	0.017	0.0000091	0.000064	0.00056	0.036	0.000020	0.00014
Manganese, total	mg/L	0.913	0.0036	0.029	0.063	0.061	0.047	0.049	0.19	0.18	0.089	0.090	0.031	0.34	0.025	0.026	0.036	0.58	0.026	0.027
Mercury, total	mg/L	0.00002	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.036	0.036	0.018	0.022	0.064	0.070	0.040	0.046	0.0055	0.35	0.00022	0.0014	0.013	0.84	0.00049	0.0032
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.0060	0.0061	0.0037	0.0042	0.017	0.016	0.0091	0.0096	0.0012	0.076	0.000041	0.00028	0.0024	0.15	0.000085	0.00058
Selenium, total	mg/L	0.002	0.000084	0.00020	0.022	0.024	0.011	0.014	0.039	0.049	0.024	0.030	0.0044	0.28	0.00016	0.0011	0.0093	0.58	0.00031	0.0022
Strontium, total	mg/L	2.5	0.080	0.11	0.28	0.29	0.18	0.20	0.47	0.53	0.34	0.38	0.18	11	0.0099	0.044	0.21	12	0.011	0.051
Silver, total	mg/L	0.00005	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00003	0.0000050	0.000010	0.000050	0.000077	0.000034	0.000047	0.00013	0.00013	0.000078	0.000089	0.000013	0.00077	0.0000048	0.0000029	0.000018	0.0011	0.0000068	0.0000041
Uranium, total	mg/L	0.0085	0.000056	0.00014	0.0045	0.0048	0.0023	0.0028	0.0078	0.0093	0.0049	0.0060	0.0014	0.084	0.000060	0.00033	0.0032	0.19	0.00012	0.00073
Zinc, dissolved	mg/L	0.0074	0.0013	0.0021	0.0088	0.0099	0.0055	0.0066	0.021	0.019	0.012	0.014	0.0021	0.12	0.000065	0.00044	0.0036	0.20	0.00011	0.00076

Red highlights indicate value above WQG calculated for the receiving stream
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_MMPs_WaterQuality_EAModel_41_20250717.xlsm

Table G-5

Parameter	Units	Rail Infrastructure Sedimentation Pond										
		Bulkley WQG	Baseline in Bulkley River		Operations							
					Final EAC Project Case (2024)				High Source terms (Alternative Case 2)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		29	40	70	66	66	63	1518	1443	1468	1377
Alkalinity, total	mg CaCO3/L		28	36	1.8	1.7	1.7	1.7	41	38	39	38
Chloride	mg/L	150	0.25	0.78	0.080	0.074	0.077	0.073	2.3	2.1	2.2	2.1
Fluoride	mg/L	0.84	0.023	0.035								
Ammonia, total	mg-N/L	1.6	0.0050	0.017								
Nitrate	mg/L	3	0.013	0.041								
Nitrite	mg/L	0.02	0.0020	0.0050								
Sulfate	mg/L	128	4.0	5.0	68	64	66	63	1600	1500	1600	1500
Aluminum, total	mg/L	0.18	0.088	1.2	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Antimony, total	mg/L		0.000050	0.00010	0.0000034	0.0000032	0.0000033	0.0000031	0.00011	0.00011	0.00011	0.00010
Arsenic, total	mg/L	0.005	0.00021	0.00069	0.00051	0.00051	0.00051	0.00051	0.00062	0.00062	0.00062	0.00061
Barium, total	mg/L	1	0.026	0.035	0.012	0.012	0.012	0.012	0.14	0.13	0.14	0.13
Beryllium, total	mg/L	0.00013	0.000050	0.00010								
Boron, total	mg/L	1.2	0.0050	0.010	0.0083	0.0078	0.0080	0.0076	0.18	0.17	0.18	0.17
Cadmium, dissolved	mg/L	8.50E-05	0.0000025	0.0000068	0.000091	0.000085	0.000087	0.000083	0.0021	0.0020	0.0020	0.0019
Chromium, total	mg/L	0.0089	0.00020	0.0010	0.0012	0.0012	0.0012	0.0012	0.0016	0.0015	0.0015	0.0015
Cobalt, dissolved	mg/L	0.00039	0.000050	0.00010	0.00080	0.00074	0.00077	0.00073	0.021	0.019	0.020	0.019
Copper, dissolved	mg/L	0.0011	0.00058	0.0016	0.00023	0.00021	0.00022	0.00021	0.0062	0.0057	0.0059	0.0056
Iron, total	mg/L	1	0.12	1.3	1.5	1.5	1.5	1.5	1.8	1.7	1.7	1.7
Iron, dissolved	mg/L	0.35	0.032	0.15	0.076	0.071	0.073	0.070	0.30	0.28	0.28	0.27
Lead, dissolved	mg/L	0.0022	0.000025	0.000050	0.000046	0.000043	0.000044	0.000042	0.0010	0.00096	0.00098	0.00094
Manganese, total	mg/L	0.73	0.012	0.053	0.071	0.068	0.069	0.067	1.2	1.1	1.2	1.1
Mercury, total	mg/L	0.00002	0.0000025	0.0000053	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00037	0.00052	0.00018	0.00017	0.00017	0.00016	0.0034	0.0032	0.0033	0.0032
Nickel, dissolved	mg/L	0.001	0.00025	0.00073	0.0023	0.0021	0.0022	0.0021	0.048	0.045	0.046	0.044
Selenium, total	mg/L	0.002	0.000025	0.00020	0.00035	0.00032	0.00033	0.00032	0.0080	0.0074	0.0077	0.0073
Strontium, total	mg/L	2.5	0.042	0.060	0.072	0.067	0.069	0.066	1.5	1.4	1.4	1.4
Silver, total	mg/L	0.00005	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00003	0.0000050	0.000013	0.00010	0.000096	0.000098	0.000094	0.0025	0.0024	0.0024	0.0023
Uranium, total	mg/L	0.0085	0.000035	0.000083	0.000031	0.000029	0.000030	0.000029	0.00047	0.00044	0.00045	0.00043
Zinc, dissolved	mg/L	0.0039	0.00075	0.0023	0.0034	0.0032	0.0033	0.0031	0.093	0.087	0.090	0.086

Red highlights indicate value above WQG calculated for the receiving stream
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_MMPs_WaterQuality_EAModel_41_20250717.xlsm

Table G-6

Parameter	Units	North Management Pond Void Space and Seepage Water Quality																		
		Goathorn WQG	Baseline in Goathorn Creek		Operations								Closure							
					Final EAC Project Case (2024)				High Source terms (Alternative Case 2)				Final EAC Project Case (2024)				High Source terms (Alternative Case 2)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	89	85	31	31	224	222	113	113	42	42	34	34	74	74	58	58
Alkalinity, total	mg CaCO3/L		54	85	200	210	86	87	600	600	300	300	260	260	170	170	440	440	290	290
Chloride	mg/L	150	0.25	0.50	2.5	2.6	1.0	1.1	8.6	8.7	4.3	4.3	2.1	2.1	2.0	2.0	2.4	2.4	2.3	2.3
Fluoride	mg/L	1.19	0.032	0.041	0.044	0.043	0.017	0.017	0.044	0.043	0.017	0.017	0.023	0.023	0.022	0.022	0.023	0.023	0.022	0.022
Ammonia, total	mg-N/L	1.56	0.0025	0.0070	0.22	0.22	0.14	0.14	0.87	0.87	0.56	0.56	0.089	0.090	0.048	0.048	0.32	0.32	0.12	0.12
Nitrate	mg/L	3	0.043	0.084	1.7	1.7	1.1	1.1	6.8	6.8	4.4	4.4	0.68	0.69	0.33	0.34	2.5	2.5	0.90	0.91
Nitrite	mg/L	0.02	0.00050	0.0020	0.040	0.040	0.026	0.026	0.16	0.16	0.10	0.10	0.016	0.016	0.0078	0.0079	0.058	0.058	0.021	0.021
Sulfate	mg/L	218	25	38	270	280	110	120	970	980	480	490	170	170	140	140	460	460	390	390
Aluminum, total	mg/L	0.27	0.034	0.66	0.022	0.023	0.010	0.010	0.031	0.032	0.015	0.016	0.016	0.016	0.010	0.010	0.017	0.017	0.011	0.012
Antimony, total	mg/L	0.074	0.000055	0.00013	0.00028	0.00029	0.00012	0.00012	0.00091	0.00092	0.00045	0.00046	0.00031	0.00032	0.00027	0.00027	0.00082	0.00083	0.00069	0.00069
Arsenic, total	mg/L	0.005	0.00020	0.00060	0.00067	0.00065	0.00024	0.00024	0.0014	0.0014	0.00067	0.00068	0.00029	0.00029	0.00026	0.00026	0.00072	0.00073	0.00059	0.00059
Barium, total	mg/L	1	0.059	0.071	0.049	0.049	0.019	0.019	0.064	0.064	0.026	0.027	0.016	0.016	0.015	0.015	0.017	0.017	0.016	0.016
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000050	0.000046	0.000016	0.000016	0.000050	0.000046	0.000016	0.000016	0.000013	0.000013	0.000013	0.000013	0.000013	0.000013	0.000013	0.000013
Boron, total	mg/L	1.2	0.0050	0.050	0.049	0.051	0.021	0.022	0.16	0.16	0.077	0.078	0.097	0.097	0.088	0.088	0.10	0.10	0.094	0.095
Cadmium, dissolved	mg/L	0.00016	0.0000075	0.000033	0.000082	0.000083	0.000034	0.000034	0.00021	0.00021	0.000094	0.000095	0.0000093	0.0000094	0.0000044	0.0000045	0.000025	0.000026	0.000014	0.000014
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.00036	0.00037	0.00014	0.00015	0.00081	0.00081	0.00039	0.00040	0.00012	0.00012	0.00011	0.00011	0.00022	0.00022	0.00021	0.00021
Cobalt, dissolved	mg/L	0.00045	0.000050	0.00010	0.0042	0.0045	0.0018	0.0019	0.019	0.019	0.0093	0.0094	0.00052	0.00053	0.00045	0.00046	0.0022	0.0023	0.0015	0.0015
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0014	0.0014	0.00057	0.00058	0.0021	0.0022	0.00097	0.00099	0.0016	0.0016	0.0013	0.0013	0.0037	0.0038	0.0025	0.0025
Iron, total	mg/L	1	0.040	0.70	0.11	0.11	0.045	0.045	0.21	0.21	0.089	0.090	0.014	0.014	0.0068	0.0068	0.032	0.032	0.029	0.029
Iron, dissolved	mg/L	0.35	0.015	0.12	0.11	0.11	0.045	0.045	0.21	0.21	0.089	0.090	0.014	0.014	0.0068	0.0068	0.032	0.032	0.029	0.029
Lead, dissolved	mg/L	0.0026	0.000025	0.000050	0.00042	0.00044	0.00018	0.00019	0.0015	0.0015	0.00074	0.00075	0.00043	0.00043	0.00034	0.00034	0.0013	0.0013	0.0010	0.0010
Manganese, total	mg/L	0.913	0.0036	0.029	0.080	0.085	0.034	0.035	0.29	0.30	0.14	0.14	0.0087	0.0089	0.0038	0.0038	0.031	0.032	0.010	0.010
Mercury, total	mg/L	0.00002	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.012	0.013	0.0053	0.0054	0.046	0.046	0.023	0.024	0.0056	0.0056	0.0050	0.0050	0.017	0.017	0.015	0.015
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.0069	0.0073	0.0029	0.0030	0.028	0.028	0.014	0.014	0.0016	0.0016	0.0013	0.0013	0.0049	0.0050	0.0041	0.0041
Selenium, total	mg/L	0.002	0.000084	0.00020	0.0082	0.0087	0.0033	0.0034	0.029	0.029	0.014	0.015	0.0056	0.0056	0.0044	0.0044	0.017	0.018	0.013	0.013
Strontium, total	mg/L	2.5	0.080	0.11	0.25	0.26	0.099	0.10	0.66	0.66	0.31	0.32	0.18	0.18	0.17	0.17	0.19	0.19	0.18	0.18
Silver, total	mg/L	0.00005	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00003	0.0000050	0.000010	0.00010	0.00010	0.000042	0.000043	0.00024	0.00024	0.00010	0.00011	0.000014	0.000014	0.000012	0.000013	0.000030	0.000030	0.000021	0.000021
Uranium, total	mg/L	0.0085	0.000056	0.00014	0.0015	0.0016	0.00066	0.00068	0.0056	0.0056	0.0028	0.0028	0.0018	0.0018	0.0015	0.0015	0.0049	0.0049	0.0041	0.0041
Zinc, dissolved	mg/L	0.0074	0.0013	0.0021	0.0097	0.010	0.0041	0.0042	0.033	0.034	0.016	0.016	0.0014	0.0014	0.0013	0.0013	0.0042	0.0042	0.0033	0.0033

Red highlights indicate value above WQG calculated for the receiving stream
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_MMPs_void_WaterQuality_EAModel_41_20250717.xlsm

Table G-7

Parameter	Units	East Management Pond Void Space and Seepage Water Quality																		
		Four Creek WQG	Baseline in Four Creek		Operations								Closure							
					Final EAC Project Case (2024)				High Source terms (Alternative Case 2)				Final EAC Project Case (2024)				High Source terms (Alternative Case 2)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		123	172	47	47	19	18	132	135	85	83	13	13	9	9	50	51	21	21
Alkalinity, total	mg CaCO3/L		140	190	130	130	63	61	340	350	220	210	36	36	16	16	120	120	43	43
Chloride	mg/L	150	0.25	0.53	1.6	1.6	0.91	0.90	5.3	5.3	3.5	3.4	0.51	0.52	0.17	0.17	2.0	2.0	0.62	0.62
Fluoride	mg/L	1.37	0.053	0.070	0.027	0.027	0.011	0.010	0.027	0.027	0.011	0.010	0.0069	0.0069	0.0047	0.0047	0.0069	0.0069	0.0047	0.0047
Ammonia, total	mg-N/L	0.992	0.0025	0.011	0.28	0.28	0.19	0.19	1.1	1.1	0.74	0.74	0.12	0.12	0.037	0.037	0.47	0.48	0.15	0.15
Nitrate	mg/L	3	0.016	0.17	2.2	2.2	1.5	1.5	8.6	8.6	5.9	5.8	0.94	0.96	0.29	0.29	3.7	3.8	1.1	1.2
Nitrite	mg/L	0.02	0.00050	0.0010	0.050	0.050	0.034	0.034	0.20	0.20	0.13	0.13	0.022	0.022	0.0067	0.0067	0.086	0.088	0.026	0.027
Sulfate	mg/L	309	2.1	26	190	200	120	120	690	690	450	450	69	70	21	22	260	260	79	80
Aluminum, total	mg/L	0.69	0.081	1.1	0.017	0.017	0.0085	0.0082	0.026	0.027	0.014	0.014	0.0051	0.0052	0.0026	0.0026	0.0083	0.0084	0.0035	0.0036
Antimony, total	mg/L	0.074	0.000050	0.00011	0.00018	0.00018	0.000093	0.000092	0.00053	0.00053	0.00035	0.00034	0.000052	0.000053	0.000020	0.000020	0.00020	0.00020	0.000064	0.000064
Arsenic, total	mg/L	0.005	0.00067	0.0010	0.00037	0.00037	0.00016	0.00016	0.00080	0.00082	0.00049	0.00048	0.000097	0.000099	0.000054	0.000055	0.00028	0.00029	0.00011	0.00011
Barium, total	mg/L	1	0.078	0.13	0.031	0.032	0.012	0.012	0.040	0.041	0.018	0.018	0.0082	0.0083	0.0063	0.0063	0.012	0.012	0.0073	0.0074
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000026	0.000027	0.0000093	0.0000088	0.000026	0.000027	0.0000093	0.0000088	0.0000065	0.0000066	0.0000056	0.0000056	0.0000065	0.0000066	0.0000056	0.0000056
Boron, total	mg/L	1.2	0.011	0.020	0.032	0.033	0.017	0.017	0.092	0.093	0.060	0.060	0.0096	0.0098	0.0036	0.0036	0.034	0.034	0.011	0.011
Cadmium, dissolved	mg/L	0.00023	0.0000050	0.000011	0.000057	0.000058	0.000034	0.000033	0.00014	0.00014	0.000089	0.000087	0.000018	0.000019	0.0000059	0.0000060	0.000049	0.000050	0.000015	0.000015
Chromium, total	mg/L	0.0089	0.00040	0.0015	0.00023	0.00023	0.00011	0.00011	0.00049	0.00050	0.00030	0.00030	0.000065	0.000066	0.000034	0.000035	0.00018	0.00018	0.000068	0.000069
Cobalt, dissolved	mg/L	0.00056	0.000050	0.00014	0.0034	0.0034	0.0023	0.0022	0.014	0.014	0.0088	0.0088	0.0013	0.0013	0.00040	0.00040	0.0051	0.0052	0.0016	0.0016
Copper, dissolved	mg/L	0.0047	0.0011	0.0033	0.00094	0.00097	0.00042	0.00041	0.0015	0.0015	0.00078	0.00076	0.00027	0.00027	0.00016	0.00016	0.00046	0.00047	0.00022	0.00022
Iron, total	mg/L	1	0.078	0.78	0.077	0.079	0.044	0.043	0.15	0.15	0.089	0.087	0.025	0.025	0.0090	0.0090	0.049	0.050	0.016	0.017
Iron, dissolved	mg/L	0.35	0.015	0.35	0.077	0.079	0.044	0.043	0.15	0.15	0.089	0.087	0.025	0.025	0.0090	0.0090	0.049	0.050	0.016	0.017
Lead, dissolved	mg/L	0.0061	0.000025	0.000075	0.00027	0.00027	0.00015	0.00014	0.00086	0.00087	0.00056	0.00055	0.000079	0.000081	0.000026	0.000027	0.00031	0.00032	0.000098	0.000098
Manganese, total	mg/L	1.089	0.0022	0.018	0.061	0.063	0.040	0.040	0.21	0.21	0.14	0.14	0.023	0.023	0.0071	0.0071	0.078	0.079	0.024	0.024
Mercury, total	mg/L	0.00002	0.0000038	0.000012	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038
Molybdenum, total	mg-N/L	0.034	0.00023	0.00040	0.0075	0.0076	0.0040	0.0040	0.026	0.026	0.017	0.017	0.0022	0.0022	0.00069	0.00069	0.0096	0.0098	0.0030	0.0030
Nickel, dissolved	mg/L	0.0047	0.00050	0.0011	0.0051	0.0052	0.0033	0.0032	0.019	0.019	0.012	0.012	0.0018	0.0019	0.00058	0.00059	0.0070	0.0072	0.0022	0.0022
Selenium, total	mg/L	0.002	0.000050	0.000095	0.0052	0.0052	0.0031	0.0031	0.019	0.019	0.012	0.012	0.0017	0.0018	0.00053	0.00054	0.0069	0.0071	0.0021	0.0021
Strontium, total	mg/L	2.5	0.17	0.24	0.17	0.17	0.093	0.091	0.43	0.43	0.28	0.28	0.055	0.055	0.024	0.024	0.16	0.17	0.057	0.058
Silver, total	mg/L	0.0015	0.0000050	0.000021	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00003	0.0000050	0.000010	0.000071	0.000073	0.000041	0.000041	0.00016	0.00016	0.00010	0.000100	0.000023	0.000023	0.0000077	0.0000078	0.000056	0.000057	0.000018	0.000018
Uranium, total	mg/L	0.0085	0.000099	0.00026	0.00096	0.00097	0.00053	0.00053	0.0032	0.0033	0.0021	0.0021	0.00029	0.00030	0.000096	0.000096	0.0012	0.0012	0.00037	0.00038
Zinc, dissolved	mg/L	0.0139	0.0010	0.0023	0.0071	0.0073	0.0043	0.0043	0.023	0.023	0.015	0.015	0.0025	0.0025	0.00086	0.00087	0.0084	0.0086	0.0027	0.0027

Red highlights indicate value above WQG calculated for the receiving stream

Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_MMPs_void_WaterQuality_EAModel_41_20250717.xlsm

Table G-8

Parameter	Units	West Management Pond Void Space and Seepage Water Quality																		
		Tenas WQG	Baseline in Tenas Creek		Operations								Closure							
					Final EAC Project Case (2024)				High Source terms (Alternative Case 2)				Final EAC Project Case (2024)				High Source terms (Alternative Case 2)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		75	101	36	36	13	13	203	199	62	62	60	60	47	46	117	117	90	90
Alkalinity, total	mg CaCO3/L		85	110	120	120	43	43	810	810	460	460	350	350	230	230	690	700	550	550
Chloride	mg/L	150	0.25	0.52	2.2	2.3	0.85	0.84	10	10	6.1	6.1	3.2	3.2	3.0	3.0	8.8	8.9	5.7	5.7
Fluoride	mg/L	1.22	0.031	0.045	0.029	0.029	0.011	0.011	0.029	0.029	0.011	0.011	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Ammonia, total	mg-N/L	1.3	0.0025	0.0085	0.37	0.37	0.19	0.18	1.3	1.3	0.70	0.70	0.35	0.35	0.17	0.17	1.2	1.2	0.55	0.55
Nitrate	mg/L	3	0.0050	0.060	2.9	2.9	1.4	1.4	10	10	5.5	5.5	2.7	2.7	1.3	1.3	9.6	9.7	4.3	4.3
Nitrite	mg/L	0.02	0.00050	0.0020	0.066	0.066	0.033	0.033	0.24	0.24	0.13	0.13	0.062	0.063	0.030	0.030	0.22	0.22	0.099	0.099
Sulfate	mg/L	218	2.6	7.3	230	230	120	120	1000	1000	620	620	250	250	240	240	880	890	740	740
Aluminum, total	mg/L	0.35	0.047	1.7	0.010	0.011	0.0046	0.0045	0.018	0.018	0.0079	0.0078	0.021	0.021	0.014	0.014	0.023	0.023	0.018	0.018
Antimony, total	mg/L	0.074	0.00012	0.00024	0.00022	0.00023	0.000078	0.000077	0.0012	0.0012	0.00072	0.00072	0.00046	0.00046	0.00039	0.00039	0.0012	0.0012	0.0012	0.0012
Arsenic, total	mg/L	0.005	0.00045	0.00089	0.00030	0.00030	0.00012	0.00011	0.0013	0.0013	0.00079	0.00078	0.00042	0.00042	0.00038	0.00038	0.0012	0.0012	0.0011	0.0011
Barium, total	mg/L	1	0.035	0.046	0.023	0.023	0.0092	0.0090	0.037	0.037	0.019	0.019	0.024	0.024	0.022	0.022	0.036	0.036	0.027	0.027
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000017	0.000017	0.0000061	0.0000060	0.000017	0.000017	0.0000061	0.0000060	0.000018	0.000018	0.000018	0.000018	0.000018	0.000018	0.000018	0.000018
Boron, total	mg/L	1.2	0.015	0.050	0.069	0.070	0.020	0.020	0.22	0.22	0.12	0.12	0.14	0.14	0.13	0.13	0.21	0.21	0.18	0.18
Cadmium, dissolved	mg/L	0.00017	0.0000025	0.0000057	0.000055	0.000056	0.000032	0.000032	0.00016	0.00016	0.000088	0.000088	0.000044	0.000045	0.000020	0.000021	0.00011	0.00011	0.000054	0.000054
Chromium, total	mg/L	0.0089	0.00032	0.0018	0.00019	0.00020	0.000085	0.000084	0.00088	0.00088	0.00051	0.00051	0.00020	0.00020	0.00018	0.00018	0.00075	0.00075	0.00048	0.00049
Cobalt, dissolved	mg/L	0.00045	0.000050	0.000050	0.0040	0.0042	0.0021	0.0021	0.019	0.020	0.0080	0.0081	0.0026	0.0026	0.0014	0.0014	0.0082	0.0083	0.0044	0.0044
Copper, dissolved	mg/L	0.0026	0.00091	0.0014	0.00081	0.00082	0.00029	0.00029	0.0021	0.0021	0.00088	0.00087	0.0023	0.0023	0.0017	0.0017	0.0050	0.0050	0.0034	0.0034
Iron, total	mg/L	1	0.043	0.25	0.063	0.063	0.038	0.038	0.13	0.13	0.079	0.079	0.056	0.057	0.026	0.026	0.12	0.12	0.074	0.074
Iron, dissolved	mg/L	0.35	0.015	0.015	0.063	0.063	0.038	0.038	0.13	0.13	0.079	0.079	0.056	0.057	0.026	0.026	0.12	0.12	0.074	0.074
Lead, dissolved	mg/L	0.0031	0.000025	0.000025	0.00025	0.00025	0.00010	0.00010	0.0021	0.0021	0.0012	0.0012	0.00061	0.00061	0.00048	0.00048	0.0019	0.0019	0.0017	0.0017
Manganese, total	mg/L	0.935	0.0044	0.010	0.071	0.074	0.039	0.039	0.27	0.29	0.11	0.11	0.048	0.049	0.021	0.021	0.11	0.11	0.048	0.048
Mercury, total	mg/L	0.00002	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00012	0.00015	0.0069	0.0070	0.0027	0.0027	0.068	0.068	0.038	0.038	0.0085	0.0085	0.0079	0.0079	0.053	0.054	0.035	0.035
Nickel, dissolved	mg/L	0.0025	0.00025	0.00025	0.0054	0.0056	0.0030	0.0030	0.026	0.026	0.013	0.013	0.0041	0.0042	0.0029	0.0029	0.014	0.014	0.0094	0.0094
Selenium, total	mg/L	0.002	0.000052	0.000067	0.0078	0.0078	0.0033	0.0033	0.037	0.037	0.021	0.021	0.0083	0.0083	0.0076	0.0076	0.031	0.031	0.026	0.026
Strontium, total	mg/L	2.5	0.11	0.13	0.21	0.21	0.093	0.092	0.53	0.55	0.32	0.32	0.27	0.27	0.26	0.26	0.48	0.48	0.36	0.36
Silver, total	mg/L	0.00005	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00003	0.0000050	0.0000050	0.000067	0.000067	0.000041	0.000041	0.00018	0.00018	0.00010	0.00010	0.000061	0.000062	0.000035	0.000035	0.00013	0.00013	0.000069	0.000069
Uranium, total	mg/L	0.0085	0.00012	0.00017	0.0013	0.0013	0.00045	0.00044	0.0080	0.0080	0.0046	0.0046	0.0027	0.0027	0.0022	0.0022	0.0075	0.0075	0.0072	0.0072
Zinc, dissolved	mg/L	0.0071	0.0010	0.0015	0.0068	0.0071	0.0039	0.0039	0.029	0.030	0.015	0.015	0.0055	0.0055	0.0033	0.0033	0.017	0.017	0.0093	0.0093

Red highlights indicate value above WQG calculated for the receiving stream
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_MMPs_void_WaterQuality_EAModel_41_20250717.xlsm

Table G-9

Parameter	Units	Tenas Control Pond Void Space and Seepage Water Quality																		
		Goathorn WQG	Baseline in Goathorn Creek		Operations								Closure							
					Final EAC Project Case (2024)				High Source terms (Alternative Case 2)				Final EAC Project Case (2024)				High Source terms (Alternative Case 2)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	136	159	86	107	230	287	152	191	63	3274	2	12	87	4721	3	18
Alkalinity, total	mg CaCO3/L		54	85	500	560	270	350	820	1000	530	650	120	7200	4.2	27	230	14000	8.3	55
Chloride	mg/L	150	0.25	0.50	6.0	6.7	3.1	4.0	10	13	6.6	8.1	2.1	120	0.072	0.46	2.7	170	0.095	0.64
Fluoride	mg/L	1.19	0.032	0.041	0.071	0.15	0.046	0.082	0.071	0.15	0.046	0.082	0.028	1.6	0.0010	0.0061	0.028	1.6	0.0010	0.0061
Ammonia, total	mg-N/L	1.56	0.0025	0.0070	0.56	1.1	0.13	0.24	2.2	4.4	0.48	0.88	0.071	2.3	0.0018	0.0093	0.19	5.3	0.0046	0.022
Nitrate	mg/L	3	0.043	0.084	4.3	8.6	0.96	1.7	17	34	3.7	6.8	0.51	16	0.013	0.065	1.5	40	0.035	0.17
Nitrite	mg/L	0.02	0.00050	0.0020	0.099	0.20	0.023	0.040	0.39	0.79	0.086	0.16	0.012	0.39	0.00031	0.0016	0.034	0.94	0.00082	0.0040
Sulfate	mg/L	218	25	38	410	420	220	260	770	850	520	590	130	7700	4.3	29	290	17000	10.0	66
Aluminum, total	mg/L	0.27	0.034	0.66	0.019	0.017	0.013	0.012	0.020	0.017	0.014	0.013	0.013	0.63	0.00039	0.0023	0.015	0.78	0.00048	0.0029
Antimony, total	mg/L	0.074	0.000055	0.00013	0.00072	0.00079	0.00038	0.00049	0.0012	0.0014	0.00078	0.00094	0.00025	0.015	0.0000085	0.000056	0.00054	0.031	0.000018	0.00012
Arsenic, total	mg/L	0.005	0.00020	0.00060	0.0013	0.0013	0.00074	0.00088	0.0020	0.0022	0.0013	0.0015	0.00041	0.022	0.000013	0.000083	0.00062	0.036	0.000020	0.00013
Barium, total	mg/L	1	0.059	0.071	0.066	0.074	0.043	0.055	0.068	0.088	0.051	0.065	0.032	1.6	0.00100	0.0060	0.034	1.7	0.0011	0.0065
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000056	0.000061	0.000038	0.000044	0.000056	0.000061	0.000038	0.000044	0.000034	0.0016	0.0000010	0.0000060	0.000034	0.0016	0.0000010	0.0000060
Boron, total	mg/L	1.2	0.0050	0.050	0.11	0.13	0.063	0.080	0.19	0.23	0.13	0.15	0.090	4.5	0.0028	0.017	0.097	5.3	0.0032	0.020
Cadmium, dissolved	mg/L	0.00016	0.0000075	0.000033	0.000034	0.000030	0.000022	0.000022	0.00011	0.00010	0.000063	0.000062	0.0000070	0.00036	0.0000021	0.0000013	0.000013	0.00075	0.00000048	0.0000029
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.00066	0.00078	0.00039	0.00051	0.00097	0.0012	0.00066	0.00082	0.00021	0.011	0.0000065	0.000041	0.00030	0.017	0.0000097	0.000063
Cobalt, dissolved	mg/L	0.00045	0.000050	0.00010	0.0029	0.0029	0.0019	0.0021	0.012	0.011	0.0050	0.0050	0.00045	0.028	0.000015	0.00011	0.00095	0.059	0.000032	0.00022
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0015	0.0015	0.0011	0.0012	0.0019	0.0019	0.0015	0.0015	0.0012	0.069	0.000042	0.00026	0.0019	0.11	0.000068	0.00041
Iron, total	mg/L	1	0.040	0.70	0.038	0.036	0.026	0.026	0.066	0.059	0.039	0.036	0.014	0.67	0.00043	0.0025	0.026	1.5	0.00094	0.0056
Iron, dissolved	mg/L	0.35	0.015	0.12	0.038	0.036	0.026	0.026	0.066	0.059	0.039	0.036	0.014	0.67	0.00043	0.0025	0.026	1.5	0.00094	0.0056
Lead, dissolved	mg/L	0.0026	0.000025	0.000050	0.0011	0.0012	0.00057	0.00072	0.0020	0.0022	0.0012	0.0015	0.00026	0.017	0.0000091	0.000064	0.00056	0.036	0.000020	0.00014
Manganese, total	mg/L	0.913	0.0036	0.029	0.038	0.036	0.022	0.024	0.16	0.15	0.064	0.065	0.0059	0.31	0.00017	0.0012	0.010	0.55	0.00030	0.0021
Mercury, total	mg/L	0.00002	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.036	0.036	0.018	0.022	0.064	0.070	0.040	0.046	0.0055	0.35	0.00019	0.0013	0.013	0.84	0.00046	0.0032
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.0060	0.0061	0.0037	0.0042	0.017	0.016	0.0091	0.0096	0.0012	0.076	0.000041	0.00028	0.0024	0.15	0.000085	0.00058
Selenium, total	mg/L	0.002	0.000084	0.00020	0.022	0.024	0.011	0.014	0.039	0.049	0.024	0.030	0.0044	0.28	0.00015	0.0011	0.0092	0.58	0.00031	0.0022
Strontium, total	mg/L	2.5	0.080	0.11	0.28	0.28	0.18	0.20	0.47	0.53	0.34	0.38	0.18	11	0.0065	0.040	0.20	12	0.0074	0.047
Silver, total	mg/L	0.00005	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00003	0.0000050	0.000010	0.000050	0.000077	0.000034	0.000047	0.00013	0.00013	0.000078	0.000089	0.000013	0.00077	0.00000048	0.0000029	0.000018	0.0011	0.00000068	0.0000041
Uranium, total	mg/L	0.0085	0.000056	0.00014	0.0044	0.0048	0.0022	0.0028	0.0078	0.0093	0.0049	0.0060	0.0014	0.084	0.000047	0.00032	0.0032	0.19	0.00011	0.00072
Zinc, dissolved	mg/L	0.0074	0.0013	0.0021	0.0088	0.0099	0.0055	0.0066	0.021	0.019	0.012	0.014	0.0021	0.12	0.000065	0.00044	0.0036	0.20	0.00011	0.00076

Red highlights indicate value above WQG calculated for the receiving stream
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_MMPs_void_WaterQuality_EAModel_41_20250717.xlsm

Table G-10

Parameter	Units	Four Creek																					
		WQG	Baseline		WQS20 Closure																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		123	172	149	201	128	133	162	201	131	70	149	201	128	133	156	208	131	74	147	205	131	133
Alkalinity, total	mg-$CaCO_3$/L		140	190	170	230	150	150	190	230	150	78	170	230	150	150	180	240	150	83	170	230	150	150
Chloride	mg/L	150	0.25	0.53	0.35	0.41	0.30	0.27	0.39	0.41	0.30	0.14	0.35	0.41	0.30	0.27	0.37	0.42	0.31	0.15	0.35	0.41	0.30	0.27
Fluoride	mg/L	1.4	0.053	0.070	0.076	0.099	0.065	0.066	0.083	0.099	0.066	0.034	0.076	0.099	0.065	0.066	0.080	0.10	0.066	0.036	0.076	0.100	0.066	0.067
Ammonia, total	mg-N/L	0.99	0.0025	0.011	0.0035	0.0041	0.0030	0.0027	0.0039	0.0041	0.0030	0.0014	0.0035	0.0041	0.0030	0.0027	0.0037	0.0042	0.0031	0.0015	0.0035	0.0041	0.0030	0.0027
Nitrate	mg/L	3.0	0.016	0.17	0.024	0.098	0.014	0.064	0.024	0.097	0.014	0.033	0.024	0.098	0.014	0.064	0.024	0.10	0.014	0.036	0.024	0.098	0.014	0.065
Nitrite	mg/L	0.020	0.00050	0.0010	0.00093	0.00081	0.00080	0.00055	0.0010	0.00081	0.00080	0.00028	0.00093	0.00081	0.00080	0.00055	0.00097	0.00085	0.00081	0.00030	0.00093	0.00082	0.00080	0.00055
Sulfate	mg/L	309	2.1	26	3.1	3.4	2.7	2.3	3.4	3.4	2.7	1.2	3.1	3.4	2.7	2.3	3.2	3.6	2.7	1.2	3.1	3.4	2.7	2.3
Aluminum, total	mg/L	0.69	0.081	1.1	0.14	0.075	0.12	0.051	0.15	0.075	0.12	0.026	0.14	0.075	0.12	0.051	0.15	0.078	0.12	0.027	0.14	0.075	0.12	0.051
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.00014	0.000081	0.00012	0.000055	0.00015	0.000081	0.00012	0.000028	0.00014	0.000081	0.00012	0.000055	0.00015	0.000085	0.00012	0.000030	0.00014	0.000082	0.00012	0.000055
Arsenic, total	mg/L	0.0050	0.00067	0.0010	0.00096	0.0010	0.00082	0.00068	0.0011	0.0010	0.00082	0.00035	0.00096	0.0010	0.00082	0.00068	0.0010	0.0011	0.00083	0.00037	0.00095	0.0010	0.00082	0.00069
Barium, total	mg/L	1.0	0.078	0.13	0.096	0.14	0.083	0.094	0.11	0.14	0.083	0.048	0.096	0.14	0.083	0.094	0.10	0.15	0.084	0.052	0.097	0.14	0.083	0.095
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.00011	0.000081	0.000090	0.000055	0.00012	0.000081	0.000090	0.000028	0.00011	0.000081	0.000090	0.000055	0.00011	0.000085	0.000092	0.000030	0.00011	0.000082	0.000090	0.000055
Boron, total	mg/L	1.2	0.011	0.020	0.014	0.021	0.012	0.014	0.015	0.021	0.012	0.0072	0.014	0.021	0.012	0.014	0.015	0.022	0.012	0.0077	0.014	0.021	0.012	0.014
Cadmium, dissolved	mg/L	0.00023	0.0000050	0.000011	0.0000072	0.0000041	0.0000061	0.0000028	0.0000079	0.0000041	0.0000061	0.0000014	0.0000072	0.0000041	0.0000061	0.0000028	0.0000075	0.0000042	0.0000062	0.0000015	0.0000072	0.0000041	0.0000061	0.0000028
Chromium, total	mg/L	0.0089	0.00040	0.0015	0.00071	0.00034	0.00060	0.00023	0.00077	0.00034	0.00060	0.00012	0.00071	0.00034	0.00060	0.00023	0.00074	0.00036	0.00061	0.00012	0.00070	0.00034	0.00060	0.00023
Cobalt, dissolved	mg/L	0.00056	0.000050	0.00014	0.00011	0.000081	0.000090	0.000055	0.00012	0.000081	0.000090	0.000028	0.00011	0.000081	0.000090	0.000055	0.00011	0.000085	0.000092	0.000030	0.00011	0.000082	0.000090	0.000055
Copper, dissolved	mg/L	0.0047	0.0011	0.0033	0.0018	0.0016	0.0016	0.0011	0.0020	0.0016	0.0016	0.00056	0.0018	0.0016	0.0016	0.0011	0.0019	0.0017	0.0016	0.00059	0.0018	0.0016	0.0016	0.0011
Iron, total	mg/L	1.0	0.078	0.78	0.13	0.067	0.11	0.045	0.15	0.066	0.11	0.023	0.13	0.067	0.11	0.045	0.14	0.070	0.12	0.024	0.13	0.067	0.11	0.046
Iron, dissolved	mg/L	0.35	0.015	0.35	0.021	0.024	0.018	0.016	0.023	0.024	0.018	0.0084	0.021	0.024	0.018	0.016	0.022	0.025	0.018	0.0089	0.021	0.025	0.018	0.016
Lead, dissolved	mg/L	0.0061	0.000025	0.000075	0.000035	0.000041	0.000030	0.000027	0.000039	0.000041	0.000030	0.000014	0.000035	0.000041	0.000030	0.000027	0.000037	0.000042	0.000031	0.000015	0.000035	0.000041	0.000030	0.000027
Manganese, total	mg/L	1.1	0.0022	0.018	0.0034	0.0023	0.0029	0.0015	0.0037	0.0023	0.0029	0.00078	0.0034	0.0023	0.0029	0.0015	0.0035	0.0024	0.0029	0.00083	0.0034	0.0023	0.0029	0.0015
Mercury, total	mg/L	0.000020	0.0000038	0.000012	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038
Molybdenum, total	mg/L	0.034	0.00023	0.00040	0.00028	0.00039	0.00024	0.00026	0.00031	0.00039	0.00024	0.00013	0.00028	0.00039	0.00024	0.00026	0.00030	0.00041	0.00025	0.00014	0.00028	0.00039	0.00024	0.00026
Nickel, dissolved	mg/L	0.0047	0.00050	0.0011	0.00071	0.00041	0.00060	0.00028	0.00077	0.00041	0.00060	0.00014	0.00071	0.00041	0.00060	0.00028	0.00074	0.00042	0.00061	0.00015	0.00070	0.00041	0.00060	0.00028
Selenium, total	mg/L	0.0020	0.000050	0.000095	0.000071	0.000041	0.000060	0.000028	0.000077	0.000041	0.000060	0.000014	0.000071	0.000041	0.000060	0.000028	0.000074	0.000042	0.000061	0.000015	0.000070	0.000041	0.000060	0.000028
Strontium, total	mg/L	2.5	0.17	0.24	0.23	0.31	0.19	0.21	0.25	0.31	0.19	0.11	0.23	0.31	0.19	0.21	0.24	0.32	0.20	0.11	0.22	0.31	0.19	0.21
Silver, total	mg/L	0.0015	0.0000050	0.000021	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.000010	0.0000071	0.0000081	0.0000060	0.0000054	0.0000077	0.0000081	0.0000061	0.0000028	0.0000071	0.0000081	0.0000060	0.0000054	0.0000074	0.0000085	0.0000061	0.0000030	0.0000070	0.0000082	0.0000061	0.0000055
Uranium, total	mg/L	0.0085	0.000099	0.00026	0.00011	0.00020	0.000095	0.00013	0.00012	0.00019	0.000095	0.000067	0.00011	0.00020	0.000095	0.00013	0.00012	0.00020	0.000096	0.000071	0.00011	0.00020	0.000095	0.00013
Zinc, dissolved	mg/L	0.014	0.0010	0.0023	0.0014	0.0023	0.0012	0.0015	0.0015	0.0023	0.0012	0.00078	0.0014	0.0023	0.0012	0.0015	0.0015	0.0024	0.0012	0.00083	0.0014	0.0023	0.0012	0.0015

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-11

Parameter	Units	Four Creek																					
		WQG	Baseline		WQS21																		
					Closure																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		123	172	131	165	122	131	140	298	115	65	131	165	122	131	137	174	122	65	131	167	122	131
Alkalinity, total	mg-$CaCO_3$/L		140	190	150	190	130	150	160	340	130	75	150	190	130	150	150	190	130	74	150	190	130	150
Chloride	mg/L	150	0.25	0.53	0.31	0.33	0.28	0.26	0.33	0.64	0.28	0.13	0.31	0.33	0.28	0.26	0.32	0.35	0.28	0.13	0.31	0.34	0.28	0.26
Fluoride	mg/L	1.4	0.053	0.070	0.067	0.082	0.060	0.063	0.071	0.15	0.060	0.033	0.067	0.082	0.060	0.063	0.070	0.084	0.061	0.032	0.067	0.082	0.061	0.063
Ammonia, total	mg-N/L	0.99	0.0025	0.011	0.0031	0.0033	0.0028	0.0026	0.0033	0.0064	0.0028	0.0013	0.0031	0.0033	0.0028	0.0026	0.0032	0.0035	0.0028	0.0013	0.0031	0.0034	0.0028	0.0026
Nitrate	mg/L	3.0	0.016	0.17	0.018	0.080	0.013	0.062	0.018	0.097	0.013	0.032	0.018	0.080	0.013	0.062	0.018	0.083	0.013	0.032	0.018	0.080	0.013	0.062
Nitrite	mg/L	0.020	0.00050	0.0010	0.00082	0.00067	0.00074	0.00052	0.00087	0.0015	0.00073	0.00027	0.00082	0.00067	0.00074	0.00052	0.00085	0.00069	0.00074	0.00027	0.00081	0.00067	0.00074	0.00052
Sulfate	mg/L	309	2.1	26	2.7	2.8	2.5	2.2	2.9	5.5	2.4	1.1	2.7	2.8	2.5	2.2	2.8	2.9	2.5	1.1	2.7	2.8	2.5	2.2
Aluminum, total	mg/L	0.69	0.081	1.1	0.12	0.062	0.11	0.048	0.13	0.18	0.11	0.025	0.12	0.062	0.11	0.048	0.13	0.064	0.11	0.024	0.12	0.062	0.11	0.049
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.00012	0.000067	0.00011	0.000052	0.00013	0.00019	0.00011	0.000027	0.00012	0.000067	0.00011	0.000052	0.00013	0.000069	0.00011	0.000027	0.00012	0.000067	0.00011	0.000053
Arsenic, total	mg/L	0.0050	0.00067	0.0010	0.00084	0.00084	0.00076	0.00065	0.00089	0.0017	0.00075	0.00034	0.00084	0.00084	0.00076	0.00065	0.00088	0.00087	0.00076	0.00033	0.00084	0.00084	0.00076	0.00066
Barium, total	mg/L	1.0	0.078	0.13	0.084	0.12	0.076	0.090	0.089	0.20	0.075	0.046	0.084	0.12	0.076	0.090	0.088	0.12	0.077	0.046	0.084	0.12	0.076	0.090
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000093	0.000067	0.000084	0.000052	0.000098	0.00012	0.000083	0.000027	0.000093	0.000067	0.000084	0.000052	0.000097	0.000069	0.000084	0.000027	0.000093	0.000067	0.000084	0.000052
Boron, total	mg/L	1.2	0.011	0.020	0.012	0.017	0.011	0.013	0.013	0.030	0.011	0.0069	0.012	0.017	0.011	0.013	0.013	0.018	0.011	0.0069	0.012	0.017	0.011	0.014
Cadmium, dissolved	mg/L	0.00023	0.0000050	0.000011	0.0000063	0.0000033	0.0000057	0.0000026	0.0000067	0.0000094	0.0000056	0.0000014	0.0000063	0.0000033	0.0000057	0.0000026	0.0000066	0.0000035	0.0000057	0.0000013	0.0000063	0.0000034	0.0000057	0.0000026
Chromium, total	mg/L	0.0089	0.00040	0.0015	0.00062	0.00028	0.00056	0.00022	0.00066	0.00087	0.00055	0.00012	0.00062	0.00028	0.00056	0.00022	0.00064	0.00029	0.00056	0.00011	0.00062	0.00028	0.00056	0.00022
Cobalt, dissolved	mg/L	0.00056	0.000050	0.00014	0.000093	0.000067	0.000084	0.000052	0.000098	0.00016	0.000083	0.000027	0.000093	0.000067	0.000084	0.000052	0.000097	0.000069	0.000084	0.000027	0.000093	0.000067	0.000084	0.000052
Copper, dissolved	mg/L	0.0047	0.0011	0.0033	0.0016	0.0013	0.0014	0.0010	0.0017	0.0029	0.0014	0.00054	0.0016	0.0013	0.0014	0.0010	0.0017	0.0014	0.0015	0.00053	0.0016	0.0013	0.0015	0.0010
Iron, total	mg/L	1.0	0.078	0.78	0.12	0.055	0.11	0.043	0.12	0.17	0.10	0.023	0.12	0.055	0.11	0.043	0.12	0.057	0.11	0.022	0.12	0.055	0.11	0.043
Iron, dissolved	mg/L	0.35	0.015	0.35	0.019	0.020	0.017	0.016	0.020	0.039	0.017	0.0080	0.019	0.020	0.017	0.016	0.019	0.021	0.017	0.0080	0.019	0.020	0.017	0.016
Lead, dissolved	mg/L	0.0061	0.000025	0.000075	0.000031	0.000033	0.000028	0.000026	0.000033	0.000064	0.000028	0.000013	0.000031	0.000033	0.000028	0.000026	0.000032	0.000035	0.000028	0.000013	0.000031	0.000034	0.000028	0.000026
Manganese, total	mg/L	1.1	0.0022	0.018	0.0030	0.0019	0.0027	0.0015	0.0032	0.0048	0.0026	0.00076	0.0030	0.0019	0.0027	0.0015	0.0031	0.0019	0.0027	0.00074	0.0030	0.0019	0.0027	0.0015
Mercury, total	mg/L	0.000020	0.0000038	0.000012	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038
Molybdenum, total	mg/L	0.034	0.00023	0.00040	0.00025	0.00032	0.00022	0.00025	0.00026	0.00057	0.00022	0.00013	0.00025	0.00032	0.00022	0.00025	0.00026	0.00033	0.00022	0.00013	0.00025	0.00032	0.00022	0.00025
Nickel, dissolved	mg/L	0.0047	0.00050	0.0011	0.00062	0.00033	0.00056	0.00026	0.00066	0.00093	0.00055	0.00014	0.00062	0.00033	0.00056	0.00026	0.00064	0.00035	0.00056	0.00013	0.00062	0.00034	0.00056	0.00026
Selenium, total	mg/L	0.0020	0.000050	0.000095	0.000062	0.000033	0.000056	0.000026	0.000066	0.000093	0.000055	0.000014	0.000062	0.000033	0.000056	0.000026	0.000064	0.000035	0.000056	0.000013	0.000062	0.000034	0.000056	0.000026
Strontium, total	mg/L	2.5	0.17	0.24	0.20	0.25	0.18	0.20	0.21	0.45	0.18	0.10	0.20	0.25	0.18	0.20	0.21	0.26	0.18	0.10	0.20	0.25	0.18	0.20
Silver, total	mg/L	0.0015	0.0000050	0.000021	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.000010	0.0000062	0.0000067	0.0000056	0.0000052	0.0000066	0.000013	0.0000055	0.0000027	0.0000062	0.0000067	0.0000056	0.0000052	0.0000064	0.0000069	0.0000056	0.0000027	0.0000062	0.0000067	0.0000056	0.0000052
Uranium, total	mg/L	0.0085	0.000099	0.00026	0.000098	0.00016	0.000088	0.00012	0.00010	0.00026	0.000087	0.000064	0.000098	0.00016	0.000088	0.00012	0.00010	0.00017	0.000088	0.000064	0.000098	0.00016	0.000088	0.00012
Zinc, dissolved	mg/L	0.014	0.0010	0.0023	0.0012	0.0019	0.0011	0.0014	0.0013	0.0031	0.0011	0.00075	0.0012	0.0019	0.0011	0.0014	0.0013	0.0019	0.0011	0.00074	0.0012	0.0019	0.0011	0.0015

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-12

Parameter	Units	Four Creek																					
					WQS03_DS																		
					Closure																		
			Baseline		Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
		WQG	P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		123	172	162	214	131	140	156	190	124	133	162	214	131	140	165	239	137	152	162	214	131	140
Alkalinity, total	mg-$CaCO_3$/L		140	190	180	240	150	160	180	220	150	160	190	240	150	170	200	270	160	180	180	240	150	160
Chloride	mg/L	150	0.25	0.53	0.47	0.47	0.34	0.33	0.42	0.45	0.35	0.34	0.95	1.1	0.43	0.49	0.73	1.8	0.36	0.62	0.44	0.45	0.33	0.33
Fluoride	mg/L	1.4	0.053	0.070	0.081	0.11	0.067	0.068	0.078	0.093	0.063	0.065	0.081	0.11	0.067	0.068	0.085	0.12	0.069	0.074	0.082	0.11	0.067	0.068
Ammonia, total	mg-N/L	0.99	0.0025	0.011	0.038	0.050	0.010	0.015	0.026	0.031	0.0086	0.010	0.14	0.19	0.032	0.051	0.080	0.32	0.013	0.078	0.030	0.043	0.0091	0.014
Nitrate	mg/L	3.0	0.016	0.17	0.29	0.43	0.072	0.16	0.19	0.28	0.059	0.12	1.1	1.5	0.24	0.45	0.62	2.6	0.095	0.66	0.23	0.38	0.062	0.15
Nitrite	mg/L	0.020	0.00050	0.0010	0.0072	0.0090	0.0021	0.0028	0.0049	0.0055	0.0018	0.0019	0.026	0.034	0.0061	0.0094	0.015	0.058	0.0027	0.014	0.0057	0.0078	0.0019	0.0025
Sulfate	mg/L	309	2.1	26	26	33	7.1	9.7	18	20	8.3	9.9	91	120	19	30	53	210	9.0	48	21	30	6.6	9.3
Aluminum, total	mg/L	0.69	0.081	1.1	0.15	0.079	0.12	0.052	0.13	0.071	0.11	0.050	0.15	0.079	0.12	0.052	0.15	0.088	0.12	0.057	0.15	0.080	0.12	0.052
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.00015	0.000087	0.00012	0.000061	0.00014	0.000086	0.00012	0.000063	0.00019	0.00014	0.00013	0.000077	0.00019	0.00020	0.00013	0.000093	0.00015	0.000087	0.00012	0.000061
Arsenic, total	mg/L	0.0050	0.00067	0.0010	0.0010	0.0011	0.00084	0.00070	0.00095	0.00097	0.00080	0.00068	0.0010	0.0011	0.00085	0.00072	0.0011	0.0012	0.00087	0.00079	0.0010	0.0011	0.00084	0.00071
Barium, total	mg/L	1.0	0.078	0.13	0.10	0.15	0.084	0.096	0.10	0.13	0.080	0.093	0.10	0.15	0.084	0.096	0.11	0.17	0.088	0.10	0.11	0.15	0.084	0.097
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.00011	0.000086	0.000091	0.000056	0.00010	0.000077	0.000087	0.000054	0.00011	0.000086	0.000091	0.000056	0.00012	0.000096	0.000095	0.000062	0.00011	0.000087	0.000092	0.000056
Boron, total	mg/L	1.2	0.011	0.020	0.016	0.023	0.013	0.015	0.016	0.023	0.014	0.016	0.023	0.028	0.014	0.018	0.022	0.041	0.014	0.021	0.016	0.023	0.013	0.015
Cadmium, dissolved	mg/L	0.00023	0.0000050	0.000011	0.000012	0.000011	0.0000074	0.0000048	0.0000097	0.0000075	0.0000067	0.0000039	0.000023	0.000025	0.0000093	0.0000081	0.000021	0.000059	0.0000081	0.000015	0.000011	0.000010	0.0000072	0.0000047
Chromium, total	mg/L	0.0089	0.00040	0.0015	0.00074	0.00036	0.00061	0.00024	0.00067	0.00032	0.00058	0.00023	0.00074	0.00037	0.00061	0.00025	0.00079	0.00041	0.00063	0.00029	0.00074	0.00036	0.00061	0.00024
Cobalt, dissolved	mg/L	0.00056	0.000050	0.00014	0.00052	0.00063	0.00017	0.00019	0.00037	0.00040	0.00015	0.00014	0.0018	0.0024	0.00042	0.00060	0.0010	0.0040	0.00021	0.00091	0.00043	0.00058	0.00016	0.00019
Copper, dissolved	mg/L	0.0047	0.0011	0.0033	0.0019	0.0017	0.0016	0.0011	0.0018	0.0016	0.0015	0.0011	0.0019	0.0017	0.0016	0.0012	0.0021	0.0019	0.0017	0.0013	0.0019	0.0017	0.0016	0.0011
Iron, total	mg/L	1.0	0.078	0.78	0.14	0.071	0.12	0.048	0.13	0.063	0.11	0.046	0.14	0.073	0.12	0.051	0.16	0.11	0.12	0.064	0.14	0.071	0.12	0.049
Iron, dissolved	mg/L	0.35	0.015	0.35	0.026	0.027	0.020	0.019	0.023	0.023	0.019	0.018	0.033	0.037	0.021	0.022	0.040	0.087	0.021	0.033	0.025	0.026	0.020	0.019
Lead, dissolved	mg/L	0.0061	0.000025	0.000075	0.000055	0.000060	0.000036	0.000036	0.000050	0.000059	0.000039	0.000040	0.00013	0.00017	0.000051	0.000061	0.000094	0.00026	0.000039	0.000082	0.000050	0.000055	0.000035	0.000035
Manganese, total	mg/L	1.1	0.0022	0.018	0.010	0.012	0.0044	0.0040	0.0077	0.0076	0.0038	0.0029	0.029	0.037	0.0079	0.0099	0.020	0.070	0.0051	0.017	0.0088	0.011	0.0042	0.0039
Mercury, total	mg/L	0.000020	0.0000038	0.000012	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038	0.0000038
Molybdenum, total	mg/L	0.034	0.00023	0.00040	0.00096	0.0012	0.00039	0.00050	0.00067	0.00083	0.00042	0.00050	0.0035	0.0047	0.00087	0.0013	0.0019	0.0068	0.00045	0.0017	0.00077	0.0011	0.00036	0.00048
Nickel, dissolved	mg/L	0.0047	0.00050	0.0011	0.0012	0.0011	0.00072	0.00048	0.00095	0.00075	0.00068	0.00041	0.0030	0.0035	0.0011	0.0010	0.0021	0.0058	0.00080	0.0015	0.0011	0.0010	0.00071	0.00047
Selenium, total	mg/L	0.0020	0.000050	0.000095	0.00064	0.00081	0.00017	0.00022	0.00042	0.00052	0.00022	0.00024	0.0024	0.0032	0.00051	0.00078	0.0013	0.0053	0.00022	0.0012	0.00050	0.00071	0.00016	0.00020
Strontium, total	mg/L	2.5	0.17	0.24	0.24	0.33	0.20	0.21	0.24	0.30	0.19	0.21	0.25	0.33	0.21	0.23	0.28	0.36	0.21	0.25	0.24	0.33	0.20	0.22
Silver, total	mg/L	0.0015	0.0000050	0.000021	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.000010	0.000013	0.000015	0.0000076	0.0000080	0.000011	0.000011	0.0000069	0.0000069	0.000025	0.000031	0.0000097	0.000012	0.000024	0.000074	0.0000084	0.000021	0.000012	0.000014	0.0000074	0.0000079
Uranium, total	mg/L	0.0085	0.000099	0.00026	0.00019	0.00025	0.00012	0.00016	0.00019	0.00027	0.00013	0.00018	0.00050	0.00067	0.00017	0.00026	0.00033	0.00099	0.00013	0.00033	0.00017	0.00023	0.00011	0.00016
Zinc, dissolved	mg/L	0.014	0.0010	0.0023	0.0020	0.0025	0.0014	0.0018	0.0017	0.0022	0.0013	0.0017	0.0040	0.0052	0.0018	0.0024	0.0032	0.0087	0.0015	0.0032	0.0019	0.0025	0.0014	0.0018

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-13

Parameter	Units	Tenas Creek																					
					WQS02																		
					Closure																		
		WQG	Baseline		Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		75	101	79	113	72	94	79	114	73	95	79	114	72	94	79	113	72	94	79	113	72	94
Alkalinity, total	mg-$CaCO_3$/L		85	110	87	120	79	95	87	130	80	100	87	130	80	100	87	110	79	95	86	120	79	95
Chloride	mg/L	150	0.25	0.52	0.29	0.38	0.27	0.28	0.32	0.61	0.28	0.35	0.31	0.63	0.28	0.36	0.29	0.35	0.27	0.28	0.29	0.37	0.27	0.28
Fluoride	mg/L	1.2	0.031	0.045	0.035	0.049	0.032	0.041	0.035	0.050	0.032	0.042	0.035	0.049	0.032	0.041	0.035	0.049	0.032	0.041	0.034	0.049	0.032	0.041
Ammonia, total	mg-N/L	1.3	0.0025	0.0085	0.0047	0.017	0.0031	0.0061	0.0089	0.040	0.0037	0.010	0.010	0.055	0.0044	0.015	0.0047	0.014	0.0031	0.0054	0.0044	0.016	0.0031	0.0060
Nitrate	mg/L	3.0	0.0050	0.060	0.020	0.16	0.0071	0.076	0.052	0.34	0.011	0.11	0.064	0.46	0.017	0.15	0.020	0.14	0.0071	0.070	0.017	0.16	0.0067	0.075
Nitrite	mg/L	0.020	0.00050	0.0020	0.00090	0.0031	0.00061	0.0011	0.0016	0.0072	0.00072	0.0019	0.0019	0.0099	0.00084	0.0028	0.00090	0.0025	0.00061	0.0010	0.00084	0.0030	0.00061	0.0011
Sulfate	mg/L	218	2.6	7.3	4.1	13	3.0	6.4	7.2	32	3.9	12	8.1	41	4.2	14	4.1	11	3.0	5.8	3.9	13	2.9	6.2
Aluminum, total	mg/L	0.35	0.047	1.7	0.061	0.040	0.055	0.033	0.061	0.040	0.056	0.034	0.061	0.040	0.055	0.034	0.061	0.039	0.055	0.033	0.061	0.040	0.055	0.034
Antimony, dissolved	mg/L	0.074	0.00010	0.00023	0.00017	0.00011	0.00016	0.000089	0.00017	0.00013	0.00016	0.000097	0.00017	0.00013	0.00016	0.00010	0.00017	0.00010	0.00016	0.000088	0.00017	0.00011	0.00016	0.000089
Arsenic, total	mg/L	0.0050	0.00045	0.00089	0.00058	0.00045	0.00052	0.00038	0.00058	0.00045	0.00053	0.00039	0.00058	0.00046	0.00053	0.00039	0.00058	0.00045	0.00052	0.00037	0.00057	0.00045	0.00052	0.00038
Barium, total	mg/L	1.0	0.035	0.046	0.037	0.046	0.034	0.038	0.037	0.046	0.034	0.039	0.037	0.046	0.034	0.038	0.037	0.046	0.034	0.038	0.037	0.046	0.034	0.038
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000058	0.000060	0.000053	0.000050	0.000058	0.000060	0.000053	0.000051	0.000058	0.000060	0.000053	0.000050	0.000058	0.000060	0.000053	0.000050	0.000057	0.000060	0.000053	0.000050
Boron, total	mg/L	1.2	0.015	0.050	0.015	0.024	0.014	0.019	0.016	0.034	0.014	0.022	0.015	0.027	0.014	0.021	0.015	0.023	0.014	0.019	0.015	0.024	0.014	0.019
Cadmium, dissolved	mg/L	0.00017	0.0000025	0.0000057	0.0000029	0.0000045	0.0000027	0.0000030	0.0000034	0.0000075	0.0000028	0.0000035	0.0000033	0.0000075	0.0000028	0.0000038	0.0000029	0.0000041	0.0000027	0.0000029	0.0000029	0.0000044	0.0000027	0.0000030
Chromium, total	mg/L	0.0089	0.00032	0.0018	0.00036	0.00041	0.00033	0.00034	0.00036	0.00041	0.00033	0.00035	0.00036	0.00041	0.00033	0.00035	0.00036	0.00041	0.00033	0.00034	0.00036	0.00041	0.00033	0.00034
Cobalt, dissolved	mg/L	0.00045	0.000050	0.000050	0.000068	0.00017	0.000057	0.000080	0.00010	0.00035	0.000062	0.00012	0.00011	0.00042	0.000066	0.00015	0.000068	0.00014	0.000057	0.000074	0.000065	0.00016	0.000056	0.000079
Copper, dissolved	mg/L	0.0026	0.00091	0.0014	0.0010	0.0011	0.00095	0.00091	0.0010	0.0012	0.00095	0.00095	0.0010	0.0011	0.00095	0.00093	0.0010	0.0011	0.00095	0.00091	0.0010	0.0011	0.00095	0.00091
Iron, total	mg/L	1.0	0.043	0.25	0.047	0.040	0.043	0.034	0.047	0.041	0.043	0.034	0.047	0.040	0.043	0.035	0.047	0.040	0.043	0.034	0.047	0.040	0.043	0.034
Iron, dissolved	mg/L	0.35	0.015	0.015	0.017	0.018	0.016	0.016	0.017	0.022	0.016	0.016	0.017	0.021	0.016	0.016	0.017	0.018	0.016	0.015	0.017	0.018	0.016	0.016
Lead, dissolved	mg/L	0.0031	0.000025	0.000025	0.000029	0.000044	0.000027	0.000029	0.000036	0.000086	0.000029	0.000040	0.000037	0.000099	0.000030	0.000048	0.000029	0.000040	0.000027	0.000028	0.000029	0.000043	0.000027	0.000029
Manganese, total	mg/L	0.94	0.0044	0.010	0.0059	0.0049	0.0054	0.0033	0.0061	0.0081	0.0055	0.0038	0.0060	0.0076	0.0055	0.0040	0.0059	0.0044	0.0054	0.0032	0.0059	0.0047	0.0054	0.0033
Mercury, total	mg/L	0.000020	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00012	0.00015	0.00017	0.00046	0.00013	0.00023	0.00029	0.0013	0.00016	0.00043	0.00047	0.0025	0.00021	0.00078	0.00017	0.00039	0.00013	0.00021	0.00016	0.00043	0.00013	0.00022
Nickel, dissolved	mg/L	0.0025	0.00025	0.00025	0.00029	0.00043	0.00027	0.00030	0.00033	0.00073	0.00028	0.00037	0.00035	0.00089	0.00029	0.00042	0.00029	0.00039	0.00027	0.00029	0.00029	0.00042	0.00027	0.00030
Selenium, total	mg/L	0.0020	0.000052	0.000067	0.000091	0.00037	0.000057	0.00014	0.00021	0.0011	0.000086	0.00033	0.00025	0.0014	0.000099	0.00044	0.000091	0.00029	0.000057	0.00013	0.000084	0.00034	0.000055	0.00014
Strontium, total	mg/L	2.5	0.11	0.13	0.11	0.16	0.10	0.13	0.11	0.17	0.10	0.14	0.11	0.16	0.10	0.14	0.11	0.16	0.10	0.13	0.11	0.16	0.10	0.13
Silver, total	mg/L	0.000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.0000050	0.0000058	0.0000077	0.0000054	0.0000057	0.0000062	0.000012	0.0000055	0.0000065	0.0000059	0.000011	0.0000055	0.0000065	0.0000058	0.0000072	0.0000054	0.0000055	0.0000058	0.0000075	0.0000053	0.0000057
Uranium, total	mg/L	0.0085	0.00012	0.00017	0.00012	0.00033	0.00011	0.00025	0.00015	0.00051	0.00012	0.00030	0.00015	0.00054	0.00012	0.00032	0.00012	0.00031	0.00011	0.00024	0.00012	0.00032	0.00011	0.00025
Zinc, dissolved	mg/L	0.0071	0.0010	0.0015	0.0012	0.0018	0.0011	0.0016	0.0012	0.0022	0.0011	0.0016	0.0012	0.0023	0.0011	0.0017	0.0012	0.0018	0.0011	0.0015	0.0012	0.0018	0.0011	0.0016

Red highlight is an WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-14

Parameter	Units	Tenas Creek																					
					WQS22																		
					Closure																		
		WQG	Baseline		Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		75	101	82	117	75	94	83	118	75	95	83	118	76	95	82	117	75	94	82	117	75	94
Alkalinity, total	mg-$CaCO_3$/L		85	110	91	120	81	98	91	130	82	100	92	150	83	110	91	120	81	97	91	120	81	97
Chloride	mg/L	150	0.25	0.52	0.31	0.50	0.28	0.32	0.35	0.68	0.29	0.37	0.36	0.94	0.30	0.45	0.31	0.45	0.28	0.30	0.31	0.48	0.28	0.31
Fluoride	mg/L	1.2	0.031	0.045	0.036	0.052	0.032	0.042	0.036	0.052	0.032	0.042	0.036	0.052	0.032	0.042	0.036	0.052	0.032	0.041	0.036	0.052	0.032	0.042
Ammonia, total	mg-N/L	1.3	0.0025	0.0085	0.0066	0.030	0.0037	0.0094	0.011	0.044	0.0042	0.011	0.017	0.099	0.0063	0.027	0.0066	0.023	0.0037	0.0081	0.0060	0.028	0.0036	0.0091
Nitrate	mg/L	3.0	0.0050	0.060	0.034	0.26	0.011	0.10	0.064	0.37	0.015	0.11	0.12	0.81	0.032	0.24	0.034	0.21	0.011	0.091	0.029	0.25	0.011	0.099
Nitrite	mg/L	0.020	0.00050	0.0020	0.0012	0.0053	0.00072	0.0017	0.0019	0.0079	0.00080	0.0020	0.0031	0.018	0.0012	0.0049	0.0012	0.0042	0.00072	0.0015	0.0011	0.0051	0.00070	0.0017
Sulfate	mg/L	218	2.6	7.3	6.0	23	3.6	9.3	9.2	37	4.6	13	13	72	6.1	25	6.0	19	3.6	8.2	5.5	22	3.5	9.0
Aluminum, total	mg/L	0.35	0.047	1.7	0.064	0.042	0.056	0.034	0.064	0.041	0.056	0.034	0.064	0.042	0.056	0.034	0.064	0.041	0.056	0.034	0.064	0.042	0.056	0.034
Antimony, dissolved	mg/L	0.074	0.00010	0.00023	0.00018	0.00012	0.00016	0.000093	0.00018	0.00014	0.00016	0.000100	0.00018	0.00018	0.00016	0.00012	0.00018	0.00011	0.00016	0.000091	0.00018	0.00012	0.00016	0.000093
Arsenic, total	mg/L	0.0050	0.00045	0.00089	0.00060	0.00047	0.00053	0.00038	0.00060	0.00047	0.00054	0.00039	0.00061	0.00049	0.00054	0.00040	0.00060	0.00047	0.00053	0.00038	0.00060	0.00047	0.00053	0.00038
Barium, total	mg/L	1.0	0.035	0.046	0.039	0.048	0.034	0.039	0.039	0.048	0.034	0.039	0.039	0.048	0.034	0.039	0.039	0.048	0.034	0.038	0.039	0.048	0.034	0.039
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000060	0.000063	0.000054	0.000051	0.000060	0.000062	0.000054	0.000051	0.000060	0.000063	0.000054	0.000051	0.000060	0.000063	0.000054	0.000050	0.000060	0.000063	0.000054	0.000051
Boron, total	mg/L	1.2	0.015	0.050	0.016	0.029	0.014	0.020	0.017	0.037	0.015	0.022	0.016	0.034	0.015	0.023	0.016	0.027	0.014	0.020	0.016	0.028	0.014	0.020
Cadmium, dissolved	mg/L	0.00017	0.0000025	0.0000057	0.0000031	0.0000062	0.0000028	0.0000035	0.0000036	0.0000081	0.0000029	0.0000036	0.0000040	0.000012	0.0000030	0.0000051	0.0000031	0.0000053	0.0000028	0.0000033	0.0000030	0.0000059	0.0000028	0.0000034
Chromium, total	mg/L	0.0089	0.00032	0.0018	0.00037	0.00043	0.00033	0.00034	0.00037	0.00042	0.00033	0.00035	0.00038	0.00044	0.00033	0.00036	0.00037	0.00043	0.00033	0.00034	0.00037	0.00043	0.00033	0.00035
Cobalt, dissolved	mg/L	0.00045	0.000050	0.000050	0.000084	0.00027	0.000062	0.00011	0.00011	0.00039	0.000066	0.00012	0.00016	0.00075	0.000083	0.00026	0.000084	0.00022	0.000062	0.000098	0.000079	0.00025	0.000061	0.00011
Copper, dissolved	mg/L	0.0026	0.00091	0.0014	0.0011	0.0012	0.00097	0.00093	0.0011	0.0012	0.00097	0.00096	0.0011	0.0012	0.00097	0.00096	0.0011	0.0012	0.00097	0.00092	0.0011	0.0012	0.00097	0.00093
Iron, total	mg/L	1.0	0.043	0.25	0.050	0.042	0.044	0.034	0.050	0.041	0.044	0.035	0.050	0.043	0.044	0.036	0.050	0.042	0.044	0.034	0.049	0.042	0.044	0.034
Iron, dissolved	mg/L	0.35	0.015	0.015	0.018	0.020	0.016	0.016	0.018	0.022	0.016	0.016	0.018	0.025	0.016	0.018	0.018	0.019	0.016	0.016	0.018	0.019	0.016	0.016
Lead, dissolved	mg/L	0.0031	0.000025	0.000025	0.000033	0.000063	0.000028	0.000034	0.000041	0.000099	0.000031	0.000043	0.000051	0.00016	0.000034	0.000068	0.000033	0.000055	0.000028	0.000032	0.000032	0.000060	0.000028	0.000034
Manganese, total	mg/L	0.94	0.0044	0.010	0.0062	0.0067	0.0056	0.0038	0.0063	0.0088	0.0056	0.0039	0.0067	0.012	0.0058	0.0055	0.0062	0.0058	0.0056	0.0036	0.0062	0.0065	0.0056	0.0038
Mercury, total	mg/L	0.000020	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00012	0.00015	0.00023	0.00079	0.00015	0.00034	0.00036	0.0014	0.00019	0.00049	0.00077	0.0044	0.00031	0.0014	0.00023	0.00064	0.00015	0.00030	0.00021	0.00073	0.00015	0.00032
Nickel, dissolved	mg/L	0.0025	0.00025	0.00025	0.00031	0.00058	0.00028	0.00035	0.00036	0.00079	0.00029	0.00039	0.00044	0.0014	0.00032	0.00061	0.00031	0.00051	0.00028	0.00033	0.00031	0.00056	0.00028	0.00035
Selenium, total	mg/L	0.0020	0.000052	0.000067	0.00015	0.00067	0.000074	0.00024	0.00025	0.0012	0.00011	0.00037	0.00043	0.0026	0.00016	0.00080	0.00015	0.00053	0.000074	0.00020	0.00013	0.00062	0.000070	0.00023
Strontium, total	mg/L	2.5	0.11	0.13	0.12	0.17	0.11	0.14	0.12	0.17	0.11	0.14	0.12	0.17	0.11	0.14	0.12	0.17	0.11	0.13	0.12	0.17	0.11	0.14
Silver, total	mg/L	0.000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.0000050	0.0000061	0.0000099	0.0000056	0.0000064	0.0000066	0.000013	0.0000056	0.0000067	0.0000067	0.000016	0.0000058	0.0000080	0.0000061	0.0000088	0.0000056	0.0000061	0.0000061	0.0000096	0.0000055	0.0000063
Uranium, total	mg/L	0.0085	0.00012	0.00017	0.00013	0.00041	0.00011	0.00027	0.00017	0.00056	0.00012	0.00031	0.00021	0.00080	0.00014	0.00041	0.00013	0.00038	0.00011	0.00026	0.00013	0.00040	0.00011	0.00027
Zinc, dissolved	mg/L	0.0071	0.0010	0.0015	0.0012	0.0020	0.0011	0.0016	0.0012	0.0022	0.0011	0.0017	0.0012	0.0029	0.0011	0.0019	0.0012	0.0019	0.0011	0.0016	0.0012	0.0019	0.0011	0.0016

Red highlight is an WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-15

Parameter	Units	Tenas Creek																					
					WQS04																		
					Closure																		
		WQG	Baseline		Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		75	101	88	127	76	94	88	127	76	95	88	128	76	98	88	127	76	94	88	127	76	95
Alkalinity, total	mg-$CaCO_3$/L		85	110	96	130	83	99	96	150	85	100	97	160	85	110	96	130	83	98	96	130	83	99
Chloride	mg/L	150	0.25	0.52	0.32	0.52	0.29	0.33	0.37	0.76	0.30	0.40	0.38	1.0	0.31	0.48	0.32	0.46	0.29	0.31	0.32	0.50	0.28	0.32
Fluoride	mg/L	1.2	0.031	0.045	0.038	0.056	0.033	0.042	0.038	0.055	0.033	0.043	0.038	0.056	0.033	0.042	0.038	0.056	0.033	0.042	0.038	0.056	0.033	0.042
Ammonia, total	mg-N/L	1.3	0.0025	0.0085	0.0068	0.031	0.0039	0.010	0.011	0.047	0.0044	0.012	0.018	0.10	0.0066	0.030	0.0068	0.024	0.0039	0.0087	0.0062	0.029	0.0037	0.0099
Nitrate	mg/L	3.0	0.0050	0.060	0.035	0.27	0.012	0.11	0.065	0.39	0.016	0.12	0.12	0.84	0.034	0.26	0.035	0.22	0.012	0.095	0.030	0.25	0.011	0.10
Nitrite	mg/L	0.020	0.00050	0.0020	0.0013	0.0056	0.00074	0.0019	0.0020	0.0084	0.00083	0.0022	0.0033	0.019	0.0012	0.0054	0.0013	0.0044	0.00074	0.0016	0.0012	0.0052	0.00072	0.0018
Sulfate	mg/L	218	2.6	7.3	6.1	24	3.7	10	10	43	4.9	15	14	79	6.4	27	6.1	19	3.7	8.8	5.6	22	3.6	9.7
Aluminum, total	mg/L	0.35	0.047	1.7	0.068	0.045	0.058	0.034	0.067	0.045	0.058	0.034	0.068	0.045	0.058	0.034	0.068	0.045	0.058	0.034	0.067	0.045	0.058	0.034
Antimony, dissolved	mg/L	0.074	0.00010	0.00023	0.00019	0.00013	0.00016	0.000095	0.00019	0.00016	0.00017	0.00010	0.00019	0.00018	0.00017	0.00012	0.00019	0.00012	0.00016	0.000093	0.00019	0.00013	0.00016	0.000095
Arsenic, total	mg/L	0.0050	0.00045	0.00089	0.00064	0.00051	0.00055	0.00039	0.00064	0.00051	0.00055	0.00039	0.00064	0.00053	0.00055	0.00041	0.00064	0.00051	0.00055	0.00038	0.00064	0.00051	0.00055	0.00039
Barium, total	mg/L	1.0	0.035	0.046	0.041	0.052	0.035	0.039	0.041	0.051	0.035	0.039	0.041	0.052	0.035	0.039	0.041	0.052	0.035	0.039	0.041	0.052	0.035	0.039
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000064	0.000068	0.000055	0.000051	0.000064	0.000067	0.000055	0.000051	0.000064	0.000068	0.000055	0.000051	0.000064	0.000068	0.000055	0.000051	0.000064	0.000068	0.000055	0.000051
Boron, total	mg/L	1.2	0.015	0.050	0.017	0.030	0.015	0.021	0.018	0.041	0.015	0.024	0.017	0.035	0.015	0.023	0.017	0.028	0.015	0.020	0.017	0.029	0.015	0.020
Cadmium, dissolved	mg/L	0.00017	0.0000025	0.0000057	0.0000032	0.0000065	0.0000029	0.0000036	0.0000037	0.0000085	0.0000029	0.0000038	0.0000042	0.000013	0.0000031	0.0000053	0.0000032	0.0000055	0.0000029	0.0000034	0.0000032	0.0000062	0.0000029	0.0000036
Chromium, total	mg/L	0.0089	0.00032	0.0018	0.00040	0.00046	0.00034	0.00035	0.00040	0.00046	0.00034	0.00035	0.00040	0.00047	0.00034	0.00036	0.00040	0.00046	0.00034	0.00035	0.00039	0.00046	0.00034	0.00035
Cobalt, dissolved	mg/L	0.00045	0.000050	0.000050	0.000090	0.00029	0.000065	0.00012	0.00012	0.00042	0.000069	0.00014	0.00017	0.00082	0.000087	0.00028	0.000090	0.00024	0.000065	0.00010	0.000084	0.00028	0.000063	0.00012
Copper, dissolved	mg/L	0.0026	0.00091	0.0014	0.0011	0.0013	0.00099	0.00094	0.0012	0.0013	0.00100	0.00098	0.0012	0.0013	0.00100	0.00097	0.0011	0.0013	0.00099	0.00093	0.0011	0.0013	0.00099	0.00094
Iron, total	mg/L	1.0	0.043	0.25	0.052	0.045	0.045	0.035	0.052	0.044	0.045	0.035	0.052	0.046	0.045	0.036	0.052	0.045	0.045	0.034	0.052	0.045	0.045	0.035
Iron, dissolved	mg/L	0.35	0.015	0.015	0.019	0.021	0.017	0.016	0.019	0.023	0.017	0.017	0.019	0.025	0.017	0.018	0.019	0.021	0.017	0.016	0.019	0.021	0.017	0.016
Lead, dissolved	mg/L	0.0031	0.000025	0.000025	0.000034	0.000065	0.000029	0.000036	0.000044	0.00012	0.000032	0.000048	0.000052	0.00018	0.000035	0.000073	0.000034	0.000057	0.000029	0.000034	0.000033	0.000062	0.000029	0.000035
Manganese, total	mg/L	0.94	0.0044	0.010	0.0065	0.0071	0.0057	0.0040	0.0066	0.0092	0.0057	0.0041	0.0069	0.013	0.0060	0.0058	0.0065	0.0061	0.0057	0.0037	0.0065	0.0068	0.0057	0.0039
Mercury, total	mg/L	0.000020	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00012	0.00015	0.00024	0.00090	0.00016	0.00038	0.00039	0.0017	0.00021	0.00058	0.00085	0.0049	0.00032	0.0015	0.00024	0.00073	0.00016	0.00033	0.00022	0.00084	0.00015	0.00037
Nickel, dissolved	mg/L	0.0025	0.00025	0.00025	0.00033	0.00063	0.00029	0.00037	0.00037	0.00085	0.00030	0.00041	0.00047	0.0016	0.00033	0.00065	0.00033	0.00054	0.00029	0.00034	0.00032	0.00061	0.00029	0.00036
Selenium, total	mg/L	0.0020	0.000052	0.000067	0.00015	0.00079	0.000079	0.00027	0.00029	0.0014	0.00012	0.00045	0.00048	0.0029	0.00017	0.00088	0.00015	0.00062	0.000079	0.00023	0.00013	0.00074	0.000074	0.00026
Strontium, total	mg/L	2.5	0.11	0.13	0.13	0.18	0.11	0.14	0.13	0.19	0.11	0.14	0.13	0.19	0.11	0.14	0.13	0.18	0.11	0.14	0.13	0.18	0.11	0.14
Silver, total	mg/L	0.000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.0000050	0.0000065	0.000010	0.0000057	0.0000066	0.0000068	0.000014	0.0000058	0.0000070	0.0000070	0.000017	0.0000060	0.0000084	0.0000065	0.0000092	0.0000057	0.0000063	0.0000064	0.000010	0.0000057	0.0000065
Uranium, total	mg/L	0.0085	0.00012	0.00017	0.00014	0.00043	0.00012	0.00028	0.00019	0.00063	0.00013	0.00033	0.00021	0.00086	0.00014	0.00043	0.00014	0.00039	0.00012	0.00027	0.00013	0.00041	0.00012	0.00028
Zinc, dissolved	mg/L	0.0071	0.0010	0.0015	0.0013	0.0021	0.0011	0.0016	0.0013	0.0024	0.0011	0.0017	0.0013	0.0031	0.0012	0.0020	0.0013	0.0021	0.0011	0.0016	0.0013	0.0021	0.0011	0.0016

Red highlight is an WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-16

Parameter	Units	Goathorn Creek																					
		WQG	Baseline		WQSEA1																		
					Operations																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	78	110	71	89	78	110	71	89	82	110	71	89	80	171	71	151	78	132	68	89
Alkalinity, total	mg-$CaCO_3$/L		54	85	67	100	54	69	72	100	53	70	87	100	60	69	67	130	54	110	73	130	55	70
Chloride	mg/L	150	0.25	0.50	0.47	0.31	0.32	0.25	0.52	0.30	0.31	0.25	0.72	0.35	0.40	0.25	0.47	0.49	0.32	0.42	0.55	0.31	0.33	0.25
Fluoride	mg/L	1.2	0.032	0.041	0.039	0.050	0.035	0.040	0.041	0.050	0.035	0.040	0.039	0.050	0.035	0.040	0.040	0.075	0.035	0.066	0.039	0.062	0.035	0.040
Ammonia, total	mg-N/L	1.6	0.0025	0.0070	0.019	0.0065	0.0058	0.0026	0.019	0.0058	0.0056	0.0026	0.065	0.019	0.014	0.0028	0.019	0.0076	0.0058	0.0043	0.019	0.0095	0.0062	0.0026
Nitrate	mg/L	3.0	0.043	0.084	0.17	0.100	0.068	0.078	0.17	0.099	0.066	0.078	0.54	0.20	0.13	0.079	0.17	0.16	0.068	0.13	0.17	0.12	0.070	0.078
Nitrite	mg/L	0.020	0.00050	0.0020	0.0034	0.0012	0.0010	0.00051	0.0033	0.0011	0.00099	0.00051	0.012	0.0035	0.0025	0.00055	0.0034	0.0014	0.0010	0.00085	0.0033	0.0017	0.0011	0.00052
Sulfate	mg/L	218	25	38	39	29	28	24	43	29	28	24	61	32	35	24	39	49	28	42	45	29	29	24
Aluminum, total	mg/L	0.27	0.034	0.66	0.063	0.030	0.048	0.018	0.065	0.030	0.047	0.019	0.063	0.030	0.048	0.018	0.063	0.036	0.048	0.029	0.072	0.038	0.049	0.019
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.00012	0.000063	0.000097	0.000050	0.00013	0.000062	0.000096	0.000050	0.00015	0.000067	0.00011	0.000050	0.00012	0.00010	0.000097	0.000085	0.00013	0.000063	0.000098	0.000051
Arsenic, total	mg/L	0.0050	0.00020	0.00060	0.00029	0.00037	0.00024	0.00019	0.00031	0.00037	0.00024	0.00019	0.00033	0.00037	0.00025	0.00019	0.00029	0.00037	0.00024	0.00030	0.00032	0.00047	0.00024	0.00019
Barium, total	mg/L	1.0	0.059	0.071	0.067	0.076	0.060	0.063	0.067	0.076	0.060	0.064	0.067	0.076	0.060	0.063	0.069	0.12	0.060	0.11	0.067	0.093	0.060	0.064
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000060	0.000053	0.000053	0.000049	0.000060	0.000053	0.000053	0.000049	0.000060	0.000053	0.000053	0.000049	0.000062	0.000095	0.000053	0.000084	0.000060	0.000063	0.000053	0.000049
Boron, total	mg/L	1.2	0.0050	0.050	0.0093	0.0087	0.0066	0.0055	0.011	0.0087	0.0064	0.0055	0.014	0.0087	0.0080	0.0055	0.0093	0.0099	0.0066	0.0088	0.011	0.011	0.0068	0.0055
Cadmium, dissolved	mg/L	0.00016	0.0000075	0.000033	0.000013	0.0000060	0.000011	0.0000049	0.000013	0.0000060	0.000011	0.0000049	0.000016	0.0000065	0.000011	0.0000049	0.000013	0.000010	0.000011	0.0000084	0.000013	0.0000060	0.000011	0.0000049
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.00031	0.00019	0.00025	0.00016	0.00033	0.00019	0.00024	0.00016	0.00033	0.00019	0.00025	0.00016	0.00031	0.00031	0.00025	0.00027	0.00034	0.00023	0.00025	0.00016
Cobalt, dissolved	mg/L	0.000450	0.000050	0.00010	0.00018	0.000076	0.000093	0.000050	0.00022	0.000074	0.000087	0.000050	0.00052	0.00012	0.00016	0.000052	0.00018	0.00011	0.000093	0.000085	0.00022	0.000090	0.00010	0.000051
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0016	0.0010	0.0014	0.00092	0.0016	0.0010	0.0014	0.00092	0.0016	0.0010	0.0014	0.00092	0.0016	0.0018	0.0014	0.0016	0.0016	0.0012	0.0014	0.00092
Iron, total	mg/L	1.0	0.040	0.70	0.14	0.040	0.080	0.018	0.14	0.038	0.077	0.018	0.14	0.041	0.081	0.018	0.14	0.048	0.080	0.028	0.17	0.057	0.086	0.018
Iron, dissolved	mg/L	0.35	0.015	0.12	0.019	0.016	0.016	0.015	0.019	0.016	0.016	0.015	0.020	0.016	0.017	0.015	0.019	0.029	0.016	0.025	0.019	0.019	0.016	0.015
Lead, dissolved	mg/L	0.0	0.000025	0.000050	0.000063	0.000035	0.000037	0.000025	0.000074	0.000035	0.000036	0.000025	0.00012	0.000042	0.000052	0.000025	0.000063	0.000054	0.000037	0.000042	0.000077	0.000035	0.000039	0.000025
Manganese, total	mg/L	0.91	0.0036	0.029	0.0077	0.0030	0.0054	0.0022	0.0081	0.0031	0.0053	0.0022	0.011	0.0035	0.0063	0.0022	0.0077	0.0048	0.0054	0.0037	0.0082	0.0031	0.0056	0.0022
Mercury, total	mg/L	0.000020	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.0017	0.00075	0.00085	0.00043	0.0020	0.00073	0.00079	0.00043	0.0034	0.00099	0.0013	0.00044	0.0017	0.0011	0.00085	0.00074	0.0021	0.00075	0.00091	0.00044
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.00051	0.00031	0.00034	0.00025	0.00058	0.00030	0.00033	0.00025	0.00092	0.00036	0.00046	0.00025	0.00051	0.00049	0.00034	0.00042	0.00059	0.00031	0.00035	0.00025
Selenium, total	mg/L	0.0020	0.000084	0.00020	0.00074	0.00027	0.00030	0.000082	0.00093	0.00025	0.00025	0.000083	0.0016	0.00042	0.00057	0.000088	0.00074	0.00034	0.00030	0.00014	0.0011	0.00027	0.00034	0.000085
Strontium, total	mg/L	2.5	0.080	0.11	0.092	0.14	0.081	0.10	0.093	0.14	0.080	0.10	0.10	0.14	0.084	0.10	0.092	0.19	0.081	0.17	0.095	0.18	0.081	0.10
Silver, total	mg/L	0.000050	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.000010	0.0000079	0.0000055	0.0000060	0.0000049	0.0000091	0.0000056	0.0000060	0.0000050	0.000011	0.0000061	0.0000069	0.0000050	0.0000079	0.0000095	0.0000060	0.0000084	0.0000083	0.0000063	0.0000060	0.0000050
Uranium, total	mg/L	0.0085	0.000056	0.00014	0.00019	0.00013	0.00010	0.000100	0.00023	0.00013	0.000092	0.00010	0.00039	0.00016	0.00016	0.00010	0.00019	0.00021	0.00010	0.00017	0.00026	0.00014	0.00011	0.00010
Zinc, dissolved	mg/L	0.0074	0.0013	0.0021	0.0020	0.0012	0.0017	0.0010	0.0021	0.0012	0.0017	0.0010	0.0024	0.0012	0.0018	0.0010	0.0020	0.0020	0.0017	0.0017	0.0021	0.0015	0.0017	0.0010

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-17

Parameter	Units	Goathorn Creek																					
					WQSEA1																		
					Closure																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
		WQG	Baseline																					
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	78	115	71	90	78	116	71	93	78	119	71	93	78	173	71	134	78	116	71	90
Alkalinity, total	mg-$CaCO_3$/L		54	85	58	120	51	83	58	100	51	78	64	150	54	96	58	160	51	120	58	120	52	83
Chloride	mg/L	150	0.25	0.50	0.35	0.73	0.29	0.41	0.34	0.41	0.29	0.33	0.39	0.93	0.31	0.51	0.36	0.89	0.29	0.63	0.36	0.56	0.29	0.42
Fluoride	mg/L	1.2	0.032	0.041	0.039	0.049	0.035	0.040	0.039	0.051	0.035	0.041	0.039	0.049	0.035	0.040	0.039	0.074	0.035	0.059	0.039	0.049	0.035	0.040
Ammonia, total	mg-N/L	1.6	0.0025	0.0070	0.0053	0.012	0.0033	0.0067	0.0050	0.0086	0.0032	0.0050	0.012	0.027	0.0046	0.015	0.0053	0.019	0.0033	0.011	0.0045	0.0094	0.0032	0.0065
Nitrate	mg/L	3.0	0.043	0.084	0.061	0.14	0.047	0.10	0.059	0.13	0.046	0.096	0.11	0.27	0.057	0.17	0.061	0.26	0.047	0.16	0.054	0.12	0.046	0.10
Nitrite	mg/L	0.020	0.00050	0.0020	0.00098	0.0020	0.00064	0.0012	0.00096	0.0016	0.00063	0.00095	0.0022	0.0048	0.00089	0.0027	0.00098	0.0034	0.00064	0.0020	0.00084	0.0017	0.00063	0.0012
Sulfate	mg/L	218	25	38	31	55	26	36	29	38	26	30	40	95	29	59	31	79	26	56	31	46	26	37
Aluminum, total	mg/L	0.27	0.034	0.66	0.056	0.099	0.044	0.039	0.049	0.037	0.042	0.023	0.057	0.099	0.044	0.039	0.057	0.081	0.044	0.055	0.057	0.077	0.044	0.040
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.00011	0.00011	0.000094	0.000072	0.00011	0.000078	0.000094	0.000060	0.00012	0.00017	0.000099	0.00011	0.00011	0.00014	0.000094	0.00011	0.00011	0.00010	0.000094	0.000072
Arsenic, total	mg/L	0.0050	0.00020	0.00060	0.00026	0.00039	0.00023	0.00024	0.00026	0.00034	0.00023	0.00022	0.00027	0.00044	0.00023	0.00027	0.00026	0.00047	0.00023	0.00034	0.00026	0.00039	0.00023	0.00024
Barium, total	mg/L	1.0	0.059	0.071	0.068	0.076	0.060	0.063	0.068	0.080	0.061	0.065	0.068	0.076	0.060	0.063	0.068	0.12	0.060	0.093	0.067	0.076	0.060	0.063
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000061	0.000059	0.000054	0.000048	0.000061	0.000060	0.000054	0.000050	0.000061	0.000059	0.000054	0.000048	0.000061	0.000095	0.000054	0.000072	0.000060	0.000058	0.000054	0.000048
Boron, total	mg/L	1.2	0.0050	0.050	0.0088	0.023	0.0062	0.012	0.0074	0.011	0.0059	0.0077	0.0091	0.026	0.0065	0.013	0.0089	0.025	0.0062	0.017	0.0087	0.019	0.0062	0.012
Cadmium, dissolved	mg/L	0.00016	0.0000075	0.000033	0.000012	0.0000072	0.000010	0.0000054	0.000012	0.0000072	0.000010	0.0000054	0.000012	0.0000095	0.000011	0.0000065	0.000012	0.000012	0.000010	0.0000082	0.000012	0.0000071	0.000010	0.0000054
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.00028	0.00045	0.00023	0.00023	0.00026	0.00024	0.00023	0.00018	0.00028	0.00047	0.00023	0.00024	0.00028	0.00044	0.00023	0.00034	0.00028	0.00036	0.00023	0.00024
Cobalt, dissolved	mg/L	0.00045	0.000050	0.00010	0.000091	0.00017	0.000065	0.00011	0.000092	0.00014	0.000064	0.000094	0.00019	0.00043	0.000088	0.00025	0.000091	0.00032	0.000065	0.00018	0.000090	0.00018	0.000065	0.00011
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0016	0.0013	0.0014	0.00099	0.0016	0.0012	0.0014	0.00096	0.0016	0.0015	0.0014	0.0011	0.0016	0.0019	0.0014	0.0015	0.0016	0.0013	0.0014	0.00098
Iron, total	mg/L	1.0	0.040	0.70	0.11	0.34	0.064	0.096	0.092	0.076	0.057	0.035	0.11	0.34	0.064	0.098	0.11	0.21	0.064	0.14	0.11	0.22	0.066	0.10
Iron, dissolved	mg/L	0.35	0.015	0.12	0.018	0.018	0.016	0.015	0.018	0.018	0.016	0.015	0.018	0.021	0.016	0.017	0.018	0.031	0.016	0.023	0.018	0.018	0.016	0.015
Lead, dissolved	mg/L	0.0026	0.000025	0.000050	0.000043	0.000094	0.000031	0.000055	0.000039	0.000053	0.000030	0.000038	0.000073	0.00020	0.000038	0.00011	0.000043	0.00012	0.000031	0.000084	0.000042	0.000089	0.000032	0.000056
Manganese, total	mg/L	0.91	0.0036	0.029	0.0059	0.0088	0.0048	0.0042	0.0053	0.0045	0.0047	0.0031	0.0067	0.0099	0.0051	0.0056	0.0059	0.0094	0.0048	0.0065	0.0059	0.0065	0.0049	0.0044
Mercury, total	mg/L	0.00002	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.00076	0.0019	0.00061	0.00099	0.00081	0.0011	0.00059	0.00076	0.0012	0.0039	0.00077	0.0020	0.00076	0.0024	0.00061	0.0016	0.00078	0.0014	0.00062	0.0010
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.00035	0.00054	0.00029	0.00039	0.00033	0.00043	0.00029	0.00033	0.00047	0.00099	0.00034	0.00069	0.00035	0.00089	0.00029	0.00061	0.00035	0.00053	0.00029	0.00039
Selenium, total	mg/L	0.0020	0.000084	0.00020	0.00033	0.0013	0.00017	0.00058	0.00035	0.00062	0.00016	0.00036	0.00074	0.0025	0.00030	0.0015	0.00033	0.0016	0.00017	0.00093	0.00032	0.0010	0.00018	0.00060
Strontium, total	mg/L	2.5	0.080	0.11	0.090	0.15	0.080	0.11	0.090	0.14	0.080	0.11	0.091	0.15	0.081	0.12	0.090	0.21	0.080	0.17	0.089	0.15	0.080	0.11
Silver, total	mg/L	0.000050	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.000010	0.0000072	0.0000090	0.0000060	0.0000066	0.0000070	0.0000085	0.0000060	0.0000062	0.0000078	0.000011	0.0000062	0.0000077	0.0000072	0.000014	0.0000060	0.0000100	0.0000072	0.0000090	0.0000060	0.0000066
Uranium, total	mg/L	0.0085	0.000056	0.00014	0.00012	0.00044	0.000076	0.00023	0.00012	0.00022	0.000072	0.00016	0.00022	0.00088	0.00011	0.00046	0.00012	0.00051	0.000076	0.00036	0.00012	0.00036	0.000078	0.00024
Zinc, dissolved	mg/L	0.0074	0.0013	0.0021	0.0018	0.0015	0.0016	0.0012	0.0018	0.0015	0.0016	0.0012	0.0019	0.0020	0.0017	0.0014	0.0018	0.0024	0.0016	0.0018	0.0018	0.0015	0.0016	0.0012

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-18

Parameter	Units	Goathorn Creek																					
		WQG	Baseline		WQS06																		
					Operations																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	81	109	71	89	81	108	71	89	85	109	72	89	83	169	71	148	82	129	71	89
Alkalinity, total	mg-$CaCO_3$/L		54	85	70	96	55	68	74	96	55	69	92	96	61	68	70	130	55	110	76	120	56	69
Chloride	mg/L	150	0.25	0.50	0.49	0.33	0.33	0.25	0.53	0.32	0.32	0.25	0.75	0.38	0.40	0.25	0.49	0.52	0.33	0.42	0.56	0.33	0.34	0.25
Fluoride	mg/L	1.2	0.032	0.041	0.041	0.048	0.036	0.039	0.042	0.048	0.036	0.039	0.041	0.048	0.036	0.039	0.042	0.074	0.036	0.065	0.041	0.060	0.036	0.039
Ammonia, total	mg-N/L	1.6	0.0025	0.0070	0.019	0.0072	0.0059	0.0026	0.019	0.0071	0.0057	0.0026	0.064	0.020	0.014	0.0029	0.019	0.0097	0.0059	0.0043	0.018	0.0084	0.0062	0.0027
Nitrate	mg/L	3.0	0.043	0.084	0.17	0.11	0.070	0.077	0.17	0.11	0.067	0.077	0.53	0.22	0.13	0.079	0.17	0.17	0.070	0.13	0.17	0.11	0.072	0.078
Nitrite	mg/L	0.020	0.00050	0.0020	0.0034	0.0013	0.0011	0.00051	0.0033	0.0013	0.0010	0.00051	0.012	0.0037	0.0025	0.00056	0.0034	0.0018	0.0011	0.00085	0.0033	0.0015	0.0011	0.00052
Sulfate	mg/L	218	25	38	41	31	29	24	44	30	28	24	63	35	36	24	41	50	29	42	46	31	30	24
Aluminum, total	mg/L	0.27	0.034	0.66	0.065	0.028	0.049	0.018	0.067	0.028	0.048	0.018	0.065	0.028	0.049	0.018	0.065	0.040	0.049	0.029	0.074	0.036	0.050	0.019
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.00013	0.000067	0.000099	0.000050	0.00013	0.000066	0.000098	0.000050	0.00016	0.000073	0.00011	0.000050	0.00013	0.00011	0.000099	0.000085	0.00013	0.000067	0.00010	0.000050
Arsenic, total	mg/L	0.0050	0.00020	0.00060	0.00031	0.00035	0.00025	0.00018	0.00032	0.00035	0.00024	0.00019	0.00035	0.00035	0.00026	0.00019	0.00031	0.00035	0.00025	0.00029	0.00033	0.00046	0.00025	0.00019
Barium, total	mg/L	1.0	0.059	0.071	0.071	0.073	0.061	0.063	0.071	0.073	0.062	0.063	0.071	0.073	0.062	0.063	0.073	0.12	0.062	0.11	0.071	0.090	0.061	0.063
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000063	0.000054	0.000055	0.000049	0.000063	0.000054	0.000055	0.000049	0.000063	0.000054	0.000055	0.000049	0.000065	0.000095	0.000055	0.000083	0.000063	0.000060	0.000055	0.000049
Boron, total	mg/L	1.2	0.0050	0.050	0.0098	0.0083	0.0067	0.0054	0.011	0.0083	0.0066	0.0054	0.015	0.0083	0.0081	0.0054	0.0098	0.010	0.0067	0.0087	0.011	0.011	0.0069	0.0054
Cadmium, dissolved	mg/L	0.00016	0.0000075	0.000033	0.000013	0.0000065	0.000011	0.0000049	0.000013	0.0000065	0.000011	0.0000049	0.000016	0.0000073	0.000012	0.0000049	0.000013	0.000011	0.000011	0.0000084	0.000013	0.0000065	0.000011	0.0000049
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.00032	0.00020	0.00025	0.00016	0.00034	0.00020	0.00025	0.00016	0.00034	0.00020	0.00026	0.00016	0.00032	0.00032	0.00025	0.00027	0.00035	0.00022	0.00026	0.00016
Cobalt, dissolved	mg/L	0.00045	0.000050	0.00010	0.00019	0.000084	0.000095	0.000050	0.00022	0.000081	0.000088	0.000050	0.00051	0.00014	0.00016	0.000052	0.00019	0.00012	0.000095	0.000084	0.00022	0.000097	0.00010	0.000051
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0016	0.0011	0.0014	0.00091	0.0016	0.0011	0.0014	0.00092	0.0016	0.0011	0.0014	0.00091	0.0017	0.0018	0.0014	0.0015	0.0016	0.0012	0.0014	0.00092
Iron, total	mg/L	1.0	0.040	0.70	0.14	0.046	0.082	0.018	0.14	0.046	0.078	0.018	0.14	0.046	0.082	0.018	0.14	0.061	0.082	0.028	0.17	0.050	0.087	0.019
Iron, dissolved	mg/L	0.35	0.015	0.12	0.019	0.016	0.017	0.015	0.019	0.016	0.017	0.015	0.021	0.017	0.017	0.015	0.019	0.028	0.017	0.025	0.020	0.018	0.017	0.015
Lead, dissolved	mg/L	0.0026	0.000025	0.000050	0.000066	0.000038	0.000038	0.000025	0.000075	0.000037	0.000036	0.000025	0.00012	0.000048	0.000053	0.000025	0.000066	0.000058	0.000038	0.000042	0.000079	0.000038	0.000040	0.000025
Manganese, total	mg/L	0.91	0.0036	0.029	0.0079	0.0035	0.0055	0.0022	0.0083	0.0035	0.0054	0.0022	0.012	0.0041	0.0064	0.0022	0.0079	0.0053	0.0055	0.0037	0.0083	0.0036	0.0057	0.0022
Mercury, total	mg/L	0.000020	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.0017	0.00085	0.00087	0.00043	0.0020	0.00081	0.00080	0.00043	0.0035	0.0012	0.0014	0.00044	0.0017	0.0012	0.00087	0.00073	0.0022	0.00085	0.00093	0.00044
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.00054	0.00033	0.00035	0.00025	0.00059	0.00032	0.00034	0.00025	0.00095	0.00042	0.00047	0.00025	0.00054	0.00052	0.00035	0.00042	0.00060	0.00034	0.00036	0.00025
Selenium, total	mg/L	0.0020	0.000084	0.00020	0.00078	0.00032	0.00030	0.000083	0.00092	0.00030	0.00026	0.000085	0.0017	0.00052	0.00058	0.000092	0.00078	0.00041	0.00030	0.00014	0.0011	0.00032	0.00034	0.000089
Strontium, total	mg/L	2.5	0.080	0.11	0.096	0.14	0.083	0.10	0.096	0.14	0.082	0.10	0.11	0.14	0.086	0.10	0.096	0.19	0.083	0.17	0.099	0.17	0.083	0.10
Silver, total	mg/L	0.000050	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.000010	0.0000082	0.0000058	0.0000061	0.0000049	0.0000093	0.0000060	0.0000061	0.0000049	0.000012	0.0000067	0.0000071	0.0000049	0.0000082	0.0000096	0.0000061	0.0000083	0.0000085	0.0000060	0.0000062	0.0000049
Uranium, total	mg/L	0.00850	0.000056	0.00014	0.00020	0.00014	0.00010	0.000099	0.00023	0.00014	0.000094	0.000099	0.00042	0.00018	0.00016	0.00010	0.00020	0.00022	0.00010	0.00017	0.00026	0.00014	0.00011	0.000100
Zinc, dissolved	mg/L	0.0074	0.0013	0.0021	0.0021	0.0012	0.0017	0.0010	0.0022	0.0012	0.0017	0.0010	0.0026	0.0013	0.0019	0.0010	0.0021	0.0020	0.0017	0.0017	0.0022	0.0014	0.0017	0.0010

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-19

Parameter	Units	Goathorn Creek																					
		WQG	Baseline		WQS06																		
					Closure																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	84	122	71	90	84	122	71	93	84	125	71	93	84	173	71	134	81	122	71	90
Alkalinity, total	mg-$CaCO_3$/L		54	85	61	120	53	82	61	100	53	77	65	150	55	95	61	160	53	120	60	120	53	83
Chloride	mg/L	150	0.25	0.50	0.36	0.82	0.30	0.41	0.34	0.43	0.29	0.33	0.40	1.1	0.32	0.50	0.37	0.88	0.30	0.62	0.37	0.58	0.30	0.41
Fluoride	mg/L	1.2	0.032	0.041	0.042	0.051	0.036	0.040	0.042	0.053	0.036	0.041	0.042	0.051	0.036	0.040	0.042	0.074	0.036	0.059	0.041	0.051	0.036	0.040
Ammonia, total	mg-N/L	1.6	0.0025	0.0070	0.0053	0.013	0.0034	0.0066	0.0051	0.0086	0.0032	0.0050	0.012	0.028	0.0047	0.015	0.0053	0.019	0.0034	0.011	0.0046	0.0094	0.0033	0.0063
Nitrate	mg/L	3.0	0.043	0.084	0.062	0.15	0.048	0.10	0.060	0.13	0.047	0.095	0.11	0.27	0.058	0.17	0.062	0.25	0.048	0.16	0.056	0.13	0.047	0.10
Nitrite	mg/L	0.020	0.00050	0.0020	0.00099	0.0023	0.00066	0.0012	0.00097	0.0016	0.00064	0.00094	0.0022	0.0050	0.00090	0.0026	0.00099	0.0034	0.00066	0.0019	0.00086	0.0017	0.00064	0.0011
Sulfate	mg/L	218	25	38	31	61	27	36	30	39	26	30	41	110	30	57	32	78	27	55	32	48	27	36
Aluminum, total	mg/L	0.27	0.034	0.66	0.058	0.12	0.045	0.038	0.051	0.039	0.043	0.023	0.058	0.12	0.045	0.038	0.059	0.084	0.045	0.054	0.059	0.080	0.045	0.040
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.00011	0.00012	0.000096	0.000071	0.00011	0.000082	0.000096	0.000060	0.00012	0.00020	0.00010	0.00010	0.00011	0.00014	0.000096	0.00011	0.00011	0.00011	0.000096	0.000071
Arsenic, total	mg/L	0.0050	0.00020	0.00060	0.00027	0.00040	0.00023	0.00023	0.00027	0.00035	0.00023	0.00022	0.00028	0.00046	0.00024	0.00027	0.00027	0.00049	0.00023	0.00033	0.00027	0.00041	0.00023	0.00024
Barium, total	mg/L	1.0	0.059	0.071	0.072	0.081	0.062	0.063	0.073	0.084	0.062	0.065	0.072	0.081	0.062	0.063	0.072	0.12	0.062	0.093	0.071	0.080	0.062	0.063
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000065	0.000062	0.000055	0.000049	0.000065	0.000064	0.000055	0.000050	0.000065	0.000062	0.000055	0.000049	0.000065	0.000095	0.000055	0.000072	0.000064	0.000062	0.000055	0.000049
Boron, total	mg/L	1.2	0.0050	0.050	0.0089	0.027	0.0063	0.011	0.0075	0.011	0.0060	0.0077	0.0092	0.031	0.0067	0.013	0.0091	0.025	0.0063	0.017	0.0090	0.019	0.0064	0.011
Cadmium, dissolved	mg/L	0.00016	0.0000075	0.000033	0.000013	0.0000076	0.000011	0.0000054	0.000013	0.0000077	0.000011	0.0000054	0.000013	0.0000099	0.000011	0.0000065	0.000013	0.000012	0.000011	0.0000083	0.000012	0.0000076	0.000011	0.0000054
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.00029	0.00052	0.00024	0.00023	0.00027	0.00025	0.00023	0.00018	0.00029	0.00055	0.00024	0.00024	0.00029	0.00045	0.00024	0.00034	0.00029	0.00038	0.00024	0.00024
Cobalt, dissolved	mg/L	0.00045	0.000050	0.00010	0.000092	0.00018	0.000066	0.00011	0.000093	0.00014	0.000065	0.000093	0.00018	0.00043	0.000089	0.00024	0.000092	0.00031	0.000067	0.00018	0.000090	0.00018	0.000066	0.00011
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0017	0.0014	0.0014	0.00099	0.0017	0.0013	0.0014	0.00096	0.0017	0.0016	0.0014	0.0011	0.0017	0.0019	0.0014	0.0015	0.0016	0.0014	0.0014	0.00099
Iron, total	mg/L	1.0	0.040	0.70	0.11	0.41	0.065	0.093	0.090	0.074	0.058	0.034	0.11	0.41	0.065	0.094	0.11	0.22	0.065	0.13	0.11	0.22	0.067	0.100
Iron, dissolved	mg/L	0.35	0.015	0.12	0.019	0.019	0.017	0.015	0.019	0.019	0.017	0.015	0.019	0.021	0.017	0.017	0.019	0.031	0.017	0.023	0.019	0.019	0.017	0.015
Lead, dissolved	mg/L	0.0026	0.000025	0.000050	0.000043	0.00011	0.000032	0.000054	0.000040	0.000053	0.000031	0.000038	0.000072	0.00020	0.000039	0.00011	0.000043	0.00012	0.000032	0.000082	0.000044	0.000091	0.000032	0.000055
Manganese, total	mg/L	0.91	0.0036	0.029	0.0060	0.010	0.0049	0.0041	0.0056	0.0047	0.0048	0.0031	0.0068	0.012	0.0052	0.0055	0.0061	0.0096	0.0050	0.0063	0.0062	0.0068	0.0050	0.0043
Mercury, total	mg/L	0.000020	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.00077	0.0021	0.00062	0.00097	0.00082	0.0011	0.00061	0.00075	0.0012	0.0046	0.00078	0.0019	0.00077	0.0024	0.00062	0.0015	0.00081	0.0014	0.00063	0.00100
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.00036	0.00060	0.00030	0.00038	0.00034	0.00044	0.00030	0.00033	0.00047	0.0010	0.00034	0.00067	0.00036	0.00089	0.00030	0.00060	0.00036	0.00054	0.00030	0.00039
Selenium, total	mg/L	0.0020	0.000084	0.00020	0.00032	0.0015	0.00017	0.00056	0.00035	0.00062	0.00016	0.00035	0.00073	0.0030	0.00031	0.0014	0.00032	0.0016	0.00017	0.00090	0.00033	0.0010	0.00018	0.00058
Strontium, total	mg/L	2.5	0.080	0.11	0.095	0.15	0.083	0.11	0.096	0.15	0.083	0.11	0.096	0.16	0.084	0.12	0.095	0.21	0.083	0.17	0.094	0.15	0.082	0.11
Silver, total	mg/L	0.000050	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.000010	0.0000074	0.0000094	0.0000062	0.0000065	0.0000073	0.0000088	0.0000061	0.0000062	0.0000080	0.000011	0.0000064	0.0000076	0.0000074	0.000014	0.0000062	0.0000099	0.0000074	0.0000094	0.0000062	0.0000066
Uranium, total	mg/L	0.00850	0.000056	0.00014	0.00012	0.00051	0.000078	0.00023	0.00012	0.00022	0.000073	0.00016	0.00022	0.0010	0.00011	0.00044	0.00012	0.00051	0.000078	0.00035	0.00012	0.00036	0.000080	0.00023
Zinc, dissolved	mg/L	0.0074	0.0013	0.0021	0.0019	0.0016	0.0017	0.0012	0.0019	0.0016	0.0017	0.0012	0.0020	0.0021	0.0017	0.0014	0.0019	0.0024	0.0017	0.0018	0.0019	0.0016	0.0017	0.0012

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-20

Parameter	Units	Goathorn Creek																					
		WQG	Baseline		WQS05																		
					Operations																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	85	93	75	87	85	93	75	87	89	93	75	87	88	142	75	126	88	142	75	126
Alkalinity, total	mg-$CaCO_3$/L		54	85	78	76	64	69	80	76	63	69	95	79	68	69	79	110	64	100	79	110	64	100
Chloride	mg/L	150	0.25	0.50	0.46	0.32	0.32	0.24	0.48	0.31	0.31	0.24	0.66	0.36	0.38	0.24	0.46	0.46	0.32	0.35	0.46	0.46	0.32	0.35
Fluoride	mg/L	1.190707	0.032	0.041	0.042	0.042	0.036	0.038	0.043	0.042	0.036	0.038	0.042	0.042	0.036	0.038	0.042	0.062	0.036	0.055	0.042	0.062	0.036	0.055
Ammonia, total	mg-N/L	1.56	0.0025	0.0070	0.015	0.0069	0.0051	0.0025	0.016	0.0068	0.0049	0.0026	0.050	0.019	0.011	0.0027	0.015	0.0095	0.0051	0.0036	0.015	0.0095	0.0051	0.0036
Nitrate	mg/L	3	0.043	0.084	0.13	0.11	0.053	0.071	0.13	0.10	0.051	0.071	0.41	0.20	0.097	0.073	0.13	0.15	0.053	0.10	0.13	0.15	0.053	0.10
Nitrite	mg/L	0.02	0.00050	0.0020	0.0027	0.0013	0.00093	0.00049	0.0027	0.0012	0.00088	0.00050	0.0090	0.0034	0.0019	0.00054	0.0027	0.0018	0.00093	0.00072	0.0027	0.0018	0.00093	0.00072
Sulfate	mg/L	218	25	38	32	26	23	21	33	26	22	21	49	32	27	21	33	36	23	29	33	36	23	29
Aluminum, total	mg/L	0.270189	0.034	0.66	0.067	0.030	0.052	0.020	0.067	0.030	0.051	0.020	0.067	0.030	0.052	0.020	0.067	0.045	0.052	0.029	0.067	0.045	0.052	0.029
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.00015	0.000075	0.00012	0.000055	0.00015	0.000074	0.00012	0.000055	0.00017	0.000080	0.00012	0.000055	0.00015	0.00011	0.00012	0.000083	0.00015	0.00011	0.00012	0.000083
Arsenic, total	mg/L	0.005	0.00020	0.00060	0.00040	0.00028	0.00033	0.00020	0.00040	0.00028	0.00033	0.00020	0.00043	0.00028	0.00034	0.00020	0.00041	0.00037	0.00033	0.00030	0.00041	0.00037	0.00033	0.00030
Barium, total	mg/L	1	0.059	0.071	0.066	0.064	0.056	0.057	0.066	0.063	0.056	0.057	0.066	0.064	0.056	0.057	0.067	0.092	0.056	0.080	0.067	0.092	0.056	0.080
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000065	0.000055	0.000056	0.000048	0.000065	0.000055	0.000056	0.000048	0.000065	0.000055	0.000056	0.000048	0.000067	0.000080	0.000056	0.000070	0.000067	0.000080	0.000056	0.000070
Boron, total	mg/L	1.2	0.0050	0.050	0.012	0.010	0.0089	0.0070	0.012	0.010	0.0088	0.0071	0.016	0.010	0.0100	0.0070	0.012	0.013	0.0089	0.011	0.012	0.013	0.0089	0.011
Cadmium, dissolved	mg/L	0.000163	0.0000075	0.000033	0.000011	0.0000061	0.0000089	0.0000045	0.000011	0.0000061	0.0000089	0.0000045	0.000013	0.0000068	0.0000096	0.0000045	0.000011	0.0000087	0.0000089	0.0000064	0.000011	0.0000087	0.0000089	0.0000064
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.00035	0.00023	0.00028	0.00018	0.00035	0.00023	0.00028	0.00019	0.00036	0.00023	0.00028	0.00018	0.00035	0.00035	0.00028	0.00028	0.00035	0.00035	0.00028	0.00028
Cobalt, dissolved	mg/L	0.00045	0.000050	0.00010	0.00016	0.000079	0.000085	0.000049	0.00017	0.000079	0.000080	0.000049	0.00045	0.00014	0.00013	0.000050	0.00016	0.00011	0.000085	0.000071	0.00016	0.00011	0.000085	0.000071
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0016	0.0011	0.0013	0.00089	0.0016	0.0011	0.0013	0.00089	0.0016	0.0011	0.0013	0.00089	0.0016	0.0015	0.0013	0.0013	0.0016	0.0015	0.0013	0.0013
Iron, total	mg/L	1	0.040	0.70	0.12	0.046	0.072	0.019	0.12	0.046	0.070	0.020	0.12	0.047	0.072	0.019	0.12	0.066	0.072	0.029	0.12	0.066	0.072	0.029
Iron, dissolved	mg/L	0.35	0.015	0.12	0.020	0.017	0.017	0.014	0.020	0.017	0.017	0.014	0.021	0.017	0.017	0.014	0.020	0.024	0.017	0.021	0.020	0.024	0.017	0.021
Lead, dissolved	mg/L	0.0026	0.000025	0.000050	0.000059	0.000036	0.000036	0.000024	0.000063	0.000035	0.000034	0.000024	0.00010	0.000047	0.000047	0.000025	0.000059	0.000051	0.000036	0.000035	0.000059	0.000051	0.000036	0.000035
Manganese, total	mg/L	0.913	0.0036	0.029	0.0076	0.0036	0.0056	0.0023	0.0080	0.0036	0.0055	0.0023	0.011	0.0042	0.0063	0.0023	0.0076	0.0053	0.0056	0.0033	0.0076	0.0053	0.0056	0.0033
Mercury, total	mg/L	0.00002	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.0014	0.00071	0.00068	0.00038	0.0015	0.00067	0.00063	0.00038	0.0028	0.0011	0.0010	0.00039	0.0014	0.00095	0.00068	0.00053	0.0014	0.00095	0.00068	0.00053
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.00050	0.00032	0.00034	0.00024	0.00052	0.00031	0.00032	0.00024	0.00084	0.00042	0.00042	0.00024	0.00050	0.00046	0.00034	0.00035	0.00050	0.00046	0.00034	0.00035
Selenium, total	mg/L	0.002	0.000084	0.00020	0.00063	0.00025	0.00024	0.000078	0.00068	0.00024	0.00020	0.000080	0.0013	0.00040	0.00044	0.000085	0.00063	0.00034	0.00024	0.00011	0.00063	0.00034	0.00024	0.00011
Strontium, total	mg/L	2.5	0.080	0.11	0.11	0.11	0.092	0.10	0.10	0.11	0.091	0.10	0.11	0.11	0.094	0.10	0.11	0.17	0.092	0.15	0.11	0.17	0.092	0.15
Silver, total	mg/L	0.00005	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.0008	0.0000050	0.000010	0.0000079	0.0000059	0.0000061	0.0000048	0.0000085	0.0000060	0.0000061	0.0000048	0.000010	0.0000067	0.0000068	0.0000048	0.0000079	0.0000087	0.0000061	0.0000070	0.0000079	0.0000087	0.0000061	0.0000070
Uranium, total	mg/L	0.0085	0.000056	0.00014	0.00019	0.00015	0.00011	0.00012	0.00020	0.00015	0.000100	0.00012	0.00035	0.00019	0.00015	0.00012	0.00019	0.00023	0.00011	0.00018	0.00019	0.00023	0.00011	0.00018
Zinc, dissolved	mg/L	0.007405	0.0013	0.0021	0.0019	0.0013	0.0016	0.0011	0.0020	0.0013	0.0016	0.0011	0.0023	0.0014	0.0017	0.0011	0.0019	0.0019	0.0016	0.0016	0.0019	0.0019	0.0016	0.0016

Red highlight is an WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-21

Parameter	Units	Goathorn Creek																					
					WQS05																		
					Closure																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
		WQG	Baseline																					
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		74	100	88	127	75	91	91	128	75	94	91	129	75	95	88	166	75	121	88	166	75	121
Alkalinity, total	mg-$CaCO_3$/L		54	85	76	120	63	85	77	130	64	87	78	140	66	98	76	160	63	110	76	160	63	110
Chloride	mg/L	150	0.25	0.50	0.36	0.66	0.31	0.37	0.42	0.56	0.32	0.38	0.47	0.84	0.34	0.49	0.36	0.84	0.31	0.53	0.36	0.84	0.31	0.53
Fluoride	mg/L	1.190707	0.032	0.041	0.043	0.055	0.036	0.041	0.043	0.055	0.036	0.042	0.043	0.055	0.036	0.041	0.043	0.073	0.036	0.053	0.043	0.073	0.036	0.053
Ammonia, total	mg-N/L	1.56	0.0025	0.0070	0.0078	0.016	0.0041	0.0082	0.012	0.023	0.0044	0.0092	0.021	0.048	0.0070	0.021	0.0078	0.033	0.0041	0.014	0.0078	0.033	0.0041	0.014
Nitrate	mg/L	3	0.043	0.084	0.068	0.17	0.043	0.11	0.098	0.24	0.046	0.12	0.17	0.43	0.066	0.21	0.068	0.34	0.043	0.16	0.068	0.34	0.043	0.16
Nitrite	mg/L	0.02	0.00050	0.0020	0.0015	0.0028	0.00078	0.0015	0.0022	0.0042	0.00084	0.0017	0.0039	0.0088	0.0013	0.0039	0.0015	0.0059	0.00078	0.0025	0.0015	0.0059	0.00078	0.0025
Sulfate	mg/L	218	25	38	26	49	22	28	29	45	22	28	37	85	26	47	26	65	22	39	26	65	22	39
Aluminum, total	mg/L	0.270189	0.034	0.66	0.060	0.089	0.049	0.033	0.059	0.045	0.048	0.026	0.060	0.090	0.049	0.033	0.061	0.069	0.049	0.044	0.061	0.069	0.049	0.044
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.00015	0.00012	0.00012	0.000077	0.00015	0.00012	0.00012	0.000078	0.00015	0.00016	0.00012	0.00011	0.00015	0.00015	0.00012	0.00011	0.00015	0.00015	0.00012	0.00011
Arsenic, total	mg/L	0.005	0.00020	0.00060	0.00041	0.00045	0.00033	0.00027	0.00041	0.00044	0.00033	0.00027	0.00041	0.00049	0.00033	0.00030	0.00041	0.00051	0.00033	0.00036	0.00041	0.00051	0.00033	0.00036
Barium, total	mg/L	1	0.059	0.071	0.066	0.074	0.056	0.056	0.066	0.074	0.056	0.057	0.066	0.074	0.056	0.056	0.066	0.098	0.056	0.072	0.066	0.098	0.056	0.072
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000068	0.000067	0.000057	0.000050	0.000068	0.000068	0.000057	0.000051	0.000068	0.000067	0.000057	0.000050	0.000068	0.000090	0.000057	0.000065	0.000068	0.000090	0.000057	0.000065
Boron, total	mg/L	1.2	0.0050	0.050	0.011	0.022	0.0090	0.014	0.014	0.022	0.0094	0.014	0.012	0.025	0.0096	0.016	0.011	0.031	0.0090	0.019	0.011	0.031	0.0090	0.019
Cadmium, dissolved	mg/L	0.000163	0.0000075	0.000033	0.000010	0.0000070	0.0000089	0.0000051	0.000010	0.0000078	0.0000089	0.0000052	0.000011	0.0000095	0.0000092	0.0000065	0.000010	0.000011	0.0000089	0.0000069	0.000010	0.000011	0.0000089	0.0000069
Chromium, total	mg/L	0.0089	0.00020	0.00084	0.00033	0.00043	0.00027	0.00026	0.00033	0.00038	0.00027	0.00024	0.00033	0.00045	0.00027	0.00027	0.00033	0.00050	0.00027	0.00034	0.00033	0.00050	0.00027	0.00034
Cobalt, dissolved	mg/L	0.00045	0.000050	0.00010	0.00011	0.00018	0.000072	0.00011	0.00014	0.00024	0.000075	0.00012	0.00023	0.00048	0.00010	0.00026	0.00011	0.00038	0.000072	0.00018	0.00011	0.00038	0.000072	0.00018
Copper, dissolved	mg/L	0.0013	0.0011	0.0036	0.0016	0.0013	0.0013	0.00098	0.0016	0.0014	0.0014	0.00099	0.0016	0.0014	0.0014	0.0010	0.0016	0.0018	0.0013	0.0013	0.0016	0.0018	0.0013	0.0013
Iron, total	mg/L	1	0.040	0.70	0.094	0.30	0.061	0.062	0.068	0.056	0.056	0.032	0.094	0.30	0.061	0.064	0.097	0.16	0.061	0.086	0.097	0.16	0.061	0.086
Iron, dissolved	mg/L	0.35	0.015	0.12	0.020	0.021	0.017	0.016	0.020	0.022	0.017	0.016	0.021	0.023	0.017	0.018	0.020	0.031	0.017	0.021	0.020	0.031	0.017	0.021
Lead, dissolved	mg/L	0.0026	0.000025	0.000050	0.000042	0.000084	0.000033	0.000046	0.000053	0.000079	0.000034	0.000045	0.000070	0.00015	0.000042	0.000091	0.000042	0.00011	0.000033	0.000066	0.000042	0.00011	0.000033	0.000066
Manganese, total	mg/L	0.913	0.0036	0.029	0.0063	0.0082	0.0053	0.0040	0.0065	0.0063	0.0053	0.0036	0.0075	0.0096	0.0057	0.0056	0.0063	0.010	0.0053	0.0058	0.0063	0.010	0.0053	0.0058
Mercury, total	mg/L	0.00002	0.0000025	0.0000052	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00048	0.00062	0.00067	0.0016	0.00052	0.00075	0.00085	0.0014	0.00055	0.00077	0.0015	0.0034	0.00076	0.0018	0.00067	0.0021	0.00052	0.0011	0.00067	0.0021	0.00052	0.0011
Nickel, dissolved	mg/L	0.0022	0.00025	0.00060	0.00037	0.00051	0.00031	0.00038	0.00043	0.00059	0.00032	0.00039	0.00058	0.0010	0.00037	0.00066	0.00037	0.00094	0.00031	0.00055	0.00037	0.00094	0.00031	0.00055
Selenium, total	mg/L	0.002	0.000084	0.00020	0.00031	0.0011	0.00016	0.00043	0.00046	0.00092	0.00018	0.00044	0.00081	0.0022	0.00033	0.0012	0.00031	0.0014	0.00016	0.00070	0.00031	0.0014	0.00016	0.00070
Strontium, total	mg/L	2.5	0.080	0.11	0.11	0.16	0.093	0.12	0.11	0.17	0.094	0.12	0.11	0.17	0.094	0.12	0.11	0.23	0.093	0.16	0.11	0.23	0.093	0.16
Silver, total	mg/L	0.00005	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.0008	0.0000050	0.000010	0.0000073	0.0000093	0.0000063	0.0000066	0.0000080	0.000010	0.0000063	0.0000067	0.0000085	0.000012	0.0000066	0.0000079	0.0000073	0.000015	0.0000063	0.0000092	0.0000073	0.000015	0.0000063	0.0000092
Uranium, total	mg/L	0.0085	0.000056	0.00014	0.00013	0.00041	0.000095	0.00023	0.00019	0.00039	0.00010	0.00023	0.00024	0.00078	0.00013	0.00041	0.00013	0.00055	0.000095	0.00033	0.00013	0.00055	0.000095	0.00033
Zinc, dissolved	mg/L	0.007405	0.0013	0.0021	0.0018	0.0020	0.0016	0.0013	0.0018	0.0021	0.0016	0.0014	0.0019	0.0024	0.0016	0.0016	0.0018	0.0027	0.0016	0.0018	0.0018	0.0027	0.0016	0.0018

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-22

Parameter	Units	Telkwa River																					
		WQG	Baseline		WQS09																		
					Operations																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		44	64	42	62	38	58	42	62	38	58	42	62	38	58	42	62	38	58	42	61	38	58
Alkalinity, total	mg-$CaCO_3$/L		43	63	37	60	34	58	37	60	34	58	38	60	35	58	37	60	34	59	37	60	35	58
Chloride	mg/L	150	0.25	0.50	0.28	0.25	0.26	0.24	0.28	0.26	0.26	0.24	0.29	0.26	0.26	0.24	0.28	0.26	0.26	0.25	0.28	0.26	0.26	0.24
Fluoride	mg/L	1.0	0.028	0.038	0.029	0.035	0.027	0.035	0.029	0.035	0.027	0.035	0.029	0.035	0.027	0.035	0.029	0.036	0.027	0.035	0.029	0.035	0.027	0.035
Ammonia, total	mg-N/L	1.7	0.0025	0.0095	0.0037	0.0050	0.0028	0.0047	0.0037	0.0050	0.0027	0.0047	0.0068	0.0059	0.0032	0.0047	0.0037	0.0052	0.0028	0.0048	0.0037	0.0050	0.0028	0.0047
Nitrate	mg/L	3.0	0.012	0.076	0.022	0.060	0.013	0.058	0.021	0.060	0.012	0.058	0.047	0.066	0.016	0.058	0.022	0.061	0.013	0.059	0.022	0.060	0.013	0.058
Nitrite	mg/L	0.020	0.00050	0.0050	0.00071	0.00056	0.00054	0.00049	0.00070	0.00055	0.00054	0.00049	0.0013	0.00071	0.00063	0.00049	0.00071	0.00057	0.00054	0.00050	0.00071	0.00056	0.00055	0.00049
Sulfate	mg/L	218	5.6	9.0	7.8	7.7	6.5	7.5	7.8	7.8	6.4	7.5	8.9	8.2	6.8	7.5	7.9	7.7	6.5	7.3	7.8	7.8	6.6	7.5
Aluminum, total	mg/L	0.19	0.12	1.5	0.25	0.046	0.24	0.034	0.25	0.046	0.24	0.034	0.25	0.046	0.24	0.034	0.25	0.048	0.24	0.035	0.25	0.046	0.24	0.034
Antimony, dissolved	mg/L	0.074	0.000050	0.000050	0.000062	0.000052	0.000056	0.000050	0.000062	0.000052	0.000056	0.000050	0.000063	0.000052	0.000057	0.000050	0.000062	0.000053	0.000056	0.000050	0.000061	0.000052	0.000057	0.000050
Arsenic, total	mg/L	0.0050	0.00023	0.00055	0.00026	0.00022	0.00024	0.00021	0.00026	0.00022	0.00024	0.00021	0.00026	0.00022	0.00024	0.00021	0.00026	0.00022	0.00024	0.00021	0.00026	0.00022	0.00024	0.00021
Barium, total	mg/L	1.0	0.041	0.048	0.043	0.043	0.040	0.042	0.043	0.043	0.040	0.042	0.043	0.043	0.040	0.042	0.043	0.044	0.040	0.042	0.043	0.043	0.040	0.042
Beryllium, total	mg/L	0.00013	0.000050	0.000050	0.000054	0.000051	0.000051	0.000049	0.000054	0.000050	0.000051	0.000049	0.000054	0.000051	0.000051	0.000049	0.000054	0.000051	0.000051	0.000049	0.000054	0.000050	0.000051	0.000049
Boron, total	mg/L	1.2	0.0050	0.050	0.0058	0.0063	0.0054	0.0052	0.0058	0.0063	0.0054	0.0052	0.0061	0.0063	0.0055	0.0052	0.0059	0.0065	0.0054	0.0053	0.0059	0.0062	0.0054	0.0052
Cadmium, dissolved	mg/L	0.00011	0.0000061	0.0000099	0.0000075	0.0000052	0.0000069	0.0000049	0.0000075	0.0000052	0.0000069	0.0000049	0.0000077	0.0000052	0.0000070	0.0000049	0.0000076	0.0000053	0.0000070	0.0000049	0.0000075	0.0000052	0.0000070	0.0000049
Chromium, total	mg/L	0.0089	0.00020	0.0010	0.00023	0.00018	0.00022	0.00018	0.00023	0.00019	0.00022	0.00018	0.00024	0.00019	0.00022	0.00018	0.00024	0.00019	0.00022	0.00018	0.00023	0.00019	0.00022	0.00018
Cobalt, dissolved	mg/L	0.000390	0.000050	0.000082	0.000060	0.000052	0.000054	0.000049	0.000062	0.000052	0.000053	0.000049	0.000078	0.000056	0.000057	0.000049	0.000061	0.000053	0.000054	0.000050	0.000064	0.000053	0.000054	0.000049
Copper, dissolved	mg/L	0.0008	0.00060	0.0016	0.00080	0.00056	0.00073	0.00054	0.00080	0.00056	0.00073	0.00054	0.00080	0.00056	0.00073	0.00054	0.00081	0.00057	0.00073	0.00054	0.00080	0.00056	0.00073	0.00054
Iron, total	mg/L	1.0	0.29	1.3	0.32	0.22	0.30	0.21	0.32	0.23	0.29	0.21	0.32	0.22	0.30	0.21	0.32	0.23	0.30	0.21	0.31	0.22	0.29	0.21
Iron, dissolved	mg/L	0.35	0.088	0.26	0.067	0.12	0.064	0.12	0.067	0.12	0.064	0.12	0.067	0.12	0.064	0.12	0.067	0.13	0.064	0.12	0.066	0.12	0.063	0.12
Lead, dissolved	mg/L	0.0	0.000025	0.000097	0.000029	0.000026	0.000026	0.000024	0.000029	0.000026	0.000026	0.000024	0.000032	0.000027	0.000027	0.000025	0.000029	0.000026	0.000026	0.000025	0.000030	0.000026	0.000026	0.000025
Manganese, total	mg/L	0.79	0.019	0.075	0.021	0.010	0.020	0.0093	0.021	0.010	0.020	0.0093	0.022	0.010	0.020	0.0093	0.021	0.011	0.020	0.0095	0.021	0.010	0.020	0.0093
Mercury, total	mg/L	0.000020	0.0000025	0.0000068	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00050	0.00072	0.00066	0.00048	0.00059	0.00044	0.00066	0.00048	0.00058	0.00044	0.00077	0.00051	0.00061	0.00044	0.00066	0.00049	0.00059	0.00045	0.00068	0.00049	0.00059	0.00044
Nickel, dissolved	mg/L	0.0013	0.00025	0.00025	0.00028	0.00025	0.00026	0.00024	0.00028	0.00026	0.00026	0.00024	0.00031	0.00026	0.00027	0.00024	0.00028	0.00026	0.00026	0.00025	0.00029	0.00026	0.00026	0.00024
Selenium, total	mg/L	0.0020	0.000080	0.00020	0.00012	0.000090	0.000091	0.000078	0.00012	0.000090	0.000088	0.000078	0.00017	0.00010	0.00011	0.000079	0.00012	0.000093	0.000091	0.000079	0.00014	0.000094	0.000095	0.000078
Strontium, total	mg/L	2.5	0.067	0.087	0.062	0.084	0.058	0.082	0.062	0.084	0.058	0.082	0.063	0.084	0.058	0.082	0.063	0.085	0.058	0.083	0.062	0.084	0.058	0.082
Silver, total	mg/L	0.000050	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.0000050	0.0000055	0.0000051	0.0000052	0.0000049	0.0000055	0.0000051	0.0000052	0.0000049	0.0000057	0.0000051	0.0000052	0.0000049	0.0000056	0.0000052	0.0000052	0.0000050	0.0000055	0.0000051	0.0000052	0.0000049
Uranium, total	mg/L	0.0085	0.000057	0.000091	0.000066	0.000084	0.000059	0.000071	0.000067	0.000084	0.000059	0.000071	0.000080	0.000084	0.000063	0.000071	0.000067	0.000086	0.000059	0.000072	0.000070	0.000083	0.000060	0.000071
Zinc, dissolved	mg/L	0.0042	0.0015	0.0015	0.0016	0.0015	0.0015	0.0014	0.0016	0.0015	0.0015	0.0014	0.0016	0.0015	0.0015	0.0014	0.0016	0.0015	0.0015	0.0015	0.0016	0.0015	0.0015	0.0014

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-23

Parameter	Units	Telkwa River																					
		WQG	Baseline		WQS09																		
					Closure																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		44	64	41	68	38	58	41	68	38	61	41	68	38	61	41	68	38	61	41	68	38	61
Alkalinity, total	mg-$CaCO_3$/L		43	63	36	67	34	59	36	68	34	60	36	68	35	61	36	68	34	60	36	67	34	60
Chloride	mg/L	150	0.25	0.50	0.27	0.28	0.26	0.26	0.27	0.28	0.26	0.26	0.28	0.30	0.26	0.27	0.27	0.28	0.26	0.26	0.27	0.28	0.26	0.26
Fluoride	mg/L	1.0	0.028	0.038	0.029	0.039	0.027	0.035	0.029	0.039	0.027	0.035	0.029	0.039	0.027	0.035	0.029	0.039	0.027	0.035	0.029	0.039	0.027	0.035
Ammonia, total	mg-N/L	1.7	0.0025	0.0095	0.0030	0.0059	0.0027	0.0052	0.0034	0.0066	0.0028	0.0053	0.0041	0.0084	0.0030	0.0064	0.0030	0.0061	0.0027	0.0053	0.0029	0.0058	0.0027	0.0052
Nitrate	mg/L	3.0	0.012	0.076	0.014	0.067	0.012	0.062	0.017	0.073	0.012	0.063	0.023	0.087	0.014	0.071	0.014	0.070	0.012	0.063	0.014	0.067	0.012	0.062
Nitrite	mg/L	0.020	0.00050	0.0050	0.00058	0.00070	0.00054	0.00058	0.00065	0.00081	0.00054	0.00060	0.00079	0.0011	0.00059	0.00080	0.00058	0.00072	0.00054	0.00060	0.00058	0.00069	0.00053	0.00058
Sulfate	mg/L	218	5.6	9.0	7.1	9.3	6.4	8.3	7.3	9.8	6.5	8.3	8.0	12	6.8	10	7.1	9.6	6.4	8.3	7.1	9.5	6.4	8.3
Aluminum, total	mg/L	0.19	0.12	1.5	0.26	0.050	0.24	0.036	0.26	0.049	0.24	0.035	0.26	0.050	0.24	0.036	0.26	0.050	0.24	0.036	0.26	0.050	0.24	0.036
Antimony, dissolved	mg/L	0.074	0.000050	0.000050	0.000060	0.000058	0.000056	0.000052	0.000059	0.000058	0.000056	0.000052	0.000060	0.000062	0.000057	0.000054	0.000060	0.000058	0.000056	0.000053	0.000059	0.000058	0.000056	0.000052
Arsenic, total	mg/L	0.0050	0.00023	0.00055	0.00025	0.00024	0.00024	0.00021	0.00025	0.00024	0.00024	0.00021	0.00025	0.00024	0.00024	0.00022	0.00025	0.00024	0.00024	0.00022	0.00025	0.00024	0.00024	0.00021
Barium, total	mg/L	1.0	0.041	0.048	0.042	0.047	0.040	0.042	0.042	0.047	0.040	0.043	0.042	0.047	0.040	0.042	0.042	0.047	0.040	0.043	0.042	0.047	0.040	0.042
Beryllium, total	mg/L	0.00013	0.000050	0.000050	0.000054	0.000054	0.000051	0.000049	0.000054	0.000054	0.000051	0.000049	0.000054	0.000054	0.000051	0.000049	0.000054	0.000054	0.000051	0.000050	0.000054	0.000054	0.000051	0.000049
Boron, total	mg/L	1.2	0.0050	0.050	0.0057	0.0069	0.0054	0.0058	0.0058	0.0070	0.0055	0.0058	0.0058	0.0071	0.0055	0.0060	0.0058	0.0070	0.0054	0.0059	0.0057	0.0069	0.0054	0.0058
Cadmium, dissolved	mg/L	0.00011	0.0000061	0.0000099	0.0000073	0.0000054	0.0000070	0.0000049	0.0000073	0.0000054	0.0000070	0.0000050	0.0000074	0.0000056	0.0000070	0.0000051	0.0000073	0.0000054	0.0000070	0.0000050	0.0000073	0.0000054	0.0000070	0.0000049
Chromium, total	mg/L	0.0089	0.00020	0.0010	0.00023	0.00021	0.00022	0.00019	0.00023	0.00021	0.00022	0.00018	0.00023	0.00021	0.00022	0.00019	0.00023	0.00021	0.00022	0.00019	0.00023	0.00021	0.00022	0.00019
Cobalt, dissolved	mg/L	0.000390	0.000050	0.000082	0.000056	0.000062	0.000053	0.000055	0.000059	0.000067	0.000053	0.000056	0.000066	0.000086	0.000056	0.000067	0.000056	0.000064	0.000053	0.000056	0.000056	0.000062	0.000053	0.000055
Copper, dissolved	mg/L	0.0008	0.00060	0.0016	0.00077	0.00063	0.00073	0.00055	0.00077	0.00063	0.00073	0.00055	0.00078	0.00064	0.00073	0.00056	0.00078	0.00064	0.00073	0.00056	0.00077	0.00063	0.00073	0.00055
Iron, total	mg/L	1.0	0.29	1.3	0.32	0.23	0.30	0.21	0.32	0.23	0.29	0.21	0.32	0.23	0.30	0.21	0.32	0.23	0.30	0.22	0.32	0.23	0.30	0.21
Iron, dissolved	mg/L	0.35	0.088	0.26	0.069	0.12	0.064	0.12	0.069	0.12	0.064	0.12	0.069	0.12	0.064	0.12	0.069	0.13	0.064	0.12	0.069	0.12	0.064	0.12
Lead, dissolved	mg/L	0.0	0.000025	0.000097	0.000028	0.000029	0.000026	0.000026	0.000027	0.000030	0.000026	0.000027	0.000030	0.000036	0.000027	0.000031	0.000028	0.000029	0.000026	0.000027	0.000028	0.000029	0.000026	0.000027
Manganese, total	mg/L	0.79	0.019	0.075	0.022	0.011	0.020	0.0094	0.022	0.011	0.020	0.0094	0.022	0.011	0.020	0.0096	0.022	0.011	0.020	0.0096	0.022	0.011	0.020	0.0094
Mercury, total	mg/L	0.000020	0.0000025	0.0000068	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00050	0.00072	0.00061	0.00053	0.00058	0.00048	0.00061	0.00054	0.00058	0.00048	0.00066	0.00070	0.00060	0.00057	0.00061	0.00053	0.00058	0.00048	0.00061	0.00053	0.00058	0.00048
Nickel, dissolved	mg/L	0.0013	0.00025	0.00025	0.00027	0.00028	0.00026	0.00026	0.00027	0.00029	0.00026	0.00026	0.00029	0.00033	0.00027	0.00028	0.00027	0.00028	0.00026	0.00026	0.00027	0.00028	0.00026	0.00026
Selenium, total	mg/L	0.0020	0.000080	0.00020	0.00010	0.00014	0.000087	0.00011	0.00011	0.00015	0.000089	0.00011	0.00014	0.00026	0.00010	0.00017	0.00010	0.00014	0.000087	0.00011	0.00010	0.00013	0.000087	0.00011
Strontium, total	mg/L	2.5	0.067	0.087	0.061	0.095	0.058	0.084	0.060	0.095	0.058	0.084	0.061	0.095	0.058	0.084	0.061	0.096	0.058	0.085	0.061	0.095	0.058	0.084
Silver, total	mg/L	0.000050	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.0000050	0.0000055	0.0000055	0.0000052	0.0000051	0.0000054	0.0000056	0.0000052	0.0000051	0.0000055	0.0000057	0.0000052	0.0000052	0.0000055	0.0000056	0.0000052	0.0000051	0.0000054	0.0000055	0.0000052	0.0000051
Uranium, total	mg/L	0.0085	0.000057	0.000091	0.000063	0.000097	0.000059	0.000082	0.000065	0.000099	0.000059	0.000082	0.000072	0.00012	0.000062	0.000098	0.000063	0.000098	0.000059	0.000084	0.000063	0.000099	0.000059	0.000082
Zinc, dissolved	mg/L	0.0042	0.0015	0.0015	0.0016	0.0016	0.0015	0.0015	0.0016	0.0016	0.0015	0.0015	0.0016	0.0016	0.0015	0.0015	0.0016	0.0016	0.0015	0.0015	0.0016	0.0016	0.0015	0.0015

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-24

Parameter	Units	Bulkley River																					
		WQG	Baseline		WQS11 Closure																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		29	40	27	34	26	34	27	34	26	34	27	34	26	34	27	34	26	34	27	34	26	34
Alkalinity, total	mg-$CaCO_3$/L		28	36	27	34	26	33	27	34	26	33	27	34	26	33	27	34	26	33	27	34	26	33
Chloride	mg/L	150	0.25	0.78	0.26	0.51	0.25	0.50	0.26	0.51	0.25	0.50	0.26	0.51	0.25	0.50	0.26	0.51	0.25	0.50	0.26	0.52	0.25	0.50
Fluoride	mg/L	0.8	0.023	0.035	0.024	0.029	0.023	0.028	0.024	0.029	0.023	0.028	0.024	0.029	0.023	0.028	0.024	0.029	0.023	0.028	0.024	0.029	0.023	0.028
Ammonia, total	mg-N/L	1.6	0.0050	0.017	0.0052	0.0061	0.0051	0.0059	0.0052	0.0061	0.0051	0.0059	0.0052	0.0061	0.0051	0.0059	0.0052	0.0061	0.0051	0.0059	0.0052	0.0061	0.0050	0.0059
Nitrate	mg/L	3.0	0.013	0.041	0.014	0.038	0.013	0.037	0.014	0.038	0.013	0.037	0.014	0.038	0.013	0.037	0.014	0.038	0.013	0.037	0.014	0.038	0.013	0.038
Nitrite	mg/L	0.020	0.0020	0.0050	0.0028	0.00065	0.0027	0.00052	0.0028	0.00065	0.0027	0.00052	0.0028	0.00065	0.0027	0.00052	0.0028	0.00065	0.0027	0.00052	0.0028	0.00065	0.0027	0.00052
Sulfate	mg/L	128	4.0	5.0	4.1	4.7	4.0	4.6	4.1	4.7	4.0	4.6	4.1	4.7	4.0	4.6	4.1	4.7	4.0	4.6	4.1	4.8	4.0	4.6
Aluminum, total	mg/L	0.18	0.088	1.2	0.11	0.045	0.11	0.039	0.11	0.045	0.11	0.039	0.11	0.045	0.11	0.039	0.11	0.045	0.11	0.039	0.11	0.045	0.11	0.039
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.000052	0.000052	0.000050	0.000050	0.000052	0.000052	0.000050	0.000050	0.000052	0.000052	0.000050	0.000050	0.000052	0.000052	0.000050	0.000050	0.000052	0.000052	0.000050	0.000050
Arsenic, total	mg/L	0.0050	0.00021	0.00069	0.00022	0.00021	0.00021	0.00020	0.00022	0.00021	0.00021	0.00020	0.00022	0.00021	0.00021	0.00020	0.00022	0.00021	0.00021	0.00020	0.00022	0.00021	0.00021	0.00020
Barium, total	mg/L	1.0	0.026	0.035	0.027	0.025	0.026	0.024	0.027	0.025	0.026	0.024	0.027	0.025	0.026	0.024	0.027	0.025	0.026	0.024	0.027	0.025	0.026	0.024
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000052	0.000052	0.000050	0.000050	0.000052	0.000052	0.000050	0.000050	0.000052	0.000052	0.000050	0.000050	0.000052	0.000052	0.000050	0.000050	0.000052	0.000052	0.000050	0.000050
Boron, total	mg/L	1.2	0.0050	0.010	0.0052	0.0052	0.0050	0.0050	0.0052	0.0052	0.0050	0.0050	0.0052	0.0052	0.0050	0.0050	0.0052	0.0052	0.0050	0.0050	0.0052	0.0052	0.0050	0.0050
Cadmium, dissolved	mg/L	0.00009	0.0000025	0.0000068	0.0000026	0.0000026	0.0000025	0.0000025	0.0000026	0.0000026	0.0000025	0.0000025	0.0000026	0.0000026	0.0000025	0.0000025	0.0000026	0.0000026	0.0000025	0.0000025	0.0000026	0.0000026	0.0000025	0.0000025
Chromium, total	mg/L	0.0089	0.00020	0.0010	0.00021	0.00018	0.00020	0.00017	0.00021	0.00018	0.00020	0.00017	0.00021	0.00018	0.00020	0.00017	0.00021	0.00018	0.00020	0.00017	0.00021	0.00018	0.00020	0.00017
Cobalt, dissolved	mg/L	0.000390	0.000050	0.00010	0.000052	0.000052	0.000050	0.000050	0.000052	0.000052	0.000050	0.000050	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000050	0.000050	0.000052	0.000052	0.000050	0.000050
Copper, dissolved	mg/L	0.0011	0.00058	0.0016	0.00060	0.00058	0.00059	0.00056	0.00060	0.00058	0.00059	0.00056	0.00060	0.00058	0.00059	0.00056	0.00060	0.00058	0.00059	0.00056	0.00060	0.00059	0.00058	0.00056
Iron, total	mg/L	1.0	0.12	1.3	0.15	0.084	0.15	0.077	0.15	0.084	0.15	0.077	0.15	0.084	0.15	0.077	0.15	0.084	0.15	0.077	0.15	0.085	0.15	0.077
Iron, dissolved	mg/L	0.35	0.032	0.15	0.016	0.035	0.015	0.035	0.016	0.035	0.015	0.035	0.016	0.035	0.015	0.035	0.016	0.035	0.015	0.035	0.016	0.035	0.015	0.035
Lead, dissolved	mg/L	0.0	0.000025	0.000050	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025
Manganese, total	mg/L	0.73	0.012	0.053	0.012	0.0080	0.012	0.0074	0.012	0.0080	0.012	0.0074	0.012	0.0080	0.012	0.0074	0.012	0.0080	0.012	0.0074	0.012	0.0080	0.012	0.0074
Mercury, total	mg/L	0.000020	0.0000025	0.0000053	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00037	0.00052	0.00038	0.00035	0.00037	0.00034	0.00038	0.00035	0.00037	0.00034	0.00038	0.00035	0.00037	0.00034	0.00038	0.00035	0.00037	0.00034	0.00038	0.00036	0.00037	0.00034
Nickel, dissolved	mg/L	0.0010	0.00025	0.00073	0.00026	0.00026	0.00025	0.00025	0.00026	0.00026	0.00025	0.00025	0.00026	0.00026	0.00025	0.00025	0.00026	0.00026	0.00025	0.00025	0.00026	0.00026	0.00025	0.00025
Selenium, total	mg/L	0.0020	0.000025	0.00020	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025
Strontium, total	mg/L	2.5	0.042	0.060	0.040	0.054	0.039	0.053	0.040	0.054	0.039	0.053	0.040	0.054	0.039	0.053	0.040	0.054	0.039	0.053	0.040	0.054	0.039	0.053
Silver, total	mg/L	0.000050	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.000013	0.0000052	0.0000052	0.0000050	0.0000050	0.0000052	0.0000052	0.0000050	0.0000050	0.0000052	0.0000052	0.0000051	0.0000050	0.0000052	0.0000052	0.0000050	0.0000050	0.0000052	0.0000052	0.0000050	0.0000050
Uranium, total	mg/L	0.0085	0.000035	0.000083	0.000036	0.000041	0.000035	0.000040	0.000036	0.000041	0.000035	0.000040	0.000036	0.000041	0.000035	0.000040	0.000036	0.000041	0.000035	0.000040	0.000036	0.000041	0.000035	0.000040
Zinc, dissolved	mg/L	0.0039	0.00075	0.0023	0.0015	0.0011	0.0015	0.00100	0.0015	0.0011	0.0015	0.00100	0.0015	0.0011	0.0015	0.00100	0.0015	0.0011	0.0015	0.00100	0.0015	0.0011	0.0015	0.00100

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-25

Parameter	Units	Bulkley River																					
		WQG	Baseline		WQS11 Closure																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		29	40	27	35	26	34	27	35	26	34	27	35	26	34	27	35	26	34	27	35	26	34
Alkalinity, total	mg-$CaCO_3$/L		28	36	27	34	26	33	27	34	26	33	27	34	26	33	27	34	26	33	27	34	26	33
Chloride	mg/L	150	0.25	0.78	0.27	0.53	0.25	0.50	0.27	0.53	0.25	0.50	0.27	0.53	0.25	0.50	0.27	0.53	0.25	0.50	0.27	0.53	0.25	0.50
Fluoride	mg/L	0.8	0.023	0.035	0.024	0.029	0.023	0.028	0.024	0.029	0.023	0.028	0.024	0.029	0.023	0.028	0.024	0.029	0.023	0.028	0.024	0.029	0.023	0.028
Ammonia, total	mg-N/L	1.6	0.0050	0.017	0.0052	0.0062	0.0051	0.0059	0.0052	0.0062	0.0051	0.0059	0.0052	0.0062	0.0051	0.0059	0.0052	0.0062	0.0051	0.0059	0.0052	0.0062	0.0051	0.0059
Nitrate	mg/L	3.0	0.013	0.041	0.014	0.040	0.013	0.038	0.014	0.040	0.013	0.038	0.014	0.040	0.013	0.038	0.014	0.040	0.013	0.038	0.014	0.040	0.013	0.038
Nitrite	mg/L	0.020	0.0020	0.0050	0.0028	0.00065	0.0027	0.00052	0.0028	0.00065	0.0027	0.00052	0.0028	0.00065	0.0027	0.00052	0.0028	0.00065	0.0027	0.00052	0.0028	0.00065	0.0027	0.00052
Sulfate	mg/L	128	4.0	5.0	4.1	4.8	4.0	4.6	4.1	4.8	4.0	4.6	4.1	4.8	4.0	4.6	4.1	4.8	4.0	4.6	4.1	4.8	4.0	4.6
Aluminum, total	mg/L	0.18	0.088	1.2	0.11	0.045	0.11	0.039	0.11	0.045	0.11	0.039	0.11	0.045	0.11	0.039	0.11	0.045	0.11	0.039	0.11	0.045	0.11	0.039
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050
Arsenic, total	mg/L	0.0050	0.00021	0.00069	0.00022	0.00021	0.00021	0.00020	0.00022	0.00021	0.00021	0.00020	0.00022	0.00021	0.00021	0.00020	0.00022	0.00021	0.00021	0.00020	0.00022	0.00021	0.00021	0.00020
Barium, total	mg/L	1.0	0.026	0.035	0.027	0.025	0.026	0.024	0.027	0.025	0.026	0.024	0.027	0.025	0.026	0.024	0.027	0.025	0.026	0.024	0.027	0.025	0.026	0.024
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050
Boron, total	mg/L	1.2	0.0050	0.010	0.0052	0.0052	0.0051	0.0050	0.0052	0.0052	0.0051	0.0050	0.0052	0.0052	0.0051	0.0050	0.0052	0.0052	0.0051	0.0050	0.0052	0.0052	0.0051	0.0050
Cadmium, dissolved	mg/L	0.00009	0.0000025	0.0000068	0.0000026	0.0000026	0.0000025	0.0000025	0.0000026	0.0000026	0.0000025	0.0000025	0.0000026	0.0000026	0.0000025	0.0000025	0.0000026	0.0000026	0.0000025	0.0000025	0.0000026	0.0000026	0.0000025	0.0000025
Chromium, total	mg/L	0.0089	0.00020	0.0010	0.00021	0.00018	0.00020	0.00017	0.00021	0.00018	0.00020	0.00017	0.00021	0.00018	0.00020	0.00017	0.00021	0.00018	0.00020	0.00017	0.00021	0.00018	0.00020	0.00017
Cobalt, dissolved	mg/L	0.000390	0.000050	0.00010	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050	0.000052	0.000052	0.000051	0.000050
Copper, dissolved	mg/L	0.0011	0.00058	0.0016	0.00060	0.00059	0.00059	0.00056	0.00060	0.00059	0.00059	0.00056	0.00060	0.00059	0.00059	0.00056	0.00060	0.00059	0.00059	0.00056	0.00060	0.00059	0.00059	0.00056
Iron, total	mg/L	1.0	0.12	1.3	0.16	0.084	0.15	0.077	0.16	0.084	0.15	0.077	0.16	0.084	0.15	0.077	0.16	0.084	0.15	0.077	0.16	0.084	0.15	0.077
Iron, dissolved	mg/L	0.35	0.032	0.15	0.016	0.037	0.015	0.035	0.016	0.037	0.015	0.035	0.016	0.037	0.015	0.035	0.016	0.037	0.015	0.035	0.016	0.037	0.015	0.035
Lead, dissolved	mg/L	0.0	0.000025	0.000050	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025
Manganese, total	mg/L	0.73	0.012	0.053	0.012	0.0080	0.012	0.0074	0.012	0.0080	0.012	0.0074	0.012	0.0080	0.012	0.0074	0.012	0.0080	0.012	0.0074	0.012	0.0080	0.012	0.0074
Mercury, total	mg/L	0.000020	0.0000025	0.0000053	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00037	0.00052	0.00038	0.00036	0.00037	0.00034	0.00038	0.00036	0.00037	0.00034	0.00038	0.00036	0.00037	0.00034	0.00038	0.00036	0.00037	0.00034	0.00038	0.00036	0.00037	0.00034
Nickel, dissolved	mg/L	0.0010	0.00025	0.00073	0.00026	0.00026	0.00025	0.00025	0.00026	0.00026	0.00025	0.00025	0.00026	0.00026	0.00025	0.00025	0.00026	0.00026	0.00025	0.00025	0.00026	0.00026	0.00025	0.00025
Selenium, total	mg/L	0.0020	0.000025	0.00020	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025	0.000026	0.000026	0.000025	0.000025
Strontium, total	mg/L	2.5	0.042	0.060	0.040	0.055	0.040	0.053	0.040	0.055	0.040	0.053	0.040	0.055	0.040	0.053	0.040	0.055	0.040	0.053	0.040	0.055	0.040	0.053
Silver, total	mg/L	0.000050	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.000013	0.0000052	0.0000052	0.0000051	0.0000050	0.0000052	0.0000052	0.0000051	0.0000050	0.0000052	0.0000052	0.0000051	0.0000050	0.0000052	0.0000052	0.0000051	0.0000050	0.0000052	0.0000052	0.0000051	0.0000050
Uranium, total	mg/L	0.0085	0.000035	0.000083	0.000036	0.000042	0.000035	0.000040	0.000036	0.000042	0.000035	0.000040	0.000036	0.000042	0.000035	0.000040	0.000036	0.000042	0.000035	0.000040	0.000036	0.000042	0.000035	0.000040
Zinc, dissolved	mg/L	0.0039	0.00075	0.0023	0.0016	0.0011	0.0015	0.00100	0.0016	0.0011	0.0015	0.00100	0.0016	0.0011	0.0015	0.00100	0.0016	0.0011	0.0015	0.00100	0.0016	0.0011	0.0015	0.00100

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-26

Parameter	Units	Bulkley River																					
		WQG	Baseline		WQS12																		
					Operations																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		29	40	30	41	29	38	30	41	29	38	30	41	29	38	30	41	29	38	30	41	29	38
Alkalinity, total	mg-$CaCO_3$/L		28	36	29	39	28	37	29	39	28	37	29	39	28	37	29	38	28	36	29	39	28	37
Chloride	mg/L	150	0.25	0.78	0.27	0.51	0.26	0.46	0.27	0.51	0.26	0.46	0.27	0.51	0.26	0.46	0.27	0.50	0.26	0.47	0.27	0.51	0.26	0.47
Fluoride	mg/L	0.8	0.023	0.035	0.025	0.031	0.024	0.029	0.025	0.031	0.024	0.029	0.025	0.031	0.024	0.029	0.025	0.031	0.024	0.029	0.025	0.032	0.024	0.029
Ammonia, total	mg-N/L	1.6	0.0050	0.017	0.0051	0.0063	0.0047	0.0057	0.0051	0.0063	0.0047	0.0057	0.0053	0.0063	0.0048	0.0057	0.0051	0.0062	0.0047	0.0057	0.0051	0.0064	0.0047	0.0057
Nitrate	mg/L	3.0	0.013	0.041	0.016	0.042	0.013	0.041	0.016	0.042	0.013	0.041	0.020	0.043	0.014	0.041	0.016	0.042	0.013	0.040	0.016	0.043	0.013	0.041
Nitrite	mg/L	0.020	0.0020	0.0050	0.0026	0.00075	0.0024	0.00053	0.0026	0.00075	0.0024	0.00053	0.0026	0.00077	0.0024	0.00053	0.0026	0.00075	0.0024	0.00053	0.0027	0.00076	0.0024	0.00053
Sulfate	mg/L	128	4.0	5.0	4.8	5.4	4.5	5.0	4.8	5.5	4.5	5.0	4.8	5.5	4.5	5.0	4.8	5.3	4.5	4.9	4.7	5.5	4.5	5.0
Aluminum, total	mg/L	0.18	0.088	1.2	0.15	0.050	0.13	0.039	0.15	0.050	0.13	0.039	0.15	0.050	0.13	0.039	0.15	0.050	0.13	0.039	0.14	0.051	0.13	0.039
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.000054	0.000055	0.000052	0.000050	0.000054	0.000056	0.000052	0.000050	0.000054	0.000055	0.000052	0.000050	0.000054	0.000055	0.000052	0.000050	0.000054	0.000056	0.000052	0.000050
Arsenic, total	mg/L	0.0050	0.00021	0.00069	0.00023	0.00022	0.00022	0.00020	0.00023	0.00022	0.00022	0.00020	0.00023	0.00022	0.00022	0.00020	0.00023	0.00022	0.00022	0.00020	0.00023	0.00023	0.00022	0.00020
Barium, total	mg/L	1.0	0.026	0.035	0.031	0.029	0.029	0.027	0.031	0.029	0.029	0.027	0.031	0.029	0.029	0.027	0.031	0.029	0.029	0.026	0.030	0.029	0.029	0.027
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000053	0.000055	0.000051	0.000050	0.000053	0.000055	0.000051	0.000050	0.000053	0.000055	0.000051	0.000050	0.000053	0.000055	0.000051	0.000050	0.000053	0.000056	0.000051	0.000050
Boron, total	mg/L	1.2	0.0050	0.010	0.0054	0.0055	0.0051	0.0050	0.0054	0.0056	0.0051	0.0050	0.0054	0.0055	0.0052	0.0050	0.0054	0.0055	0.0051	0.0050	0.0054	0.0056	0.0051	0.0050
Cadmium, dissolved	mg/L	0.00009	0.0000025	0.0000068	0.0000038	0.0000031	0.0000033	0.0000029	0.0000038	0.0000031	0.0000033	0.0000029	0.0000038	0.0000031	0.0000033	0.0000029	0.0000038	0.0000030	0.0000033	0.0000028	0.0000036	0.0000031	0.0000032	0.0000029
Chromium, total	mg/L	0.0089	0.00020	0.0010	0.00022	0.00019	0.00021	0.00017	0.00022	0.00019	0.00021	0.00017	0.00022	0.00019	0.00021	0.00017	0.00022	0.00019	0.00021	0.00017	0.00022	0.00019	0.00021	0.00017
Cobalt, dissolved	mg/L	0.000390	0.000050	0.00010	0.000054	0.000055	0.000051	0.000050	0.000054	0.000055	0.000051	0.000050	0.000057	0.000055	0.000052	0.000050	0.000054	0.000055	0.000051	0.000050	0.000054	0.000056	0.000051	0.000050
Copper, dissolved	mg/L	0.0011	0.00058	0.0016	0.00064	0.00062	0.00061	0.00056	0.00064	0.00062	0.00061	0.00056	0.00064	0.00062	0.00061	0.00056	0.00064	0.00061	0.00061	0.00055	0.00064	0.00063	0.00061	0.00056
Iron, total	mg/L	1.0	0.12	1.3	0.20	0.11	0.18	0.099	0.20	0.11	0.18	0.099	0.20	0.11	0.18	0.099	0.20	0.11	0.18	0.096	0.19	0.11	0.17	0.099
Iron, dissolved	mg/L	0.35	0.032	0.15	0.028	0.050	0.024	0.048	0.028	0.050	0.024	0.048	0.028	0.050	0.024	0.048	0.028	0.048	0.024	0.046	0.026	0.050	0.023	0.048
Lead, dissolved	mg/L	0.0	0.000025	0.000050	0.000027	0.000028	0.000026	0.000025	0.000027	0.000028	0.000026	0.000025	0.000027	0.000028	0.000026	0.000025	0.000027	0.000027	0.000026	0.000025	0.000027	0.000028	0.000026	0.000025
Manganese, total	mg/L	0.73	0.012	0.053	0.015	0.0090	0.013	0.0077	0.015	0.0090	0.013	0.0078	0.015	0.0090	0.013	0.0078	0.015	0.0088	0.013	0.0077	0.014	0.0090	0.013	0.0078
Mercury, total	mg/L	0.000020	0.0000025	0.0000053	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00037	0.00052	0.00044	0.00040	0.00041	0.00036	0.00044	0.00040	0.00041	0.00036	0.00044	0.00040	0.00042	0.00036	0.00044	0.00039	0.00041	0.00035	0.00043	0.00040	0.00041	0.00036
Nickel, dissolved	mg/L	0.0010	0.00025	0.00073	0.00027	0.00028	0.00026	0.00025	0.00027	0.00028	0.00026	0.00025	0.00027	0.00028	0.00026	0.00025	0.00027	0.00027	0.00026	0.00025	0.00027	0.00028	0.00026	0.00025
Selenium, total	mg/L	0.0020	0.000025	0.00020	0.000042	0.000036	0.000036	0.000033	0.000041	0.000036	0.000036	0.000033	0.000046	0.000038	0.000039	0.000033	0.000042	0.000035	0.000036	0.000032	0.000041	0.000037	0.000036	0.000033
Strontium, total	mg/L	2.5	0.042	0.060	0.045	0.061	0.043	0.057	0.045	0.061	0.043	0.057	0.045	0.061	0.043	0.057	0.045	0.060	0.043	0.057	0.045	0.062	0.043	0.057
Silver, total	mg/L	0.000050	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.000013	0.0000053	0.0000055	0.0000051	0.0000050	0.0000053	0.0000055	0.0000051	0.0000050	0.0000053	0.0000055	0.0000051	0.0000050	0.0000053	0.0000055	0.0000051	0.0000050	0.0000053	0.0000056	0.0000051	0.0000050
Uranium, total	mg/L	0.0085	0.000035	0.000083	0.000042	0.000048	0.000040	0.000045	0.000042	0.000048	0.000040	0.000045	0.000042	0.000048	0.000040	0.000045	0.000042	0.000047	0.000040	0.000044	0.000042	0.000048	0.000039	0.000045
Zinc, dissolved	mg/L	0.0039	0.00075	0.0023	0.0016	0.0012	0.0015	0.0011	0.0016	0.0012	0.0015	0.0011	0.0016	0.0012	0.0015	0.0011	0.0016	0.0012	0.0015	0.0011	0.0016	0.0012	0.0015	0.0011

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

Table G-27

Parameter	Units	Bulkley River																					
		WQG	Baseline		WQS12																		
					Closure																		
					Final EAC Project Case (2024)				Maximized hydraulic groundwater conductivity (Alt Case 1)				High Source terms (Alt Case 2)				Low Flow (Alt Case 5)				10% Increased precipitation (Alt Case 7)			
			P50	P95	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter	Max Summer	Max Winter	Average Summer	Average Winter
Total Hardness	mg-$CaCO_3$/L		29	40	31	41	29	38	31	41	29	38	31	41	29	38	31	41	29	38	31	41	29	38
Alkalinity, total	mg-$CaCO_3$/L		28	36	30	41	28	37	30	41	28	37	30	41	28	37	30	40	28	36	30	41	28	37
Chloride	mg/L	150	0.25	0.78	0.27	0.54	0.26	0.47	0.27	0.55	0.26	0.47	0.27	0.55	0.26	0.47	0.27	0.54	0.26	0.47	0.27	0.55	0.26	0.47
Fluoride	mg/L	0.8	0.023	0.035	0.026	0.033	0.024	0.029	0.026	0.033	0.024	0.029	0.026	0.033	0.024	0.029	0.026	0.032	0.024	0.029	0.026	0.033	0.024	0.029
Ammonia, total	mg-N/L	1.6	0.0050	0.017	0.0049	0.0066	0.0047	0.0058	0.0049	0.0068	0.0047	0.0058	0.0049	0.0070	0.0048	0.0060	0.0049	0.0066	0.0047	0.0058	0.0049	0.0066	0.0047	0.0058
Nitrate	mg/L	3.0	0.013	0.041	0.015	0.047	0.013	0.041	0.015	0.048	0.013	0.041	0.015	0.049	0.014	0.042	0.015	0.046	0.013	0.041	0.015	0.047	0.013	0.041
Nitrite	mg/L	0.020	0.0020	0.0050	0.0025	0.00077	0.0024	0.00054	0.0025	0.00077	0.0024	0.00055	0.0025	0.00079	0.0024	0.00057	0.0025	0.00076	0.0024	0.00054	0.0025	0.00076	0.0024	0.00054
Sulfate	mg/L	128	4.0	5.0	4.7	5.7	4.5	5.1	4.8	5.9	4.5	5.1	4.8	6.0	4.5	5.3	4.7	5.6	4.5	5.0	4.7	5.7	4.5	5.1
Aluminum, total	mg/L	0.18	0.088	1.2	0.15	0.051	0.13	0.040	0.15	0.051	0.13	0.039	0.15	0.051	0.13	0.040	0.15	0.051	0.13	0.040	0.15	0.051	0.13	0.040
Antimony, dissolved	mg/L	0.074	0.000050	0.00010	0.000055	0.000057	0.000052	0.000050	0.000055	0.000057	0.000052	0.000050	0.000055	0.000057	0.000052	0.000051	0.000055	0.000056	0.000052	0.000050	0.000055	0.000057	0.000052	0.000050
Arsenic, total	mg/L	0.0050	0.00021	0.00069	0.00023	0.00023	0.00022	0.00020	0.00023	0.00023	0.00022	0.00020	0.00023	0.00023	0.00022	0.00020	0.00023	0.00022	0.00022	0.00020	0.00023	0.00023	0.00022	0.00020
Barium, total	mg/L	1.0	0.026	0.035	0.031	0.030	0.029	0.027	0.031	0.030	0.029	0.027	0.031	0.030	0.029	0.027	0.031	0.029	0.029	0.026	0.031	0.030	0.029	0.027
Beryllium, total	mg/L	0.00013	0.000050	0.00010	0.000054	0.000056	0.000051	0.000050	0.000054	0.000057	0.000051	0.000050	0.000054	0.000056	0.000051	0.000050	0.000054	0.000056	0.000051	0.000050	0.000054	0.000056	0.000051	0.000050
Boron, total	mg/L	1.2	0.0050	0.010	0.0054	0.0057	0.0052	0.0051	0.0054	0.0058	0.0052	0.0051	0.0054	0.0058	0.0052	0.0051	0.0054	0.0057	0.0052	0.0051	0.0054	0.0057	0.0052	0.0051
Cadmium, dissolved	mg/L	0.00009	0.0000025	0.0000068	0.0000038	0.0000032	0.0000033	0.0000028	0.0000038	0.0000032	0.0000033	0.0000029	0.0000038	0.0000032	0.0000033	0.0000029	0.0000038	0.0000031	0.0000033	0.0000028	0.0000038	0.0000032	0.0000033	0.0000028
Chromium, total	mg/L	0.0089	0.00020	0.0010	0.00022	0.00020	0.00021	0.00017	0.00022	0.00020	0.00021	0.00017	0.00022	0.00020	0.00021	0.00017	0.00022	0.00019	0.00021	0.00017	0.00022	0.00019	0.00021	0.00017
Cobalt, dissolved	mg/L	0.000390	0.000050	0.00010	0.000054	0.000058	0.000051	0.000051	0.000054	0.000059	0.000051	0.000051	0.000054	0.000060	0.000052	0.000052	0.000054	0.000057	0.000051	0.000051	0.000054	0.000058	0.000051	0.000051
Copper, dissolved	mg/L	0.0011	0.00058	0.0016	0.00065	0.00063	0.00062	0.00056	0.00065	0.00063	0.00062	0.00056	0.00065	0.00063	0.00062	0.00056	0.00065	0.00062	0.00062	0.00056	0.00065	0.00063	0.00062	0.00056
Iron, total	mg/L	1.0	0.12	1.3	0.20	0.11	0.18	0.097	0.20	0.11	0.18	0.098	0.20	0.11	0.18	0.097	0.20	0.11	0.18	0.096	0.20	0.11	0.18	0.097
Iron, dissolved	mg/L	0.35	0.032	0.15	0.028	0.052	0.024	0.046	0.028	0.053	0.024	0.047	0.028	0.052	0.024	0.046	0.028	0.050	0.024	0.045	0.028	0.052	0.024	0.046
Lead, dissolved	mg/L	0.0	0.000025	0.000050	0.000027	0.000028	0.000026	0.000025	0.000027	0.000029	0.000026	0.000025	0.000027	0.000029	0.000026	0.000026	0.000027	0.000028	0.000026	0.000025	0.000027	0.000029	0.000026	0.000025
Manganese, total	mg/L	0.73	0.012	0.053	0.015	0.0090	0.014	0.0078	0.015	0.0091	0.014	0.0078	0.015	0.0091	0.014	0.0078	0.015	0.0089	0.014	0.0077	0.015	0.0090	0.014	0.0078
Mercury, total	mg/L	0.000020	0.0000025	0.0000053	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025	0.0000025
Molybdenum, total	mg-N/L	0.034	0.00037	0.00052	0.00045	0.00040	0.00041	0.00036	0.00045	0.00041	0.00041	0.00036	0.00045	0.00042	0.00041	0.00037	0.00045	0.00040	0.00041	0.00036	0.00045	0.00041	0.00041	0.00036
Nickel, dissolved	mg/L	0.0010	0.00025	0.00073	0.00027	0.00028	0.00026	0.00025	0.00027	0.00029	0.00026	0.00025	0.00027	0.00029	0.00026	0.00025	0.00027	0.00028	0.00026	0.00025	0.00027	0.00028	0.00026	0.00025
Selenium, total	mg/L	0.0020	0.000025	0.00020	0.000041	0.000045	0.000036	0.000037	0.000042	0.000046	0.000036	0.000037	0.000043	0.000057	0.000038	0.000045	0.000041	0.000041	0.000036	0.000036	0.000041	0.000042	0.000036	0.000037
Strontium, total	mg/L	2.5	0.042	0.060	0.046	0.064	0.043	0.057	0.046	0.064	0.043	0.057	0.046	0.064	0.043	0.057	0.046	0.063	0.043	0.057	0.046	0.064	0.043	0.057
Silver, total	mg/L	0.000050	0.0000050	0.000020	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050	0.0000050
Thallium, total	mg/L	0.00080	0.0000050	0.000013	0.0000054	0.0000057	0.0000051	0.0000050	0.0000054	0.0000057	0.0000051	0.0000050	0.0000054	0.0000057	0.0000051	0.0000050	0.0000054	0.0000056	0.0000051	0.0000050	0.0000054	0.0000057	0.0000051	0.0000050
Uranium, total	mg/L	0.0085	0.000035	0.000083	0.000043	0.000051	0.000040	0.000046	0.000043	0.000052	0.000040	0.000046	0.000043	0.000054	0.000040	0.000048	0.000043	0.000050	0.000040	0.000045	0.000043	0.000051	0.000040	0.000046
Zinc, dissolved	mg/L	0.0039	0.00075	0.0023	0.0016	0.0012	0.0015	0.0011	0.0016	0.0012	0.0015	0.0011	0.0016	0.0012	0.0015	0.0011	0.0016	0.0012	0.0015	0.0011	0.0016	0.0012	0.0015	0.0011

Red highlight is a WQG exceedance
Source: https://srk.sharepoint.com/sites/NACAPR002055/Internal/Water Balance Modelling/Results/20250403_FEAC_2024/Results_Streams_WaterQuality_UEA_v41_20250717.xlsm

APPENDIX 2: TENAS PROJECT, HYDROMETEOROLOGICAL BASELINE AND MODEL DEVELOPMENT REPORT (UPDATE 2025), SRK

TELKWA COAL
LIMITED

Tenas Project – Hydrometeorological Baseline and Model Development Report (update 2025)

Prepared for

Telkwa Mining Ltd



Prepared by

srk consulting

SRK Consulting (Canada) Inc.
CAPR002055
August 2025

Tenas Project – Hydrometeorological Baseline and Model Development Report (update 2025)

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File Name: Telkwa_Hydromet_update2025_20250826_Final

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Attachments

Attachment A AGRA 1999 Report
Attachment B Baseflow Separation Results
Attachment C AGRA Data

Executive Summary

As part of the Tenas Project Environmental Assessment, SRK Consulting (Canada) Inc. (SRK) was retained by Telkwa Mining Ltd (TCM) to complete a hydrometeorological analysis for the Tenas Project (the Project).

The Project is located approximately 25 km southwest of the town of Smithers, BC within the Telkwa River watershed and is composed of an open pit, backfill, external stockpiles, water management ponds, control ponds, process plant and rail load out.

This report presents the hydrometeorological baseline of the Project. The key objective of this report is to to develop inputs to the Project water management plan and water and load balance model.

Site hydrometeorological conditions are monitored via a site weather station and five (5) hydrometric stations located on each of the major watercourses (Goathorn-Hydro, Telkwa-Hydro, Tenas-Hydro/Tenas-Hydro B, and Four-Hydro). The weather station was operated from 2017 to 2022. Hydrometric stations have two to three complete hydrologic years of data recorded within the 2017 to 2022 period. For this assessment, the relatively short site datasets are supplemented with regional datasets and climate re-analysis models.

Synthetic long-term Project climate datasets were developed based on transposing the regional datasets at Smithers Airport to the site and adjusting for observed orographic effects. These datasets were used to derive Project design parameters and water and load balance inputs, as well as to support development of a rainfall-runoff model. This model was developed and calibrated for each of the local hydrometric stations. A combination of the calibrated models from Goathorn Creek and Tenas Creek were applied to the Tenas Project area.

Selected climate parameters are summarized in Table 0-1 to Table 0-3.

Table 0-1: Derived Monthly and Annual Project Climate Normals

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Temperature (°C)[1]	-9.2	-6.1	-2.7	2.1	6.8	10.7	13.0	12.5	8.4	2.6	-3.8	-7.9	2.2
Rainfall (mm) [1]	4.3	2.6	3.1	15.1	41.7	70.7	58.1	55.8	63.8	42.8	10.2	2.0	370.2
Snowfall (mm) [1]	56.6	32.8	24.0	17.5	8.9	0.2	0.0	0.3	4.6	42.7	63.6	54.4	305.6
Total Precipitation (mm) [1]	60.9	35.4	27.2	32.6	50.5	70.9	58.1	56.1	68.4	85.6	73.8	56.4	675.9
Evaporation (mm)[2]	0	0	0	60	97	108	116	99	50	0	0	0	529

Notes:

[1] Based on 1981 – 2022

[2] Based on 1953 – 2018

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Evaporation_rev02.Rmd and in \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Table 0-2: Extreme Precipitation

Return Period	24-hour Precipitation [mm]	72-hour Precipitation [mm]
2	42.0	56.7
5	56.1	75.6
10	66.3	89.3
25	80.2	108.1
50	91.3	123.0
100	103.1	138.9
200	115.6	155.7
500	133.3	179.6
1000	147.7	199.1
PMP (Spring)	297	-
PMP (Summer/Autumn)	334	-

Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Table 0-3: Extreme Snowmelt

Return Period	24-hour Snowmelt [mm SWE]	72-hour Snowmelt [mm SWE]
2	34.0	57.5
5	43.3	73.3
10	50.9	86.1
25	62.8	106.4
50	74.0	125.4
100	87.7	148.5
200	104.4	176.8
500	132.4	224.3
1000	159.4	269.9

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Mean annual runoff for the Project was determined to be 219 mm/year with an annual runoff coefficient of 0.36 with the highest flows occurring in May and June due to freshet, and low flows occurring during the winter.

Climate change scenarios for RCP4.5, RCP6.5 and RCP8.5 were evaluated for the Project Area. The effects of the RCP4.5 scenario were used to generate mean annual and monthly temperature and precipitation correction factors, which also affect runoff and evaporation rates, as summarized in Table 0-4.

Table 0-4: Projected Climate Change Impacts on Selected Climate Parameters

Timeframe	Mean Annual Temperature (°C)	Mean Annual Precipitation (mm)	Mean Annual Evaporation (mm)
2011-2040	1.2°C	+5%	+2%
2041-2070	2.4°C	+12%	+4%
2071-2100	3.0°C	+15%	+5%

Source: Compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\Rwork\Climate_Change_rev03.Rmd

Extreme precipitation magnitudes are expected to increase. Monthly streamflow is expected to experience an overall increase in flow magnitude and a shift to an earlier spring freshet. No significant trend in peak flows is projected.

The short duration of the Project meteorological and hydrometric datasets is a limitation of this hydrometeorological baseline report. SRK recommends ongoing monitoring of Project meteorologic conditions, and continued hydrometric station monitoring at Four-Hydro and Tenas-Hydro B as a minimum.This report should be updated when additional data become available. In particular, the Four-Hydro discharge record requires additional flow measurements to characterize baseline conditions for effects assessments and to support predictive modelling.

1 Introduction

SRK Consulting (Canada) Inc. has been tasked with updating the meteorological and hydrological characterization to develop inputs required for the Tenas Project (the Project) in support of the Environmental Assessment (EA).

The following report provides an updated summary of baseline meteorology and hydrology data collected between 2017 and 2022. Regional records were used to extend the local records in order to develop statistical climate and hydrologic parameters that will be used to support various technical studies for the EA, including water management designs, groundwater modeling, and the water and load balance model. The main changes pertain to the updating of the synthetic climate record based on additional data from the local station since the development of the EA baseline report (SRK 2022) and the hydrological parameters based on new calibration to the available data.

1.1 Project Setting

The Tenas Coal Project is a proposed coal mine located in the Coast Mountains of the Cordilleran Region near the Town of Telkwa approximately 25 km southwest of Smithers, British Columbia. The coal preparation plant, maintenance facilities and service facilities would be located approximately 6 km southwest of Telkwa. The Project footprint elevation ranges from 750 to 1050 meters above sea level (masl) with a median elevation of 800 masl. The Ministry of Environment and Climate Change Strategy (MECCS) have published hydrological zones that represent areas of homogeneous hydrologic and geomorphic characteristics. The Tenas Project is within Zone 8 – Nechako Plateau.

The Project encompasses the lower reaches of the Telkwa River, Tenas Creek, Goathorn Creek and Four Creek. The Telkwa River is a major tributary to the Bulkley River near the village of Telkwa, British Columbia, which ultimately flows into the Skeena River. Four Creek is a tributary of Goathorn Creek, and Goathorn Creek and Tenas Creek are tributaries of the Telkwa River.

Figure 1-1 shows the Project location.

Tenas Project

Site Location

610000 615000 620000 625000 630000 635000

6070000 6065000 6060000 6055000 6050000

Smithers

Telkwa

Telkwa River

Bulkley River

Goathorn Creek

Tenas Creek

Four Creek

Legend

- Backfill
- Core Footprint
- Pit Lake
- Plant and Maintenance Area
- Pond
- Rock Cover
- Watercourse

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Features: Allegiance Coal, 2020
- Basedata: Government of British Columbia
- Basemap: World Topo Base

N

1:105,000

0 1 2 3 4 5

Kilometers

NAD 1983 UTM Zone 9N

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1.2 Scope of Report

Meteorology and hydrology studies conducted as part of the Telkwa Coal Project Prefeasibility studies (SRK 2017a, 2017b) identified gaps in the existing meteorological and hydrological datasets. Site specific hydrometeorological data started being collected in 2017. The first years of records (2017-2019) were used by SRK to develop a hydrometeorological baseline for the site (SRK, 2022). Project data collection continued between 2020 and 2022. These new records were incorporated into the hydrometeorological analysis to support Project advancement in 2022 and are documented in this report.

This report is an update to the the baseline Project climate and hydrology previously developed by SRK (SRK, 2022) and generates projections of future climate conditions. This update includes available data up to October 2023.

- Section 2 presents the available meteorological datasets (2017-2022)
- Section 3 presents the available hydrometric datasets (2017-2022)
- Section 4 describes how available datasets were used to develop the Project Area meteorology and hydrometric synthetic time series
- Section 5 outlines how climate change impacts on Project air temperature, precipitation, lake evaporation and streamflow were evaluated from 2022 onwards.

2 Baseline Meteorology

2.1 Section Overview

Meteorological characteristics are typically assessed by integrating Project-specific and regional meteorology records as well as comparing previous studies related to the Project and regional indices. Placing the Project-specific parameters in context using regional analyses is important to be able to provide meteorological inputs to the Project based on extended periods of record.

2.2 Available Meteorological Data

Baseline meteorological monitoring was initiated at the Telkwa Coal Project site in September 2017 by ERM Consultants.

This section summarizes the available monitoring data for the Telkwa Coal Project. Regional climate data from the surrounding area has also been assessed to place the Telkwa Coal Project climate into context.

2.2.1 Project Data

Baseline climate data for the Project Area was collected at the Tenas Deposit automatic weather station (54.59° N, 127.19° W), installed on 29 September 2017 and operated through September 2022. Figure 2-1 illustrates the location of the Tenas Deposit Station and Table 2-1 provides the metadata.

The monitoring record from the Tenas Deposit Station was compiled, reviewed, and validated by ERM (ERM 2019). The following data is recorded at the weather station:

- Hourly average wind speed
- Hourly wind direction and standard deviation of wind direction for 2017
- Hourly average air temperature
- Hourly average relative humidity
- Hourly average solar radiation
- Hourly average barometric pressure
- Hourly sampled snow depth
- 5-minute and hourly accumulated total precipitation

Details concerning the meteorological station configuration, data collection and preliminary gap-filling procedures are outlined in Section 4 of The Tenas Project 2017 to 2019 Baseline Report (ERM 2019).

2.2.2 Regional Data

Regional meteorological data for British Columbia is available from private as well as provincial and federal government sources. Regional re-analysis products for historical climate and future scenarios are available as gridded products developed by third parties based on government

datasets. Within the Nechako Plateau hydrological zone, there are over 90 regional meteorological stations monitored by the Meteorological Service of Canada (MSC). This division of Environment and Climate Change Canada provides public historical meteorological data and information.

Figure 2-1 illustrates the locations of selected regional meteorological stations with respect to the Project. Three stations have historically operated in the town of Smithers. Smithers Airport Auto and Smithers A are understood to be the same station, after an upgrade in 2018. Table 2-1 presents the metadata for the selected regional stations.

Table 2-1: Regional Meteorological Station Selections

Station Name	Climate Identifier	Latitude [° N]	Longitude [° W]	Elevation [masl]	Record Start	Record End	Distance from Project [km]
QUICK	1076638	54.62	126.90	533	1962	1995	19.1
SMITHERS AIRPORT AUTO	1077501	54.82	127.19	518	2013	2023	25.2
SMITHERS A	1077500	54.82	127.18	522	1942	2018	25.2
SMITHERS	1077499	54.83	127.18	523	2010	2023	26.3
HOUSTON	1073615	54.40	126.67	610	1957	2023	40.0
TOPLEY LANDING	1078209	54.82	126.16	722	1962	2017	71.0
EQUITY SILVER	1072692	54.2	126.28	1280	1981	2021	73.6
SUSKWA VALLEY	107G879	55.29	127.17	534	1982	2023	77.5
BURNS LAKE DECKER LAKE	1091174	54.38	125.96	713	1990	2023	83.1

Source: in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Temperature_1CT027.003_rev01.html

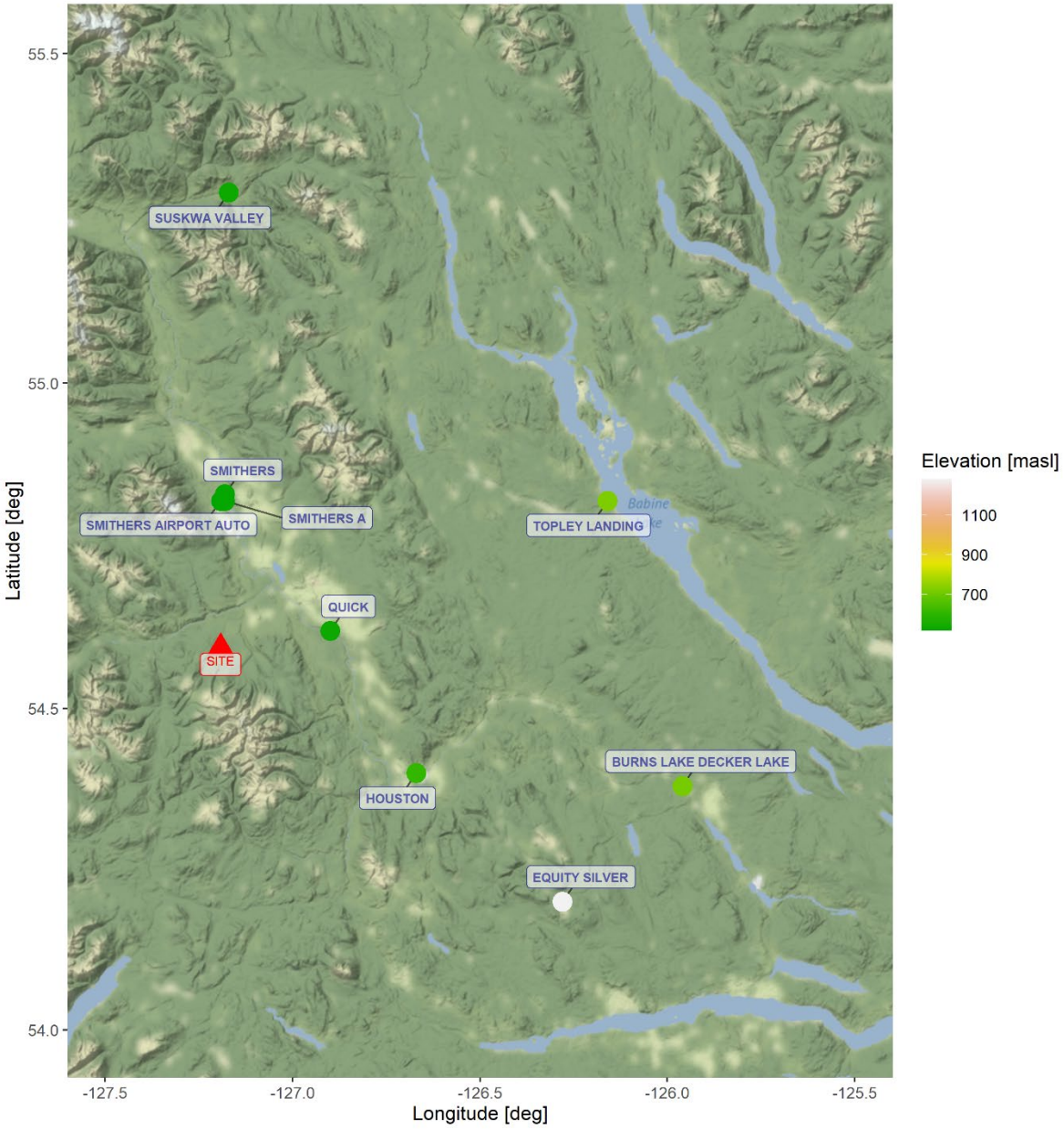


Figure 2-1: Meteorological Stations Used in Project ("Site") and Regional Assessment

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Temperature_1CT027.003_rev01.html

Note: Smithers A and Smithers Airport Auto are located at the same geographic location.

2.2.3 Missing Data

The meteorological records from the Tenas Deposit Station have low amount of absent records with nearly 100% of records available for precipitation and air temperature (maximum, minimum, and daily averages). Higher quantity of missing records were found for solar radiation - mostly during the winter, presumably because of snow cover – and pan evaporation. The missing records and data availability are provided in Figure 2-2 for all measured variables.



Figure 2-2: Site meteorological records availability

Source: compiled from R code SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Note: Total data availability is presented after the variable name in parenthesis. Abbreviations have the following measing, ir row-wise order: evap = Pan Evaporation, gust = Wind Gust, prcp = Precipitation, rain = Rainfall, rh = Relative Humidity, snow = Snowfall, snowpack = Snowpack, ssrd = Shortwave Solar Radiation, tavg = Average Daily Temperature, tmax = Maximum Daily Temperature, tmin = Minimum Daily Temperature, ws = Wind Speed.

In terms of regional datasets, most stations also present some gaps in their records. Based on the correlations between stations these gaps could be patched appropriately as described in the sections below. Figure 2-3 and Figure 2-4 present the number of days with mean temperature and precipitation records respectively available at each regional station from 1942 to 2023. The color ramp on the right-hand side indicates 0 days of data (white) to a full 366 days (dark blue).

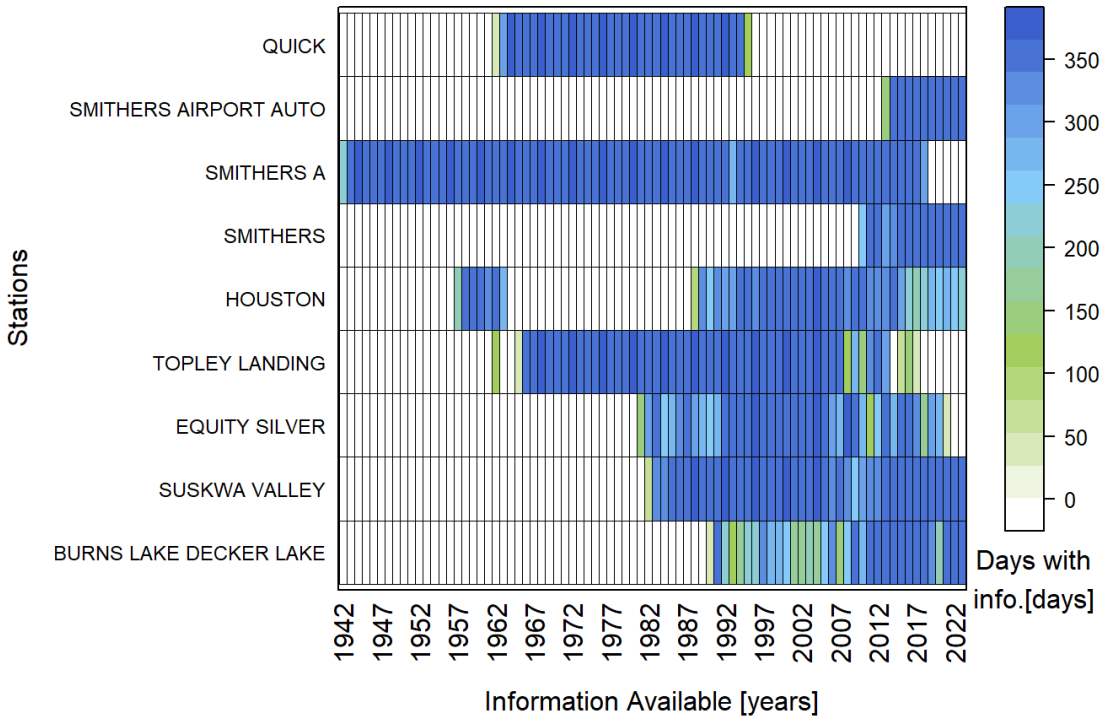


Figure 2-3: Number of Days with Mean Temperature Data Available Every Year from Regional Stations

Source: compiled in text from R code SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

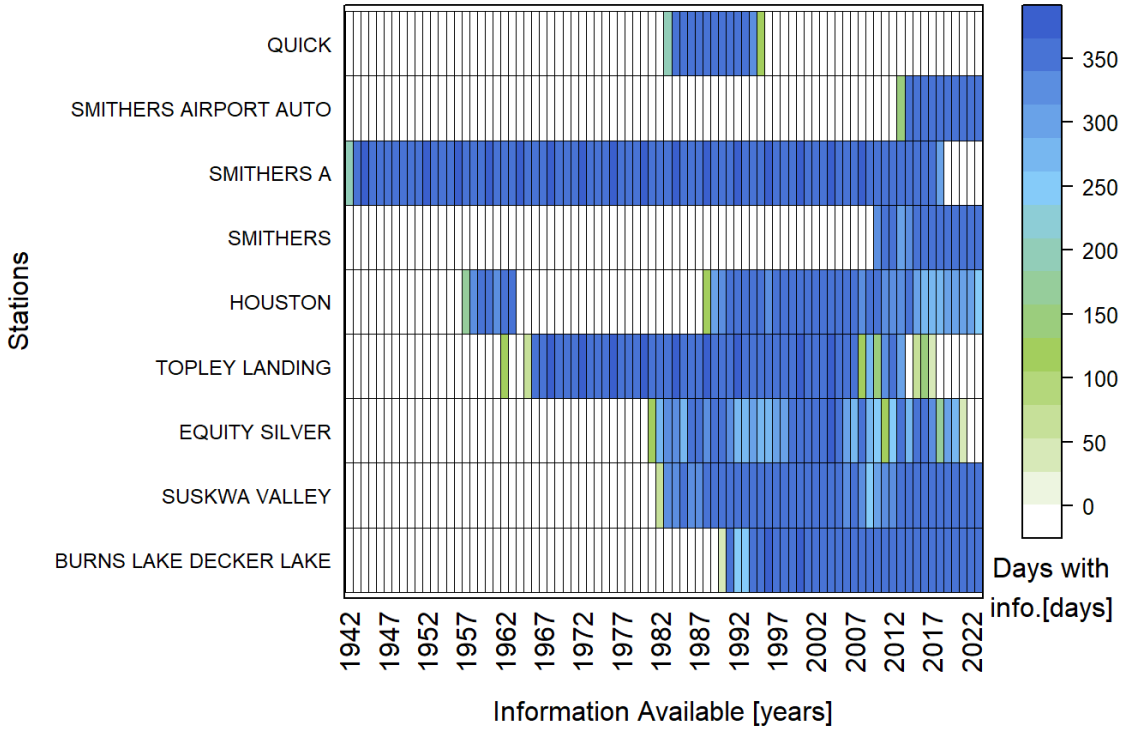


Figure 2-4: Number of Days with Precipitation Data Available Every Year from Regional Stations

Source: compiled in text from R code SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

2.2.4 Regional Snow Datasets

The British Columbia Snow Survey Data includes datasets from two regional networks:

The Automated Snow Weather Station (ASWS) network is comprised of stations operated by the Ministry of Environment, BC Hydro and others. These stations collect hourly snow water equivalent, snow depth, air temperature, and precipitation. Data is available in near-real-time. Tsai Creek Station is the closest station of this type to the Project and is published by the Ministry of Environment and Climate Change Strategy (MECCS, 2020).

The Manual Snow Survey Sites network is operated by the province of British Columbia and manually measures snow depth and snow water equivalent. Measurements are taken monthly when snow is present, providing a record of snowpack across the province. Hudson Bay is the closest manual survey site to the Project. This data is also published by MECCS (2019).

Figure 2-5 illustrates the locations of Tsai Creek and Hudson Bay snow survey stations, and Table 2-2 presents details pertaining to these stations.

Table 2-2: Regional Snow Survey Stations

Station Name	Station Identifier	Latitude [°]	Longitude [°]	Elevation [masl]	Record Start	Record End	Distance from Project [km]
Tsai Creek	4B17P	54.64	-127.68	1360	2003	Current	31.8
Hudson Bay	4B03A	54.76	-127.27	1480	1972	Current	19.4

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\Rwork Snowpack_rev02.Rmd

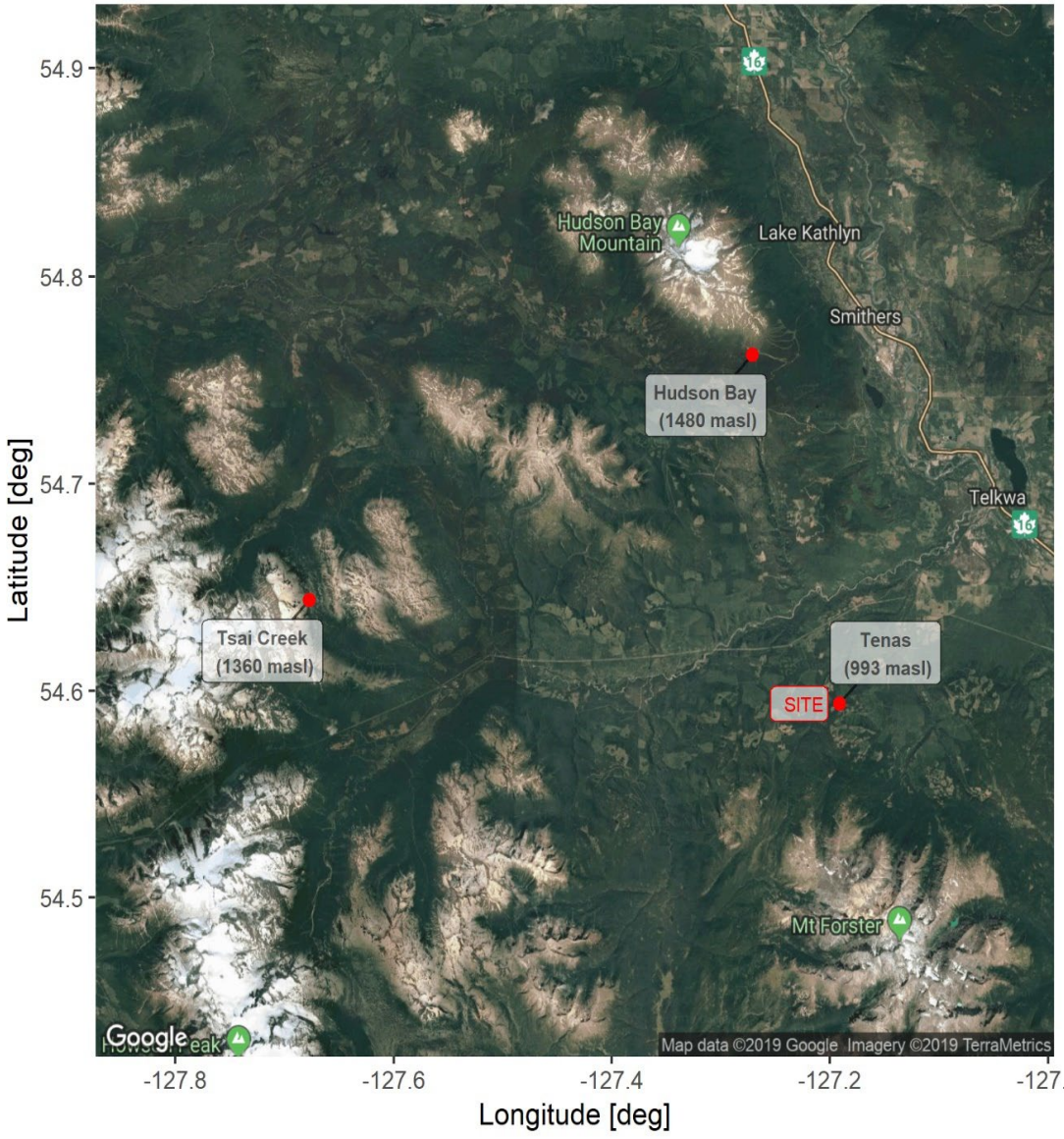


Figure 2-5: Regional Snow Pillow Stations Hudson Bay and Tsai Creek Shown in Relation to Tenas Deposit Station

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\Rwork Snowpack_rev02.Rmd

2.2.5 Reanalysis Meteorological Datasets

Reanalysis products were used to calculate regional orographic trends for precipitation and temperature. The regional stations could not account for these orographic trends, particularly in winter due to inversions present at some stations, and Project data did not produce a meaningful relationship to regional stations due to its relatively short duration of record.

Climate reanalysis combines gridded global models with observed historical data to produce historical climate and to incorporate adjustments based on developed relationships. Multiple reanalysis datasets are available in different spatiotemporal resolutions. Table 2-3 presents the three reanalysis datasets examined for this study.

Table 2-3: Overview of Reanalysis Datasets Examined in this Study

Reanalysis	Institution	Period of Record
ERA-5 (ECMWF 2020)	European Centre for Medium-Range Weather Forecast (ECMWF)	1979-current
MERRA-2 Modern-Era Retrospective Analysis for research and applications (NASA, 2017)	US National Aeronautics and Space Administration (NASA)	1980- current
PRISM (PCIC 2014)	Pacific Climate Impact Consortium (PCIC)	1950-2007

Source: Compiled in text.

ERA-5 and MERRA-2 are global datasets that provide sub-daily values for multiple meteorological parameters. PRISM is a climate-elevation regression model, used to generate a reanalysis dataset that provides precipitation and maximum and minimum temperature averages on a monthly timestep for the Pacific Region of Canada and the northwestern USA.

2.3 Summary of Available Data

This section presents a summary of the Project Area and regional meteorological datasets.

Meteorological parameters were summarized for the three years of Project data using monthly averages of daily minimum, mean and maximum air temperatures. Monthly average sums of the minimum, mean and maximum total precipitation were calculated. Annual maximum snow water equivalent (SWE) was computed for the Project based on regional snow survey data, transposed to the Project Area.

Other parameters measured at the Tenas Deposit Station include: Wind speed and direction, solar radiation, relative humidity, and barometric/atmospheric pressure. Evaporation rates were calculated based on thes parameters. Measured and calculated parameters are summarized for the Project Area and the long-term regional records in the following sections.

2.3.1 Air Temperature

Project

Temperature is used to estimate snowmelt, evaporation, evapotranspiration, and other inputs such as pond freeze depths. Air temperatures recorded at the Tenas Deposit Station ranged from -31.7°C (January 15, 2020) to 34.5°C (June 27, 2021). Figure 2-6 presents the daily maximum,

average and minimum temperature at the Tenas Deposit Station. During the period of record, the coldest month was the month of December 2021 with a mean temperature of -14.0°C, and the hottest month was the month of July 2018 at 15.5°C. The summary of monthly maximum, average and minimum daily temperatures is presented in Table 2-4.

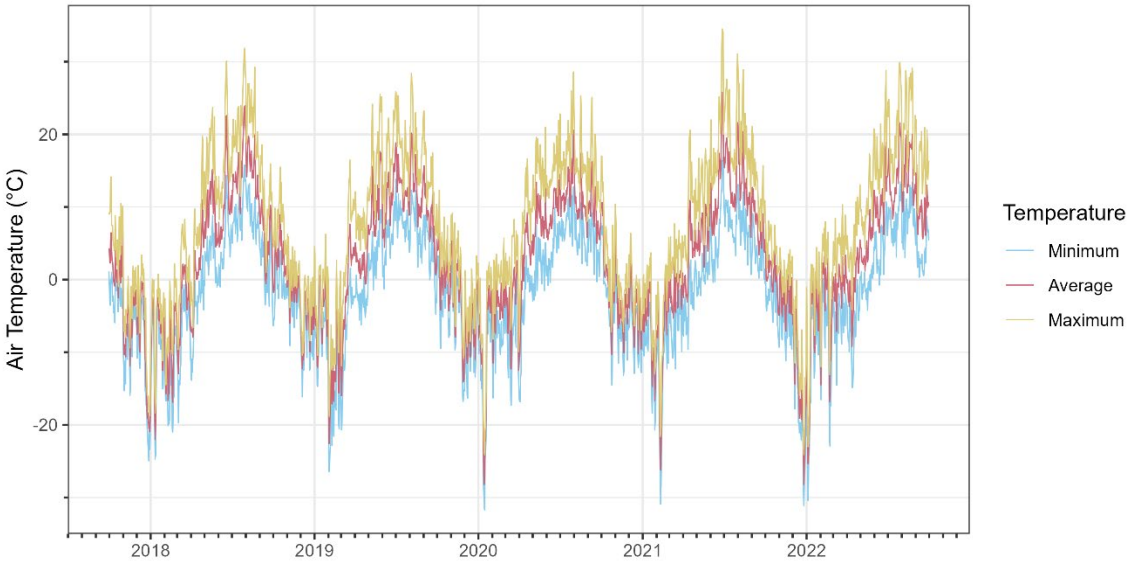


Figure 2-6: Tenas Deposit Meteorological Station Temperature Record

Source: SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\graphs\ts_site_airtemp.png

Table 2-4: Tenas Deposit Meteorological Station Daily Air Temperature (°C) for October 2017-2022

Year	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2017	Max.										14.2	2.5	3.4	14.2
	Mean										1.9	-5.6	-8.9	-4.2
	Min.										-5.9	-15.9	-24.9	-24.9
2018	Max.	0.8	2.2	8.3	19.8	23.7	30.1	31.8	29.3	18.5	15.5	6.2	0.6	31.8
	Mean	-7.6	-9.8	-3.3	1.1	9.4	10.6	15.5	15.3	5.9	3.0	-1.0	-6.1	2.8
	Min.	-24.7	-21.0	-19.7	-13.9	-1.1	-1.0	5.0	4.9	-5.2	-6.3	-9.1	-16.1	-24.7
2019	Max.	6.2	2.7	16.5	12.7	25.6	24.8	25.9	28.4	23.2	12.3	9.1	1.3	28.4
	Mean	-3.8	-12.7	-1.3	2.4	10.5	10.9	12.9	12.9	8.2	0.7	-1.9	-7.9	2.6
	Min.	-14.7	-26.5	-20.7	-6.2	-1.4	-1.3	3.8	1.7	-4.8	-9.5	-16.8	-16.3	-26.5
2020	Max.	2.4	5.7	8.3	16.6	21.0	21.9	28.6	25.3	25.1	17.0	10.4	6.4	28.6
	Mean	−9.8	−3.5	−3.2	2.0	8.3	9.3	12.6	10.7	9.4	0.7	−3.4	−3.8	2.4
	Min.	−31.7	−16.3	−17.3	−16.8	−3.0	−0.8	4.6	1.9	−0.3	−14.5	−13.2	−12.9	-31.7
2021	Max.	3.7	5.8	7.7	20.6	18.0	34.5	31.1	29.4	21.1	8.1	4.4	0.6	34.5
	Mean	−6.4	−8.9	−1.5	3.1	6.5	13.0	14.4	13.1	7.7	0.6	−2.4	−14.0	2.1
	Min.	−20.7	−30.9	−12.3	−9.6	−2.3	−0.4	3.3	0.7	0.0	−8.8	−11.2	−31.1	-31.1
2022	Max.	4.4	8.0	10.3	13.1	20.8	28.8	29.9	29.1	22.0				29.9
	Mean	−7.6	−3.5	−0.6	−0.7	4.9	11.0	14.3	15.0	9.4				4.7
	Min.	−30.4	−22.9	−14.5	−14.9	−4.2	−0.8	3.1	3.0	0.3				-30.4

*Light grey denotes no measurements.

Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Regional

Temperature records for the Smithers Airport station were extended and patched using data from the Houston station. Figure 2-7 shows the annual distribution of regional temperatures, where the coldest and warmest months are typically January and July, respectively. Regional stations show similar temperature behaviour throughout the year except for Tsai Creek and Equity Silver. These two regional stations appear to show milder winters suggesting a temperature inversion for higher elevations. This suggests monthly correction factors are more appropriate to account for the potential of temperature inversions during the winter months.

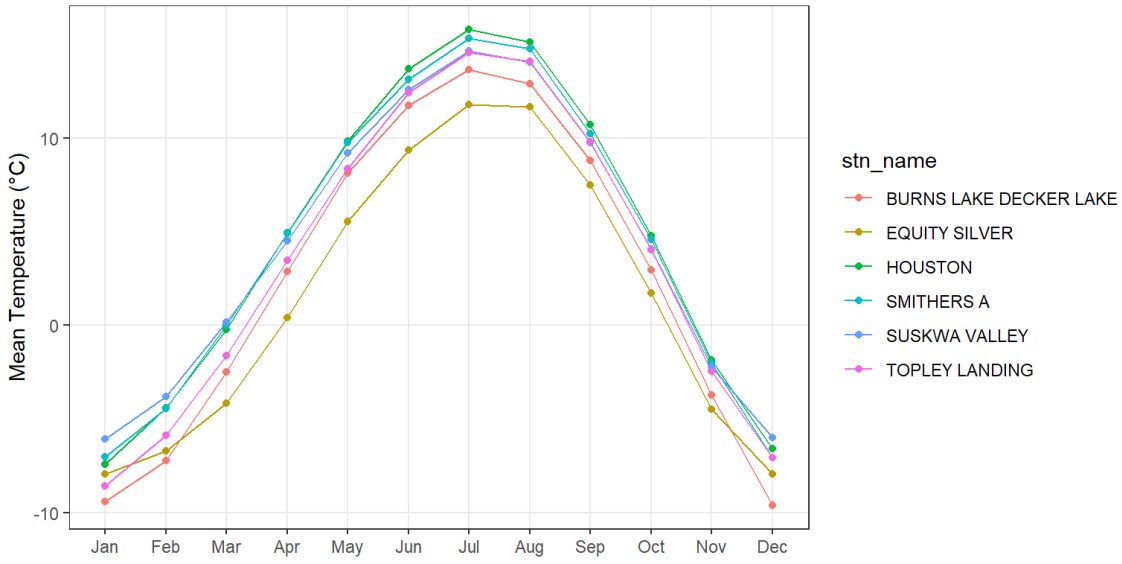


Figure 2-7: Monthly Average Temperatures at Regional Meteorological Stations

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Regionally, mean annual temperature decreases with increasing elevation. For a Project site elevation of 993 m (corresponding to the location of the Tenas Deposit Station), the mean annual temperature is approximately 2.5°C colder than temperatures recorded at the Smithers Airport Station (Figure 2-8).

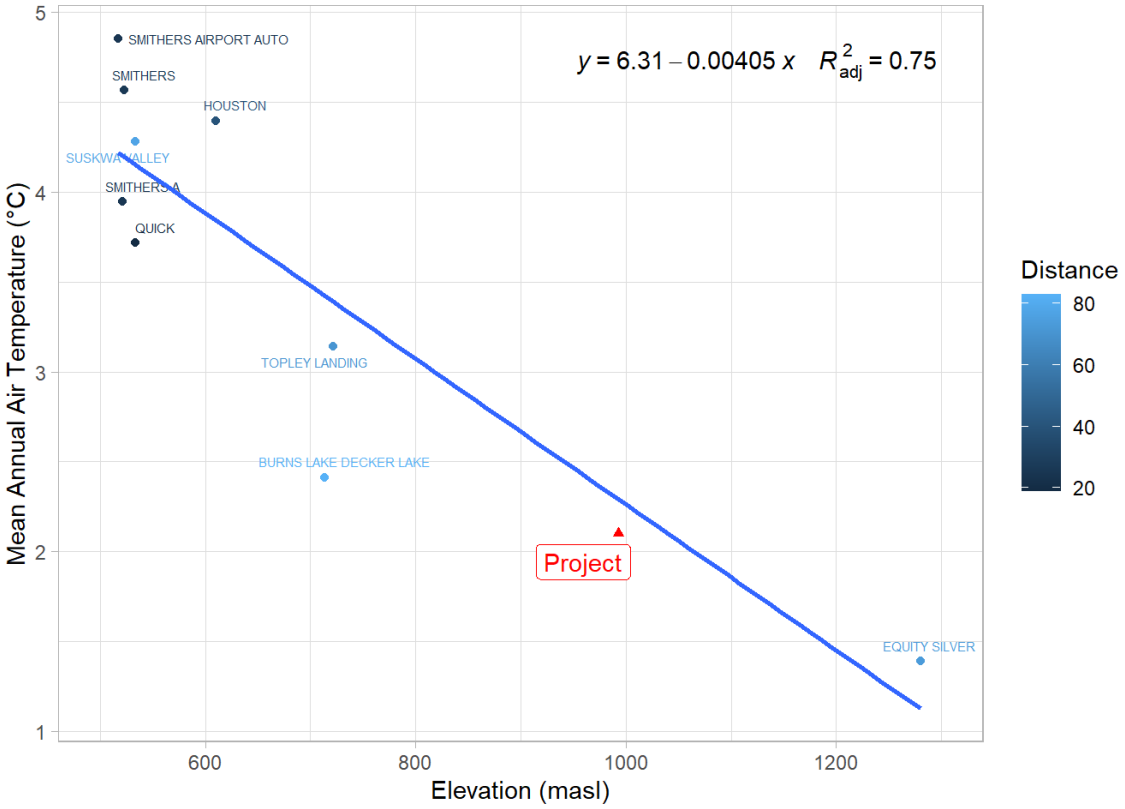


Figure 2-8: Regional Mean Annual Temperature – Elevation Trend

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

2.3.2 Precipitation

Project

The Tenas Deposit Station recorded annual precipitation from 502 mm to 719 mm in 2018 – 2021. Figure 2-9 presents the recorded daily precipitation from October 2017 to September 2022. The largest single-day precipitation events occurred on 24 October 2017 for rainfall (73 mm) and on 7 February 2018 for snowfall (65 mm). The 24 October 2017 event corresponds to an exceptional runoff event that exceeded historical streamflow records for regional stations in the area (ERM 2019).

The recorded total precipitation at the Tenas Deposit Station (Figure 2-9) was divided into rainfall (mm) and snowfall (mm SWE) components if the Project air temperature record was less than 0 degrees Celsius. Using this estimation, snow ranged from 34% to 71% of total annual precipitation (see Table 2-8 for regional comparison). Monthly cumulative values of measured total precipitation and estimated rainfall and snowfall are summarized in Table 2-5.

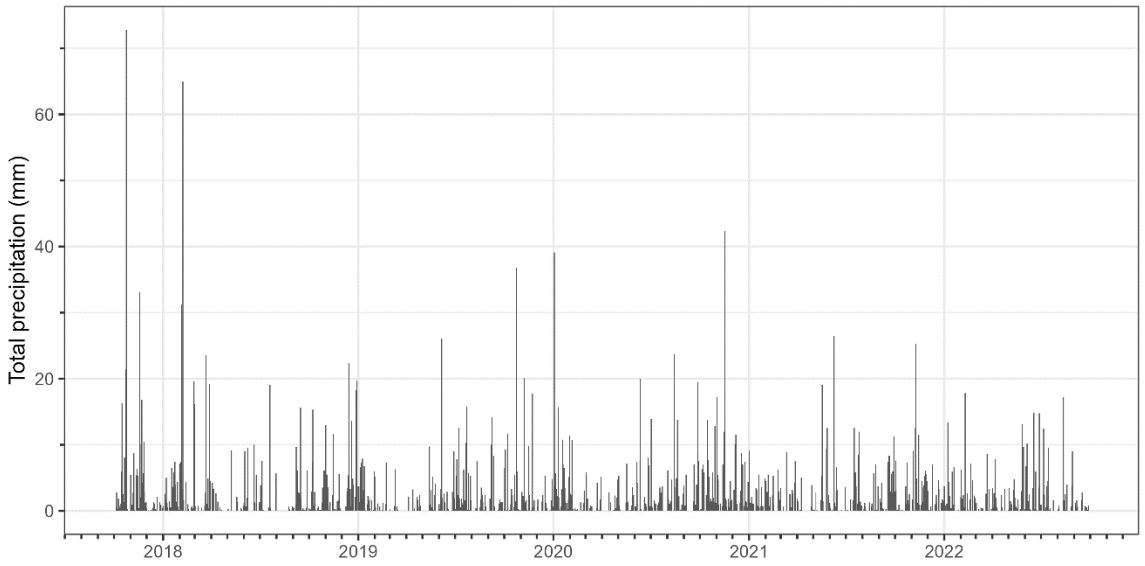


Figure 2-9: Tenas Deposit Meteorological Station Measured Total Precipitation for October 2017-2019

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Table 2-5: Tenas Deposit Meteorological Station Total Precipitation (measured), Rain (estimated), Snow (estimated)

Year	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2017	Total Precipitation [mm]										147	134	10	--
	Rainfall [mm]										114	0	0	--
	Snowfall [mm SWE]										33	134	10	--
2018	Total Precipitation [mm]	50	150	81	14	14	42	50	2	50	54	51	113	672
	Rainfall [mm]	0	0	1	3	14	42	50	2	30	42	9	0	195
	Snowfall [mm SWE]	50	150	80	10	0	0	0	0	20	11	42	113	477
2019	Total Precipitation [mm]	60	19	8	13	26	57	83	21	47	93	73	22	522
	Rainfall [mm]	5	0	0	7	26	57	83	21	46.5	69	32	0	346
	Snowfall [mm SWE]	55	19	8	6	0	0	0	0	0.5	24	41	22	176
2020	Total Precipitation [mm]	126	26	30	14	25	63	35	84	55	84	107	70	719
	Rainfall [mm]	0	1	1	14	25	63	35	84	55	20	23	18	339
	Snowfall [mm SWE]	126	25	29	0	0	0	0	0	0	64	84	51	380

Year	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2021	Total Precipitation [mm]	43	40	36	14	56	52	61	24	75	32	107	29	568
	Rainfall [mm]	0	1	4	5	53	52	61	24	75	16	13	0	305
	Snowfall [mm SWE]	43	39	32	9	3	0	0	0	0	15	94	29	263
2022	Total Precipitation [mm]	43	55	21	28	48	75	41	41	11				--
	Rainfall [mm]	0	23	9	3	47	75	41	41	11				--
	Snowfall [mm SWE]	43	31	12	25	1	0	0	0	0				--

*Light grey denotes no measurements.

Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Regional

A regional precipitation analysis was carried out to identify trends and elevation correlations. The Smithers Airport Auto and Smithers A stations (10775001 and 1077500) were merged to generate a long-term record. Remaining gaps in this record were patched with Quick as well as ERA-5, using quantile mapping methods. The resulting patched Smithers A record provides 73 years of complete data.

Average yearly precipitation, rainfall and snowfall for regional stations are presented in Table 2-6 for their corresponding period of record. Regional stations present varying mean annual precipitation (MAP) in the range of 415 mm to 760 mm with precipitation occurring mainly as rainfall except for Equity Silver where almost half of the precipitation falls as snow due to its higher elevation.

Table 2-6: Regional Stations Annual Precipitation, Rain, Snow and Corresponding Proportions

Station	Mean Annual Precipitation [mm]	Mean Annual Rainfall [mm]	Mean Annual Rainfall [%]	Mean Annual Snowfall [SWE mm]	Mean Annual Snowfall [%]
SMITHERS A (patched)	511	344	67%	166	33%
QUICK	469	308	66%	161	34%
HOUSTON	425	293	69%	132	31%
TOPLEY LANDING	539	310	58%	229	42%
EQUITY SILVER	661	348	53%	314	47%
SUSKWA VALLEY	756	552	73%	204	27%
BURNS LAKE DECKER LAKE	415	249	60%	166	40%

Notes:
1. Rainfall and snowfall proportions as percentages of the mean annual precipitation.
2. Smithers A patched with Smithers Airport Auto, Quick and ERA-5.
3. Mean annual values calculated based only on years with snow and rain measurements

Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html and Canadian Climate Normals https://climate.weather.gc.ca/climate_normals/index_e.html

Figure 2-10 illustrates the regional correlation between MAP and elevation. A negative value for the determination coefficient (R^2 presented in Figure 2-10) indicates the correlation between elevation and MAP using only the regional meteorological datasets is poor.

The relationship between MAP and elevation is likely less significant at this location due to the more dominant effects of topography and the Pacific Ocean as a moisture source. The west-east gradient and proximity to mountain range with rain shadow effects are the most important factors affecting precipitation in this area. Orographic gradients were further evaluated using Reanalysis datasets and are discussed in Section 4.1.2.

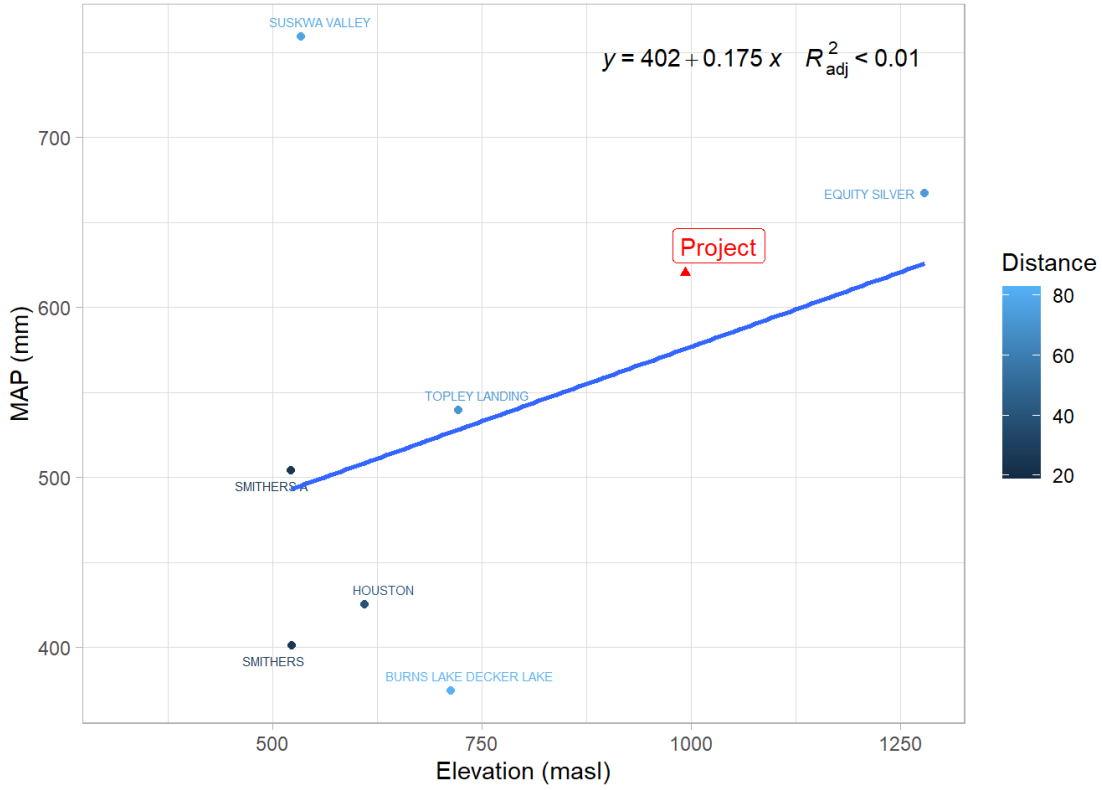


Figure 2-10: Regional Mean Annual Precipitation – Elevation Trend

Note: Quick station data not included due to differing timelines
Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Monthly precipitation was also reviewed and compared to site data over the concurrent period of record. Monthly precipitation data for the regional stations is presented in Table 2-7.

Table 2-7: Regional Stations Monthly Precipitation Records

Year	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2017	SMITHERS A (patched)	45	11	7	17	86	46	255	21	89	143	68	3	579
	HOUSTON	0[1]	10[1]	1[1]	6[1]	83[1]	34[1]	7[1]	1[1]	3[1]	81[1]	17 [1]	4[1]	245
	TOPLEY LANDING			0[1]	24[1]	62[1]								--
	EQUITY SILVER	52	50	44		116	74	30	26	50	133	95	23	692
	SUSKWA VALLEY	38	17	36	32	120	69[1]	75	55	104	149	83	26	804
	BURNS LAKE DECKER LAKE	21	12	13	23	68	38	30	11	48	70	48	4	385
2018	SMITHERS A (patched)	21	24	33	10	21	69	17	0	23	38	68	28	404
	HOUSTON	8[1]	39[1]	33[1]	2[1]	12[1]	23[1]	41[1]	0[1]	31[1]	24[1]	40[1]	20[1]	245
	TOPLEY LANDING													--
	EQUITY SILVER	77	130	64	21	29	24[1]							--
	SUSKWA VALLEY	53	46[1]	67	22	20	49	46	7	58	55	76	78	575
	BURNS LAKE DECKER LAKE	37	54	25	6	15	36	37	3	40	44	48	0[1]	346
2019	SMITHERS A (patched)	55	6	7	21	21	41	68	28	26	79	85	19	381
	HOUSTON	23[1]	1[1]	0[1]	0[1]	16.8[1]	40[1]	42[1]	26	49.4	73[1]	12[1]	13[1]	297
	TOPLEY LANDING													--
	EQUITY SILVER	0[1]	5[1]	10	24	37.6	68	121	40	41[1]	24[1]	44[1]	38	451
	SUSKWA VALLEY	94	22	12	42	31	43	99	70	51	105	88	28	685
	BURNS LAKE DECKER LAKE	8[1]	11	2	14	34	39	72	20	26	58	34	16	334
2020	SMITHERS A (patched)	32	21	12	10	31	66	59	115	19	2	1	0	498
	HOUSTON	54[1]	17[1]	5[1]	11[1]	14[1]	56	59[1]	55[1]	16[1]	63[1]	41[1]	10[1]	402
	TOPLEY LANDING													--
	EQUITY SILVER		16[1]	22[1]	22	34	93	68	111	64	67	65[1]	34[1]	--
	SUSKWA VALLEY	83	39	60	24	45	94	100	174	102	94	68	71	954
	BURNS LAKE DECKER LAKE	66	12	10	14	3[1]					0[1]	63	36	--

Year	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2021	SMITHERS A (patched)	2	21	27	5	22	24	38	31	91	21	79	6	369
	HOUSTON	3[1]	18[1]	6[1]	2[1]	52[1]	19[1]	27[1]	19	40[1]	14[1]	21[1]	19[1]	250
	TOPLEY LANDING													--
	EQUITY SILVER	42												--
	SUSKWA VALLEY	47	36	61	25	53	47	50	54	128	46	118	53	717
	BURNS LAKE DECKER LAKE	30	28	11	9	63	23	52	37	60	21	41	26	402
2022	SMITHERS A (patched)	47	43	8	28	45	49	17	35	9	49	39	29	388
	HOUSTON	27[1]	4[1]	1[1]	2[1]	49[1]	70	49[1]	34[1]	4[1]	30[1]	15[1]	19[1]	304
	TOPLEY LANDING													--
	EQUITY SILVER													--
	SUSKWA VALLEY	50	71	20	42	63	79	70	62	37	80	63	52	690
	BURNS LAKE DECKER LAKE	42	17	10	12	47	75	62	65	5	11	32		415
2023	SMITHERS A (patched)	16	40	9	25	7	12	26	23	18	32	28[1]		--
	HOUSTON	7[1]	13[1]	3[1]	0[1]	0[1]	6[1]	79	8[1]	17[1]	11[1]	0[1]		--
	TOPLEY LANDING													--
	EQUITY SILVER													--
	SUSKWA VALLEY	64	85	18	72	32	21	60	44	48	47	85		--
	BURNS LAKE DECKER LAKE	23	42	9	25	9	105	106	25	22	41	16		--

[1]Incomplete month. More than 5 days missing from record.

*Light grey denotes no measurements.

Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

2.3.3 Snow Depth

Project

Table 2-8 presents the daily mean snow depth data recorded at the Tenas Deposit Station. Snowpack at the Project does not have a large potential of being redistributed by wind as the general surrounding area is heavily forested and recorded wind speeds are low (see Section 2.3.4). Snow depth measurements recorded at the Tenas Deposit Station are believed to be representative of the Project (ERM 2019). Snow depths are measured continuously at the Project while snowpack snow water equivalent measurements are not available.

Table 2-8: Snow Depth Summary at Tenas Deposit Station for October 2017 to 2022

Year	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	Maximum Snow Depth [cm]										16	60	51
	Average Snow Depth [cm]										4	28	47
	Minimum Snow Depth [cm]										0	3	44
2018	Maximum Snow Depth [cm]	78	122	149	140	64	0	0	0	8	4	16	75
	Average Snow Depth [cm]	63	101	119	110	12	0	0	0	1	0	9	38
	Minimum Snow Depth [cm]	51	76	97	68	0	0	0	0	0	0	3	13
2019	Maximum Snow Depth [cm]	76	83	83	55	6	0	0	0	0	29	19	15
	Average Snow Depth [cm]	66	75	74	32	0	0	0	0	0	5	5	14
	Minimum Snow Depth [cm]	56	72	56	10	0	0	0	0	0	0	0	12
2020	Maximum Snow Depth [cm]	72	83	80	73	1	0	0	0	0	23	45	60
	Average Snow Depth [cm]	58	70	73	45	0	0	0	0	0	9	23	46
	Minimum Snow Depth [cm]	27	65	66	5	0	0	0	0	0	0	4	32
2021	Maximum Snow Depth [cm]	78	100	100	93	20	0	0	0	0	2	40	60
	Average Snow Depth [cm]	68	91	94	70	2	0	0	0	0	0	27	50
	Minimum Snow Depth [cm]	63	77	89	25	0	0	0	0	0	0	1	40
2022	Maximum Snow Depth [cm]	74	88	86	80	50	0	0	0	0			
	Average Snow Depth [cm]	71	78	79	73	15	0	0	0	0			
	Minimum Snow Depth [cm]	63	71	72	53	0	0	0	0	0			

*Light grey denotes no measurements.

Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Regional

The Tenas Deposit Station records total precipitation and snow depth but does not measure the snow water equivalent. The automated regional snow pillow station operated by environment Canada at Tsai Creek measures precipitation, temperature, snow depth and hourly snow water equivalent. The snow depth record at Tsai Creek is much higher than the snow depth record at the Tenas Deposit Station although the accumulation pattern is similar. However, melt timing occurs later at Tsai Creek due to the elevation difference between the two stations as well as

other physiographic characteristics such as aspect. At Tsai Creek, snowmelt typically begins in April, peaks in May and then is finished by early June.

Hudson Bay manual survey station also offers records near the Project. Figure 2-11 illustrates snow depth records at these regional stations compared to the project records, and Table 2-9 presents monthly average snow depth at Tsai Creek together with monthly survey results carried out at Hudson Bay.

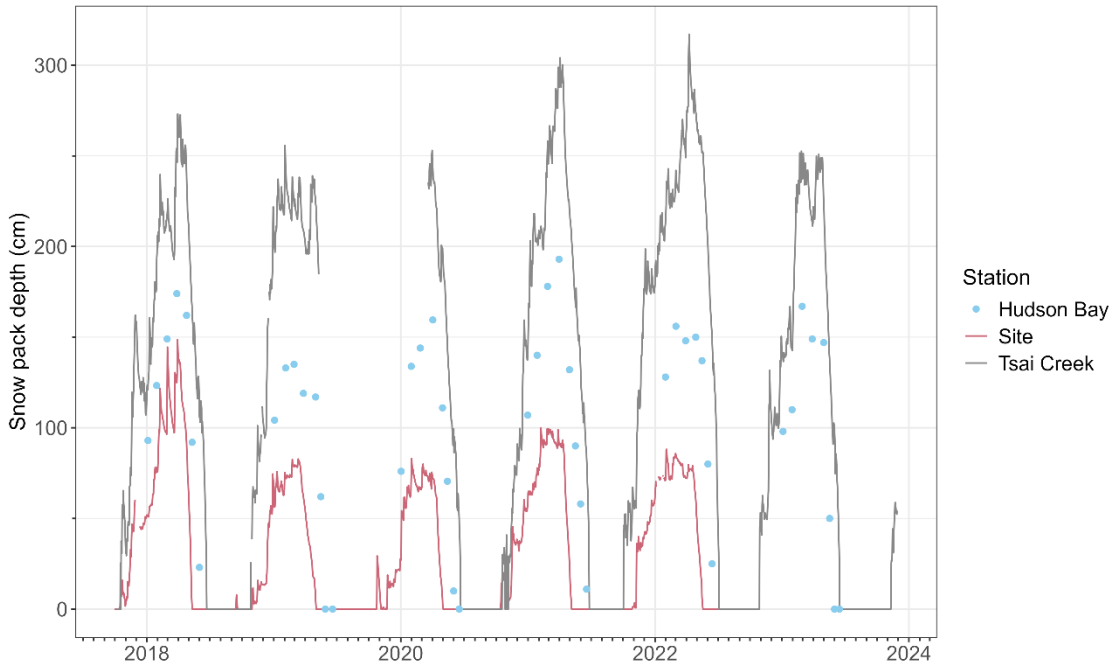


Figure 2-11: Snow Depth Records at Tsai Creek, Hudson Bay and Tenas Deposit

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Table 2-9: Average Snow Depth at Tsai Creek and Hudson Bay Stations for October 2017 to 2023

Year	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	Average Snow Depth at Tsai Creek [cm]									0	23	85	126
	Hudson Bay monthly Snow Depth Survey [cm]	105		127		126	25						
2018	Average Snow Depth at Tsai Creek [cm]	155	215	219	249	155	60	0	0	0	4	80	148
	Hudson Bay monthly Snow Depth Survey [cm]	108	149	174	162	92	23						108
2019	Average Snow Depth at Tsai Creek [cm]	219	229	220	215	197	0	0					
	Hudson Bay monthly Snow Depth Survey [cm]	104	134	119		60	0						
2020	Average Snow Depth at Tsai Creek [cm]			240	211	140	45	0	0	0	10	47	117
	Hudson Bay monthly Snow Depth Survey [cm]	105	144		135	70	5						107
2021	Average Snow Depth at Tsai Creek [cm]	195	218	269	264	177	78	0	0	0	47	109	181
	Hudson Bay monthly Snow Depth Survey [cm]	140	178	193	132	90	34						
2022	Average Snow Depth at Tsai Creek [cm]	202	228	248	285	247	141	4	0	0	5	67	110
	Hudson Bay monthly Snow Depth Survey [cm]	128		152	150	137	52						
2023	Average Snow Depth at Tsai Creek [cm]	147	218	231	238	149	34	0	0	0	0	30	
	Hudson Bay monthly Snow Depth Survey [cm]	104	167	149		98	0						

*Light grey denotes no measurements.

Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

2.3.4 Wind

Project

Wind speeds at the Project are generally low (less than 2 m/s) and are predominantly from the southwest (i.e., travelling down the Tenas Creek watershed). Figure 2-12 illustrates the wind rose representing wind speed data for the hydrologic year from October 2017 to September 2022. Table 2-10 presents the monthly average wind speed for each year of record from the Project station. The maximum hourly mean wind speed recorded at the Tenas Deposit Station between October 2017 to September 2022 was 6.7 m/s and the maximum wind gust speed was 15.9 m/s.

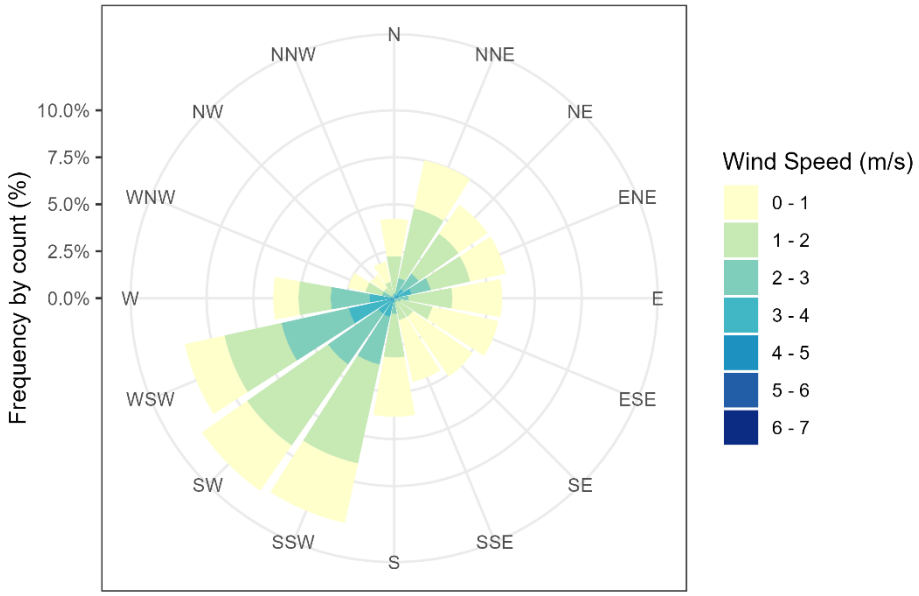


Figure 2-12: Wind Rose at Project for 2017-2022

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Table 2-10: Project Monthly Average Wind Speed Summary [m/s]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017										1.2	1.1	0.9
2018	0.7	1.2	1.5	2.0	2.5	2.9	3.3	2.3	1.4	1.1	0.9	1.1
2019	1.0	1.4	1.3	1.6	1.8	1.7	1.4	1.5	1.3	1.1	1.2	0.7
2020	1.2	1.5	1.8	1.7	1.9	1.8	1.7	1.6	1.1	1.2	1.2	1.0
2021	1.2	1.6	1.7	1.7	1.5	1.6	1.5	1.6	1.4	1.3	1.3	1.0
2022	1.5	1.6	1.3	1.6	1.5	1.5	1.6	1.4	1.2			

Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Regional

Winds at the Smithers Airport station were found to be predominantly from the southeast and slightly higher than the Project Area. Wind speeds are typically used to evaluate evaporation and wave run-up and setup for freeboard estimates. Given the short period of record overlap, it was determined that higher wind speed measured at the Smithers Airport station is conservative and appropriate for application to the Project.

Figure 2-13 illustrates the wind roses based on wind speeds recorded from October 2017 to November 2023 at Smithers Airport station.

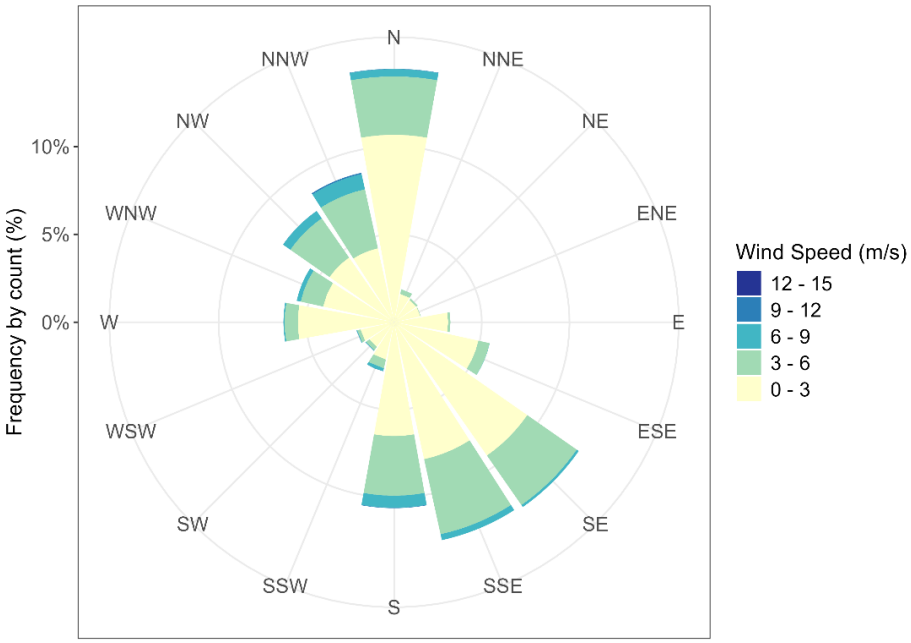


Figure 2-13: Wind Rose for Smithers A – October 2017 to November 2023

Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Smithers A values have been adapted to the Project for design purposes but should be replaced with Project-specific data when it becomes available. Wind speeds are typically not transposable across large distances and due to physiographic characteristics unique to each location. Table 2-11 summarizes the monthly average wind speeds and Table 2-12 presents the frequency analysis for sustained wind speeds adopted for the Project.

Table 2-11: Average Monthly Wind Speed [m/s] at Smithers A Regional Station

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average (m/s)	2.0	1.9	2.0	2.2	2.0	1.8	1.6	1.5	1.4	1.9	1.9	2.0	1.9

Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Table 2-12: Sustained Wind Speed Frequency Analysis for Smithers Airport Station

Return Period	Wind Speed [m/s]
2	12.6
5	14.8
10	16.3
25	18.2
50	19.5
100	20.9
200	22.3
500	24.1
1000	25.5

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\Rwork\ Wind_and_Freeboard_EA_rev00.Rmd

2.3.5 Solar Radiation

Project

The amount and intensity of solar radiation is a function of elevation, latitude, catchment orientation (slope and aspect) and shadows cast by topographic features and the atmosphere (i.e., cloud cover). Solar radiation at the Tenas Deposit Station is measured in power density units of W/m^2. Many periods of erroneous data were removed from the dataset due to snow accumulation on top of the sensor. Figure 2-14 illustrates daily solar radiation measured at the Tenas Deposit Station from October 2017 to September 2022.

Average daily solar radiation ranged from 1.5 W/m^2 to 376 W/m^2. As illustrated, incoming solar radiation has both seasonal and annual cycles. Diurnal variation in the sub-daily record (not shown) demonstrate typically higher values at midday and during summer while lower values typically occur between late evening to morning, and in winter. Table 2-13 presents the average monthly solar radiation at the Tenas Deposit Station.

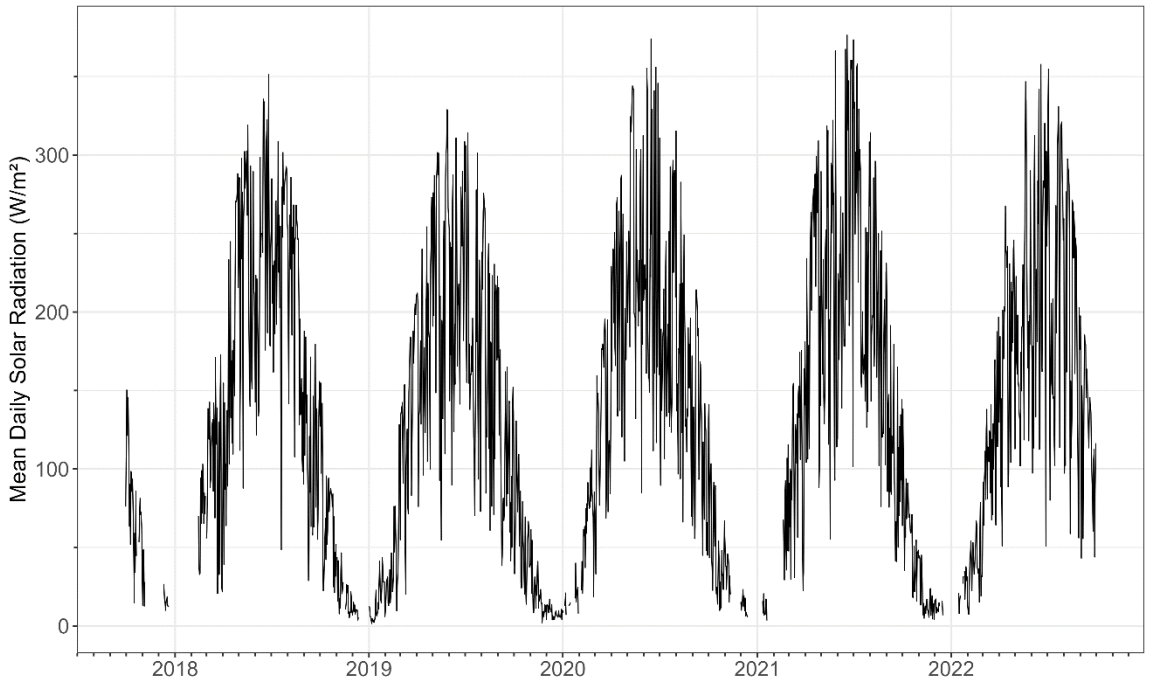


Figure 2-14: Average Daily Solar Radiation at the Tenas Deposit Station for October 2017 to 2019

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Table 2-13: Average Monthly Solar Radiation at the Tenas Deposit Station for October 2017 to 2022 [W/m^2]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2017										79.8	30.2	15.7	
2018		72.0	99.3	165.2	233.0	237.6	242.2	202.3	112.5	73.1	20.1	9.2	
2019	18.4	40.8	137.3	181.4	230.5	219.5	182.3	183.6	108.5	58.4	20.9	11.1	115.5
2020	16.8	66.4	126.8	206.2	245.4	228.2	196.0	165.5	120.2	51.3	34.3	12.3	122.4
2021	11.6	67.4	105.1	214.3	213.0	249.1	242.4	196.5	112.1	59.1	17.1	12.4	125.0
2022	25.8	38.7	109.9	176.2	192.7	221.1	229.4	194.4	125.0				

*Light grey denotes no measurements.

Source: compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Regional

The Smithers Airport Station does not record solar radiation. The Canadian Weather Energy and Engineering Dataset (CWEEDS) dataset is available for the location of Smithers Airport and was compared to incoming solar radiation recorded at the Tenas Deposit Station. Table 2-14 presents the average monthly solar radiation at the Smithers Airport station from the CWEEDS dataset.

Table 2-14: Average Monthly Solar Radiation [W/m^2] at Smithers Airport Location

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average	67	133	249	366	465	485	425	327	232	147	77	48	196

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Evaporation_1CT027.003_rev01.Rmd

Based on available data, incoming solar radiation at the Project was found to be lower than the solar radiation from the CWEEDS dataset for the Smithers Airport location, understood to be due to the former being located in the north face of a mountain while the latter is located in an open, flat location and receives greater insolation.

2.3.6 Relative Humidity

Relative humidity refers to the ratio of the amount of moisture in the air to the relative maximum potential amount that air could hold at a given temperature and atmospheric pressure. As relative humidity approaches 100%, the likelihood of precipitation increases. On a monthly basis, the average relative humidity was typically greatest from November to January, remaining consistently above 85%, and was the lowest overall during the months of July and August (Figure 2-16). The monthly maximum, average and minimum daily relative humidity values are summarized in Table 2-15.

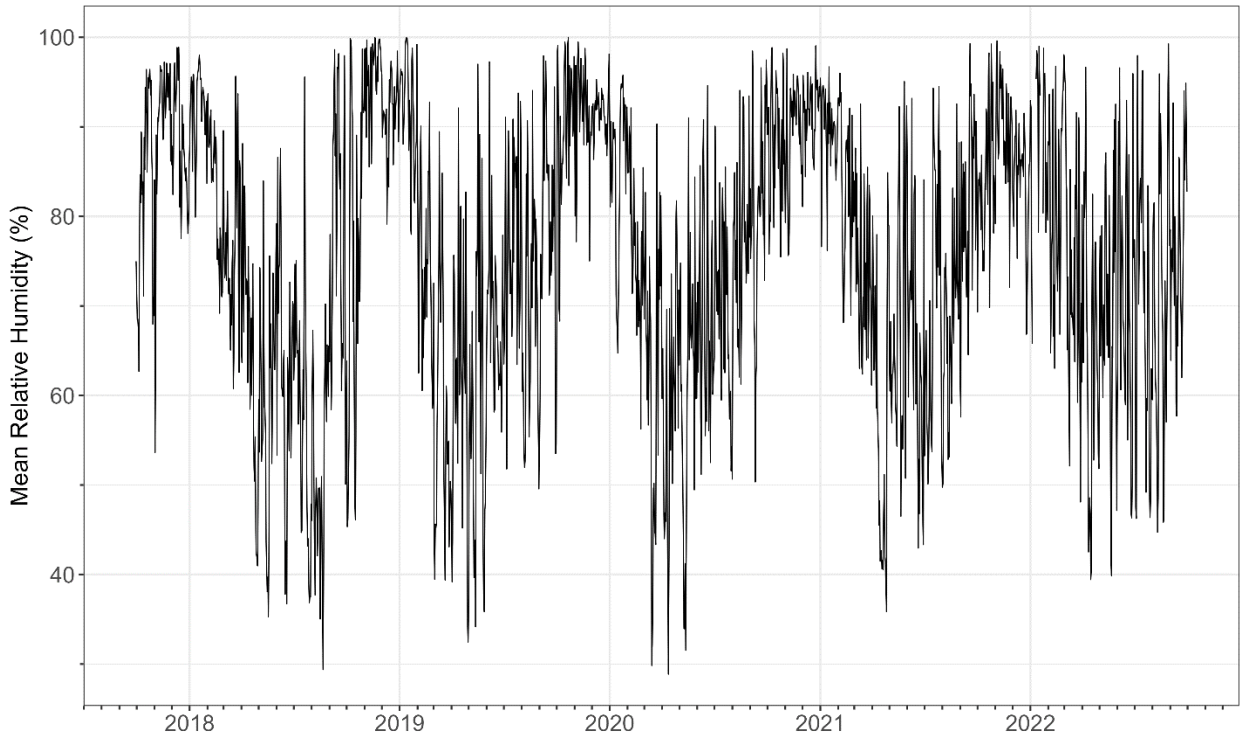


Figure 2-15: Average Daily Relative Humidity at the Tenas Deposit Station for October 2017 to September 2022

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Table 2-15: Tenas Deposit Monthly Average Relative Humidity [%]

Year	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2017	Max										94.9	95.4	93.1	95.4
	Avg										80.8	83.2	90.0	88.3
	Min										72.0	65.6	83.5	65.6
2018	Max	95.5	91.5	91.4	85.9	82.9	84.7	78.9	72.5	94.2	89.5	99.6	96.1	99.6
	Avg	92.0	83.2	76.8	63.9	59.6	63.2	58.2	51.6	78.3	75.5	96.0	91.3	74.1
	Min	87.5	72.3	59.9	42.9	37.9	42.8	38.8	32.0	59.2	59.6	89.7	84.9	32.0
2019	Max	96.7	86.8	77.7	84.9	82.4	90.3	93.9	90.7	93.9	98.1	97.4	94.8	98.1
	Avg	96.7	86.8	77.7	84.9	82.4	90.3	93.9	90.7	93.9	98.1	97.4	94.8	98.1
	Min	86.3	59.1	40.0	38.6	36.8	47.1	56.9	48.9	59.8	75.1	81.7	86.9	36.8
2020	Max	90.3	90.8	81.7	82.3	86.0	89.2	88.5	93.3	94.6	97.4	95.5	97.0	97.4
	Avg	85.6	76.9	62.9	58.3	60.4	68.9	70.4	76.4	81.1	88.5	89.2	91.6	75.9
	Min	79.3	61.3	43.8	36.9	36.5	47.4	51.8	56.9	63.6	75.4	80.0	83.6	36.5
2021	Max	95.0	90.5	92.3	78.6	90.6	88.6	91.3	91.4	95.9	96.3	97.4	89.0	97.4
	Avg	89.6	83.7	74.1	56.8	67.4	66.2	69.7	68.8	81.7	83.7	90.3	83.5	76.3
	Min	82.4	75.0	53.7	35.5	45.6	43.2	48.6	46.6	61.7	66.8	78.6	77.4	35.5
2022	Max	92.4	94.1	94.8	88.7	93.6	94.3	92.3	91.8	96.9				96.9
	Avg	84.9	82.0	74.1	64.8	69.8	71.2	70.4	70.6	76.7				73.8
	Min	75.8	67.9	49.6	41.1	44.3	48.2	48.7	49.8	52.1				44.1

*Light grey denotes no measurements.

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Regional

Hourly relative humidity recorded at the Smithers Airport station was evaluated for the period of record (1953-2023) and the monthly average values are presented in Table 2-16. Patterns in relative humidity were similar to what was observed at the Tenas Deposit Station.

Table 2-16: Average Monthly Relative Humidity [%] at Smithers A Location

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average (%)	83.3	79.3	71.6	63.8	62.2	66.4	69.8	73.4	80.2	82.2	85.8	85.0	75.2

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Evaporation_1CT027.003_rev01.Rmd

Monthly relative humidity values were compared between October 2017 and September 2022 and are shown in Figure 2-16, where the red line represents the identity function. Based on these records, the Smithers Airport station relative humidity is generally lower than at the Tenas Deposit Station.

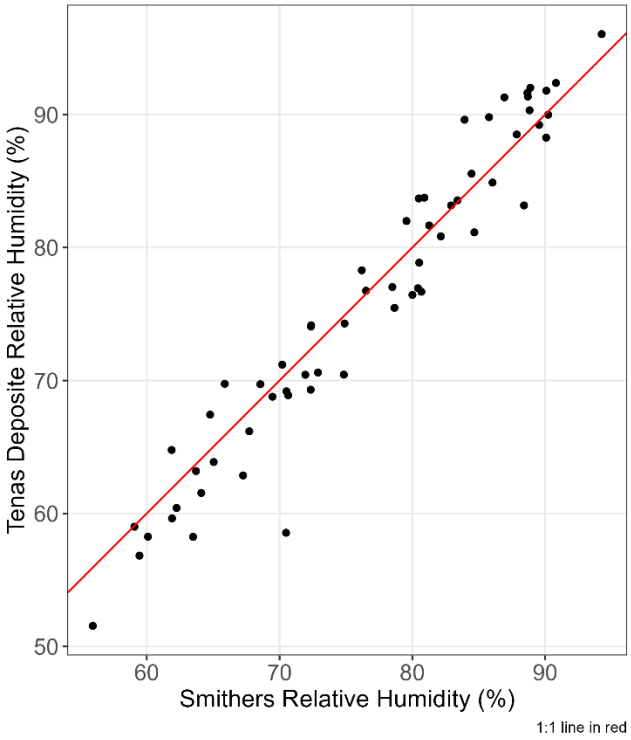


Figure 2-16: Monthly Average Relative Humidity at Smithers Airport Station and Tenas Deposit Station for October 2017 to September 2022

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

2.3.7 Evaporation

Project

Open water evaporation is an important component of the water balance for the Project area. Since the initial EAC application (Aug 2022), new pan evaporation data from site has become available from 2019 and 2022 readings. Daily records are illustrated in Figure 2-17. The monthly total evaporation values are summarized in Table 2-17 showing only complete months of data (August 2019 and June-September 2022).

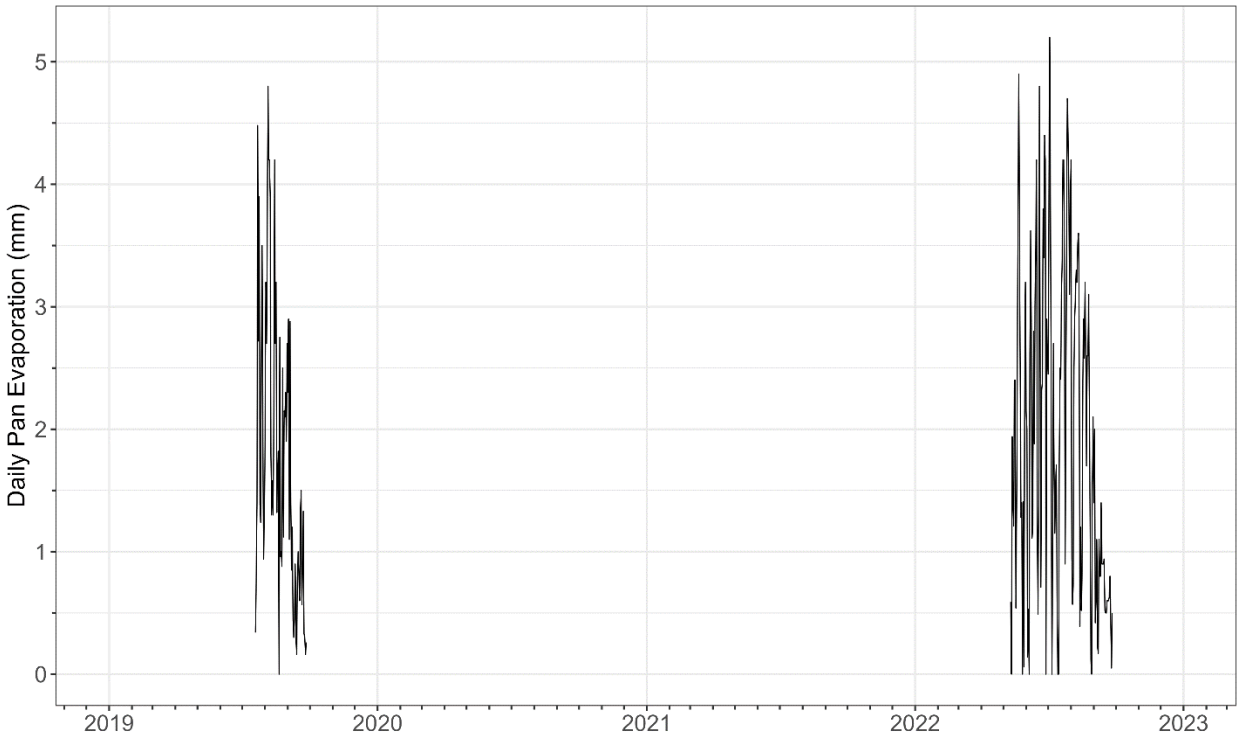


Figure 2-17: Daily Pan Evaporation at the Tenas Deposit Station for July 2019 to September 2022

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Table 2-17: Monthly Pan Evaporation at the Tenas Deposit Station for July 2019 to 2022 [mm]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019								72.0				
2022						68.9	79.4	65.2				

*Light grey denotes no measurements.

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Regional

Two approaches were used in order to evaluate open water evaporation: (1) Penman (Penman, 1948) and (2) Morton CRWE (Morton, 1983) approaches. The Penman and Morton CRWE approaches were applied to three datasets to estimate mean daily potential evaporation and then subsequently compared to the Topley Landing pan evaporation measurements (adjusted to represent lake evaporation). The three datasets are: (1) patched regional data (Smithers Airport Station), (2) patched Project data (Tenas Deposit Station) and (3) derived Project data based on reanalysis and regional datasets. Monthly average lake evaporation results are presented in Figure 2-18.

The Penman formula is a semi-empirical equation that incorporates energy budget and mass transfer approaches to estimate daily potential evapotranspiration or open water evaporation. Open water evaporation E_0 (in mm/day) is calculated according to the formula:

$$E_o = \frac{\left(\frac{\Delta}{\gamma} H + E_a\right)}{\frac{\Delta}{\gamma} + 1}$$

Where $\frac{\Delta}{\gamma}$ is an empirical parameter dependent on temperature, H is calculated based on incoming solar radiation, outgoing radiation, albedo of the open water surface and the proportion of cloudiness.

E_a is calculated semi-empirically as well using windspeed, and vapour pressure.

The Morton CRWE formula generates an estimate of monthly potential evaporation using the input parameters in Table 2-18.

Table 2-18: Morton CRWE Evaporation Formulation Input Parameters

Parameter	Description	Value
T_{max}, T_{min}	Timeseries of daily maximum and minimum project temperatures	See Section 2.3.1, 4.2.2
RH_{max}, RH_{min}	Timeseries of daily maximum and minimum project relative humidity	See Section 2.3.6, 4.1
T_{dew}	Timeseries of daily project dew point temperature.	Computed with the Magnus Formula (Magnus, 1844)
Rs	Timeseries of daily project solar irradiance	See Section 2.3.5, 4.2.5
epsilon	Surface emissivity (Morton, 1986)	0.92

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\Rwork\Telkwa_EA_Evaporation_1CT027.003_rev01.Rmd

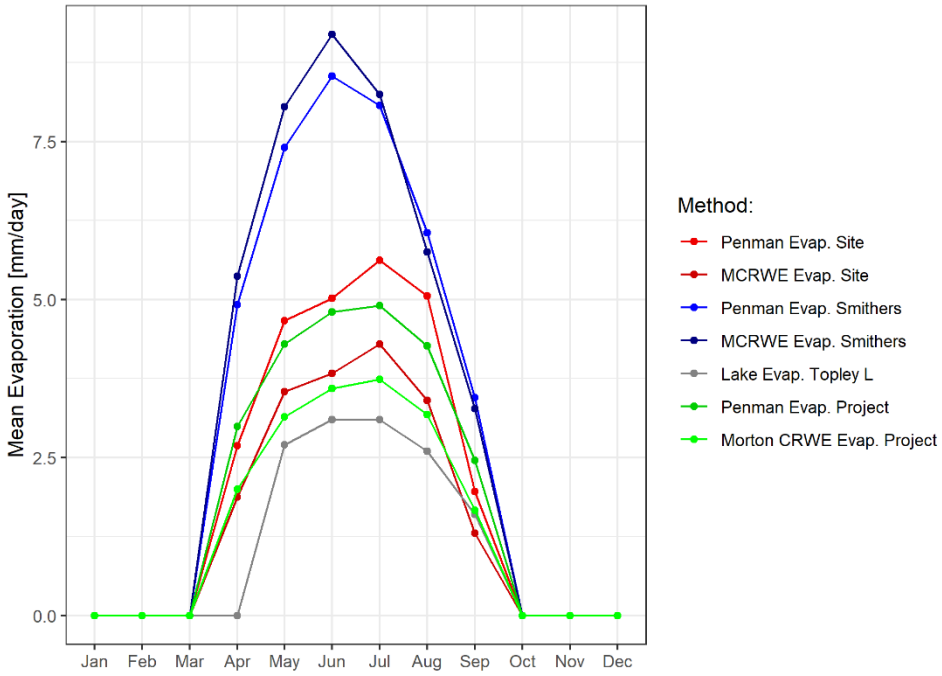


Figure 2-18: Estimated Monthly Average Lake Evaporation

The only regional station with evaporation measurements is Topley Landing, located 71 km northeast of the Project at an elevation of 722 masl. Mean annual lake evaporation at Topley Landing was 401 mm based on the 1981-2010 Canadian Climate Normals published by Environment Canada. Note that relative humidity and solar radiation are not measured at Topley Landing so the methods listed above could not be directly compared for Topley Landing.

3 Baseline Hydrology

3.1 Section Overview

The baseline characterization incorporates historical flow records from selected long-term Water Survey of Canada (WSC) stations as well as available data from local Project hydrometric stations.

Local data has been collected as part of the Tenas Project baseline monitoring program. Information from September 2017 to September 2018 is synthesized in the Tenas Project 2017 to 2018 Baseline Report (ERM 2019) with more recent information provided by ERM in the form of field reports. New hydrologic data has also been collected at Tenas-Hydro, and Four-Hydro stations between 2021 and 2022. Additional data collected by AGRA Earth and Environmental Ltd in 1997-1998 is presented in Attachment C.

Hydrometric records generated for the Project Area spanning 2017 to 2022 are shown in Section 3.2 for the open water period. Regional data for each Water Survey of Canada station are discussed in Section 3.2 and summarized in Section 3.3.

3.2 Available Hydrometric Data

3.2.1 Project Data

Catchment Delineations

Catchment areas were defined by ERM (ERM 2019) and verified by SRK. Project Area hydrometric stations as well as regional Water Survey of Canada stations are shown in Figure 3-1.

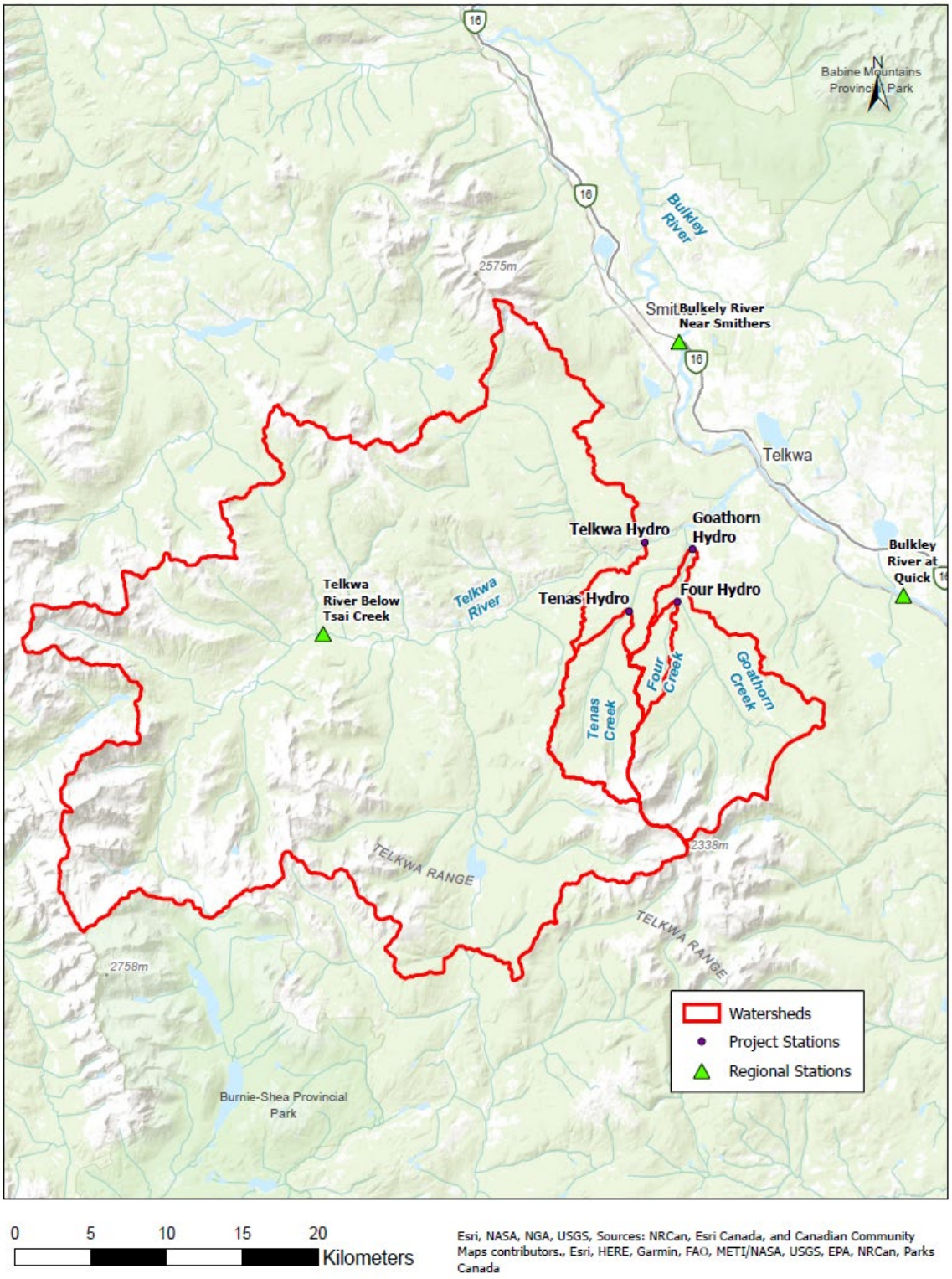


Figure 3-1: Map of Project Area With Project Hydrometric Station Catchments Delineated

Source: \\srk.ad\dfs\na\van\Projects \01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\!080_Deliverables\Hydromet Baseline Update\040_Figures\ Figure3.1_Hydrometric_Stations_20201023.jpg

Hydrometric Data

Historical hydrometric data was collected in 1997-1998 by AGRA Earth and Environmental Ltd for development of the Project Area by Luscar Ltd. Hydrometric spot measurements were collected at Four Creek and Tenas Creek and converted to continuous discharge for a subset of each open-water season. Four Creek data from this period was assessed in more detail than Tenas Creek records due to the short duration of data collected in 2020 by ERM.

Table 3-1 summarizes relevant information for each Project hydrometric station.

Recent rating curves and continuous discharge were developed for each hydrometric station by ERM (Figure 3-2). Additional details on the instrumentation and rating curve development is summarized in the 2017-2018 Baseline Report (ERM 2019). The Tenas-Hydro station was moved approximately 200 m upstream in 2018. Additional monitoring, rating curve development and analysis for 2019 hydrometric data was completed by ERM.

The Four-Hydro station was installed in April 2020. Monitoring of other local hydrometric stations in 2020 was not completed. Additional streamflow data were collected in Four Creek and Tenas Creek in 2021 and 2022.

Table 3-1: Summary of Project Area Hydrometric Stations Location and Measurement Information

Station Name	Longitude	Latitude	Average Catchment Elevation (masl)	Area (km^2)	Period of Measurement	Rating Curve Equation Q = C(h-a)b (developed at)	# of Manual Measurements
Telkwa-Hydro	54.65	-127.17	1,243	966.9	May 2017 – November 2019	C: 56.634 a: 97.955 b: 2.113 (March 2020)	8 (2017) 10 (2018) 6 (2019)
Tenas-Hydro & Tenas-Hydro B	54.62	-127.19	1,181	46.8 47.6	May 2017 – November 2022	C: 13.233 a: 97.21 b: 2.278 (October 2022)	5 (2017) 10 (2018) 6 (2019) 4 (2021) 9 (2022)
Goathorn-Hydro	54.65	-127.12	1,243	123.5	May 2017 – November 2019	C: 9.383 a: 98.18 b: 2.361 (March 2020)	9 (2017) 10 (2018) 6 (2019)
Four-Hydro	54.62	-127.14	985	11.0	April 2020 – November 2022	breakpoint at h = 99.330 for h ≤ 99.330 C: 36.987 a: 99.311 b: 1.964 for h > 99.330 C: 18.379 a: 99.246 b: 2.860 (October 2022)	8 (2020) 4 (2021) 9 (2022)

Source: Compiled in text. \\srk.ad\dfs\na\van\Projects \01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\!020_Project_Data\020_Client\20200312_HydrologyData_DFarmer\2.0 Rating Curves and Hydrographs

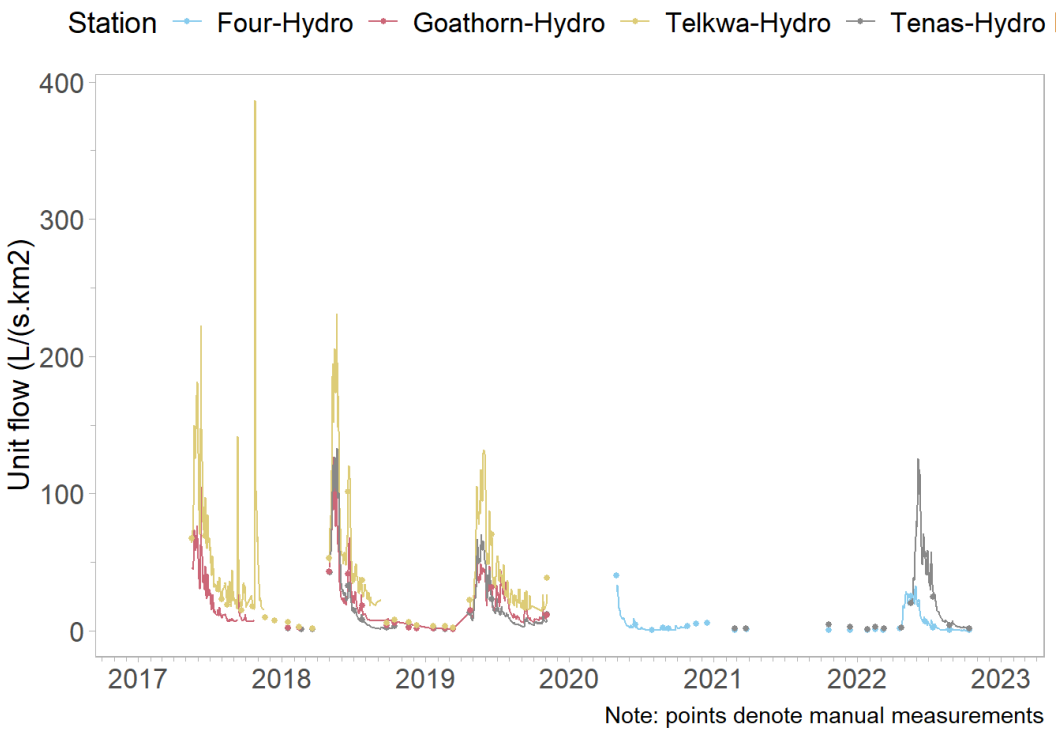


Figure 3-2: Available Streamflow Data Recorded at the Project Hydrometric Stations

Source: Compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

3.2.2 Regional Data

Water Survey of Canada (WSC) is the national authority responsible for the collection, interpretation and dissemination of standardized water resource data in Canada. Stations within the same BC hydrological zone were evaluated and additional selection criteria were subsequently applied.

Figure 3-1 illustrates the four regional WSC stations selected based on proximity to the Project hydrometric stations as well as for having similar flow regimes. These stations have more than 10 years of data and catchment areas ranging between 125 km^2 to 8,940 km^2. Table 3-2 summaries the metadata for these stations and the length of published historical record.

Table 3-2: Summary of Regional Hydrometric Stations

Station ID	Station Name	Longitude [°]	Latitude [°]	Area [km^2]	First Year	Last Year
08EE008	Goathorn Creek near Telkwa	54.65	-127.12	125	1960	2024[1]
08EE020	Telkwa River below Tsai Creek	54.61	-127.50	367	1975	2024
08EE004	Bulkley River at Quick	54.62	-126.90	7,340	1930	2020
08EE005	Bulkley River near Smithers	54.77	-127.13	8,940	1945	2023

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.002 2017-18 permitting Support (Phase 2)\0200_SurfaceWater\Hydrology\R files\Flows_update_rev02.Rmd

Notes:
1. Goathorn Creek near Telkwa (08EE008) was decommissioned in January 2018 and re-installed in October 2019.

Discharge from all four Water Survey of Canada regional stations (Table 3-2) followed a nival regime with an initial increase in discharge observed in April followed by annual maximum in response to snowmelt typically during May. Discharge responded to rainfall events throughout the summer and a recession to annual low flows was observable in the late fall and winter. The time series of each regional hydrometric station are shown in Figure 3-3, Figure 3-4 , Figure 3-5, Figure 3-6.

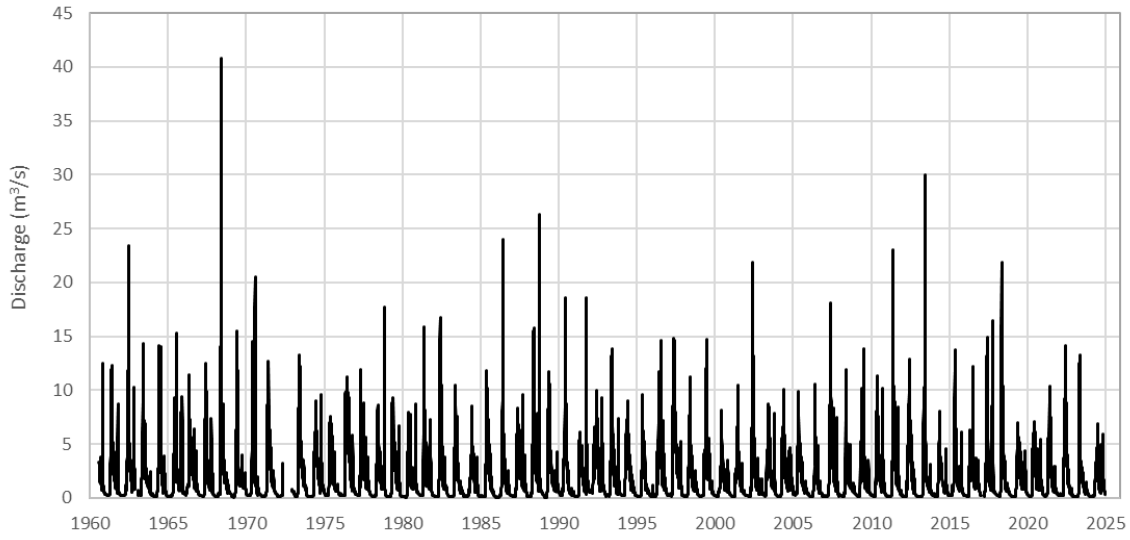


Figure 3-3: Goathorn Creek Near Telkwa (08EE008) Discharge data from 1960-2024

Source: NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

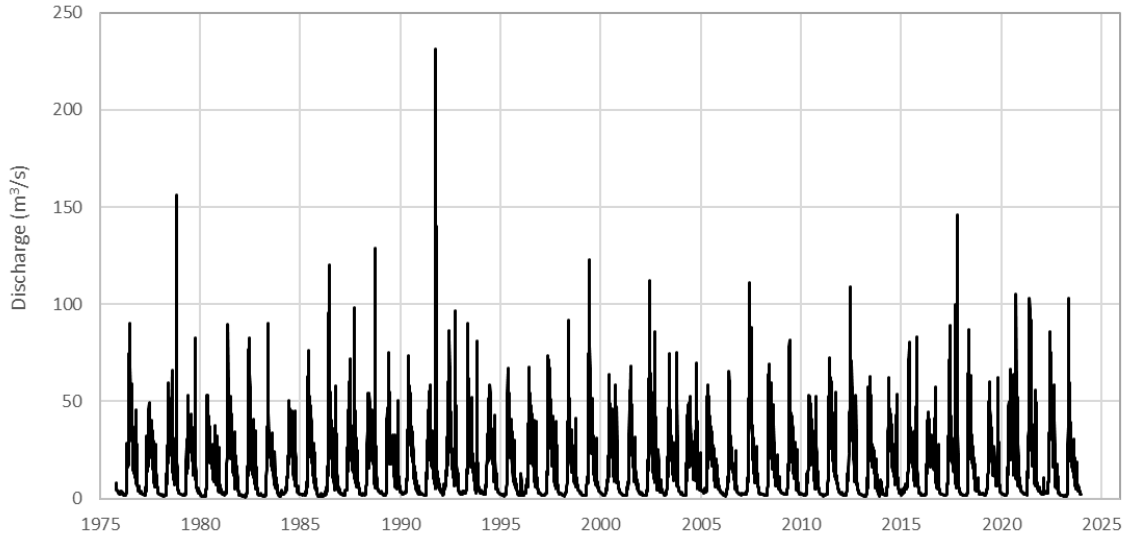


Figure 3-4: Telkwa River Below Tsai Creek (08EE020) Discharge from 1975-2023

Source: NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

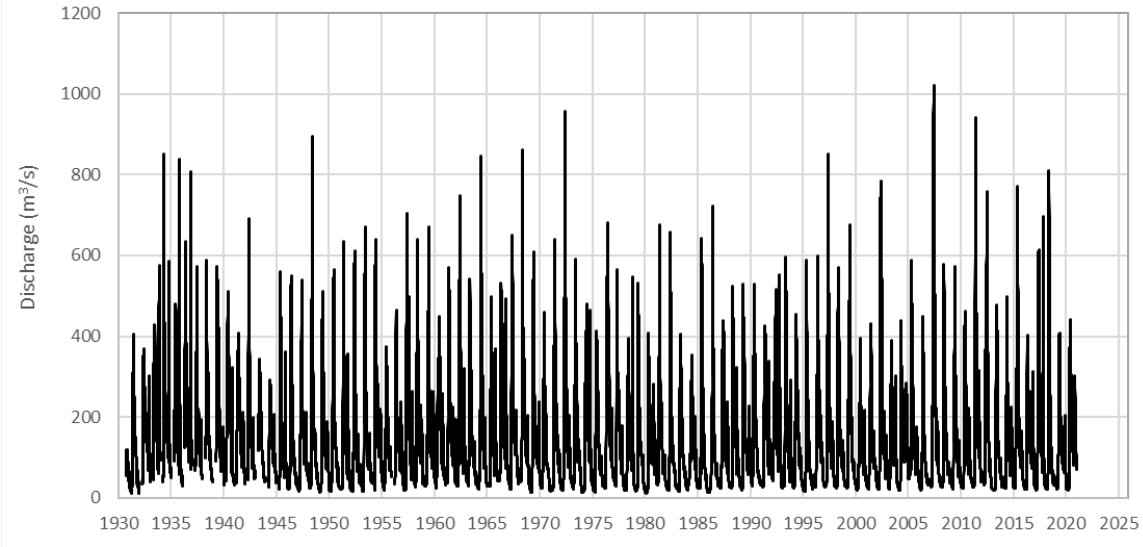


Figure 3-5: Bulkley River At Quick (08EE004) Discharge for 1930-2020

Source: NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

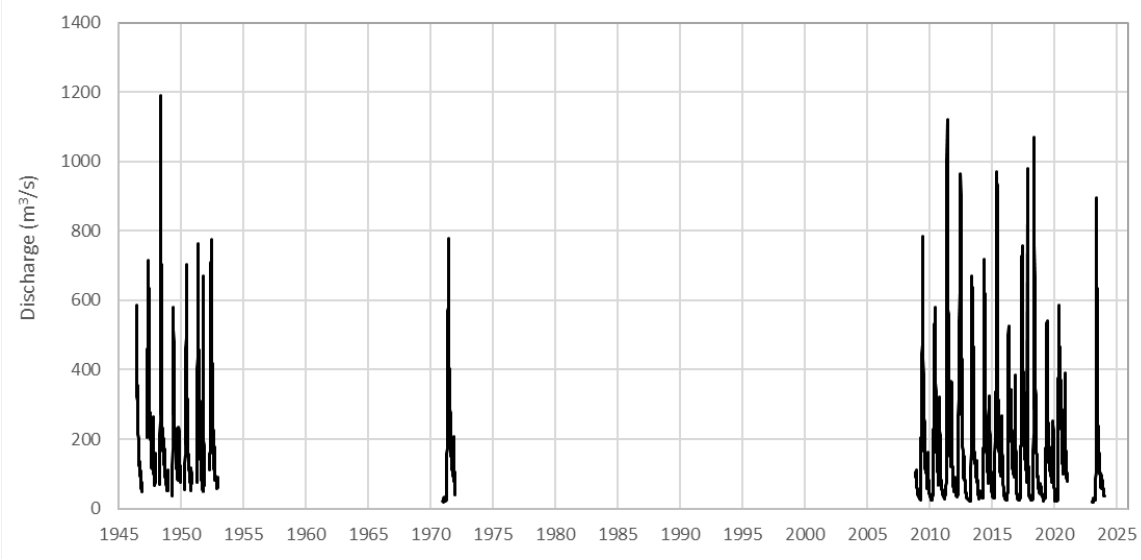


Figure 3-6: Bulkley River Near Smithers (08EE005) Discharge for 1945-2023

Source: NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

3.3 Summary of Available Data

3.3.1 Project Hydrometric Monitoring Data

Discharge

Historical Four Creek discharge data for 1997-1998 will not be presented in this section but is summarized in Attachment C. Continuous discharge was generated from water level measurements and rating curves developed for each Project Area hydrometric station for the open water period. Average monthly discharge are presented for each station in Table 3-3 and unit discharge values are presented in Table 3-4 by dividing monthly average flow by the associated catchment area (Table 3-1).

Table 3-3: Average Monthly Discharge for the Open-Water Period (m^3/s)

Station Name	Year	Apr[1]	May[1]	Jun	Jul	Aug	Sep	Oct	Nov[1]
Telkwa-Hydro	2017		121.0*	93.9	37.7	28.3	32.2	51.5	24.5*
	2018		135.5	66.1	34.7	22.3	20.2*	7.7*	5.9*
	2019	16.1*	84.9	56.1	36.3	23.2	18.8	16.5	20.5*
Tenas-Hydro	2017		4.0*	2.4	0.5	0.2*			
Tenas-Hydro B	2018		4.1	1.2	0.5	0.1	0.1	0.1*	0.1*
	2019	0.4*	2.2	1.3	0.6	0.3	0.3	0.3	0.3*
	2020								
	2021							0.2*	
	2022	0.1*	2.0*	3.3	1.2	0.3	0.1	0.1*	
	2017		7.3*	5.1	2.0	1.1	1.3	0.9	

Goathorn-Hydro	2018		8.7	3.7	2.2	1.0	0.9	0.8	0.6
	2019	1.3	4.6	3.3	3.4	1.3	1.3	1.1	1.2*
Four-Hydro	2020	0.321*	0.122	0.030	0.009	0.008	0.011	0.026	0.056*
	2021							0.006*	
	2022	0.118*	0.261	0.122	0.039	0.006	0.003	0.002*	

Source: NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

Notes:
1. Measurements in April, May and November were conducted on differing days per month between years and stations.
2. Light grey denotes no measurements.
3. Months with less than 20 measurements are marked with *

Table 3-4: Average Monthly Unit Discharge (L/s/km^2) for the Open-Water Period

Station Name	Catchment Area (km^2)	Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Telkwa-Hydro	966.9	2017		121.4*	94.2	37.8	28.4	32.3	51.6	24.5*
		2018		135.9	66.3	34.8	22.4	20.3*	7.7*	5.9*
		2019	16.1*	85.1	56.3	36.4	23.3	18.8	16.5	20.5*
Tenas-Hydro & Tenas-Hydro B	46.8 47.6	2017		85.3*	50.3	11.5	5.2*		5.5	5.3
		2018		86.6	25.3	9.9	2.9	1.9	2.6*	2.6*
		2019	9.2*	45.7	26.4	12.9	5.4	5.3	6.0	7.0*
		2020								
		2021							4.3*	
		2022	2.0*	41.0*	70.3	26.0	6.3	3.1	2.0*	
Goathorn-Hydro	123.5	2017		59.0*	41.3	16.3	9.0	10.5	7.2	
		2018		70.4	30.0	17.5	8.0	7.7	6.6	4.9
		2019	10.6	37.2	26.9	27.3	10.5	10.3	9.0	9.9*
Four-Hydro	11.0	2020	29.2*	11.1	2.7	0.8	0.7	1.0	2.4	5.1*
		2021							0.5*	
		2022	10.7*	23.7	11.1	3.6	0.6	0.3	0.2*	

Source: NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

Notes:
1. Light grey denotes no measurements.
2. Months with less than 20 measurements are marked with *

Low Flows

Low flows are critically important parameters due to their low dilution capacity as well as the implications for biological organisms. Low flow statistics are based on available records to estimate the lowest flow within a watercourse over some period of time. Low flow statistics are expressed as an averaging period (e.g., 7 day average) over a recurrence interval where 10 years is common for hydrologically-based flows (7Q10). A low flow calculation requires several years of record as a distribution model (i.e, Log Pearson Type III) is applied to the collected lowest flow event from each year of record. The short length of the Project Area hydrometric records does not allow for a 7Q10 calculation. Low flows were therefore conservatively estimated as the minimum daily average flow for each month for each station (Table 3-5).

Table 3-5: Minimum Instantaneous Discharge (m^3/s)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Telkwa-Hydro	2017					63.7[1]	59.7	24.4	18.0	16.1	15.6	9.8[1]	7.5[2]	7.5
	2018	6.5[2]	2.5[2]	1.7[2]		49.5	34.6	24.7	18.2	5.6[1]	7.7[2]	5.9[2]	4.1[2]	1.7
	2019	3.2[2]	3.4[2]	2.4[2]	13.5[1]	15.9	30.8	21.3	16.5	15.1	14.3	18.0[1]		2.4
Tenas-Hydro & Tenas-Hydro B	2017					54.6[1]	19.4	7.3	3.7[1]		5.5[2]	5.3[2]	3.2[2]	3.2
	2018	1.7[2]	1.2[2]	1.1[2]		34.3[1]	13.4	5.7	1.5	1.2	1.6[1]	2.6[2]	1.4[2]	1.1
	2019	1.3[2]	0.8[2]	0.7[2]	7.4[1]	8.7	12.6	9.2	3.3	2.6	3.8	6.1[1]		0.7
	2020													
	2021		1.4[2]	1.4[2]							4.3[2]		2.5[2]	1.4
	2022	1.2[2]	2.8[2]	1.6[2]	2.0[2]	19.5[1]	39.9	10.0	4.0	2.1	1.7[1]			1.2
Goathorn-Hydro	2017					44.5[1]	23.7	10.8	6.8	6.9[1]	6.8[1]			6.8
	2018	2.4[2]	2.0[2]			23.8	18.6	11.4	7.6	7.4	5.8	4.1	2.5	2.0
	2019	1.3	1.2	1.0	7.3	11.2	14.5	17.5	6.5	5.7	6.1	8.6[1]		1.0
Four-Hydro	2020				29.2[2]	2.7	0.9	0.2	0.2	0.4	1.6[1]	5.1[2]	5.5[2]	0.2
	2021		0.7[2]	1.1[2]							0.5[2]		0.7[2]	0.5
	2022	0.3[2]	1.1[2]	0.5[2]	1.5[1]	18.8	3.8	0.7	0.2	0.1	0.1[1]			0.1

Source: NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

Notes:
[1]Incomplete month.
[2]Single measurement.
*Light grey denotes no measurements.

3.3.2 Regional Hydrometric Records

Discharge

Discharge data from Water Survey of Canada compiled for each station was summarized as average monthly and annual discharge for the four regional hydrometric stations (Table 3-6).

Table 3-6: Average Monthly and Mean Annual Discharge (m^3/s)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Goathorn Creek near Telkwa (08EE008)	1960-2024	0.2	0.2	0.2	1.1	5.1	5.2	3.2	1.7	1.3	1.4	0.9	0.4	1.7
Telkwa River below Tsai Creek (08EE020)	1975-2023	2.6	2.2	2.1	5.3	27.6	41.0	30.8	21.3	15.4	12.6	7.0	3.4	14.3
Bulkley River at Quick (08EE004)	1930-2020	38.3	31.1	29.2	87.6	315.5	365.1	230.2	142.4	101.4	110.0	102.7	59.2	134.4
Bulkley River near Smithers (08EE005)	1946-2023	35.9	30.9	35.0	129.9	454.7	447.0	260.9	156.0	116.4	124.1	112.9	63.5	163.9

Source: NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

Unit Discharge

The monthly average discharge for each regional station was converted to unit discharge, which normalizes discharge per unit area of the catchment (Table 3-7).

Table 3-7: Average Monthly and Annual Unit Discharge (L/s/km^2)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Goathorn Creek near Telkwa (08EE008)	1960-2024	0.3	1.4	1.6	9.1	40.8	41.6	25.5	13.4	10.0	10.9	7.2	2.9	13.7
Telkwa River below Tsai Creek (08EE020)	1975-2023	0.7	5.9	5.7	14.3	75.3	111.6	83.9	57.9	42.0	34.3	19.2	9.3	38.3
Bulkley River at Quick (08EE004)	1930-2020	5.2	4.2	4.0	11.9	43.0	49.7	31.4	19.4	13.8	15.0	14.0	8.1	18.3
Bulkley River near Smithers (08EE005)	1946-2023	0.1	3.5	3.9	14.5	50.9	50.0	29.2	17.5	13.0	13.9	12.6	7.1	18.0

Source: NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

Lowest 7-Day Average Flow (7Q10)

For the regional records, the 7-day average flow that occurred (on average) once every 10 years was calculated for each regional hydrometric station (Table 3-8).

Table 3-8: 7Q10 Values for Regional Stations (m^3/s)

Station Name	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Goathorn Creek near Telkwa (08EE008)	0.1	0.1	0.1	0.1	1.0	2.1	1.2	0.7	0.5	0.4	0.2	0.1	0.1
Telkwa River below Tsai Creek (08EE020)	1.6	1.4	1.2	1.4	4.9	19.7	17.4	11.6	5.9	4.2	2.3	1.7	1.2
Bulkley River at Quick (08EE004)	19.1	17.2	16.2	18.2	77.0	196.9	127.9	84.6	59.3	48.8	36.4	24.7	15.1
Bulkley River near Smithers (08EE005)	26.1	23.5	22.4	23.7	129.8	214.2	141.4	90.0	65.2	50.2	39.5	30.5	22.9

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Flows_update_rev09.Rmd

4 Derived Project Parameters

4.1 Derived Meteorological Parameters

Due the the relatively short record of Tenas Deposit Station data, meteorological parameters for the Project are derived by adjusting the patched long-term datasets at Smithers Airport to the site, based on spatial and orographic gradients. Adjustment factors are derived based on trends in regional stations, or when these are not adequate, reanalysis datasets, as described in the following sections.

4.1.1 Air Temperature

Historical Smithers Airport monthly temperatures were compared to the reanalysis datasets for the same location. Of the reanalysis datasets investigated, the PRISM model was determined to provide the best fit for precipitation as described in Section 4.1.2. Figure 4-1 illustrates the monthly temperature regression between measured and modelled PRISM temperatures at the Smithers Airport Station. Given the good correlation, PRISM data for the Project at the Tenas Deposit Station was obtained and monthly correction factors relative to the Smithers Airport station were developed to account for orographic gradients and temperature inversion effects (Table 4-1).

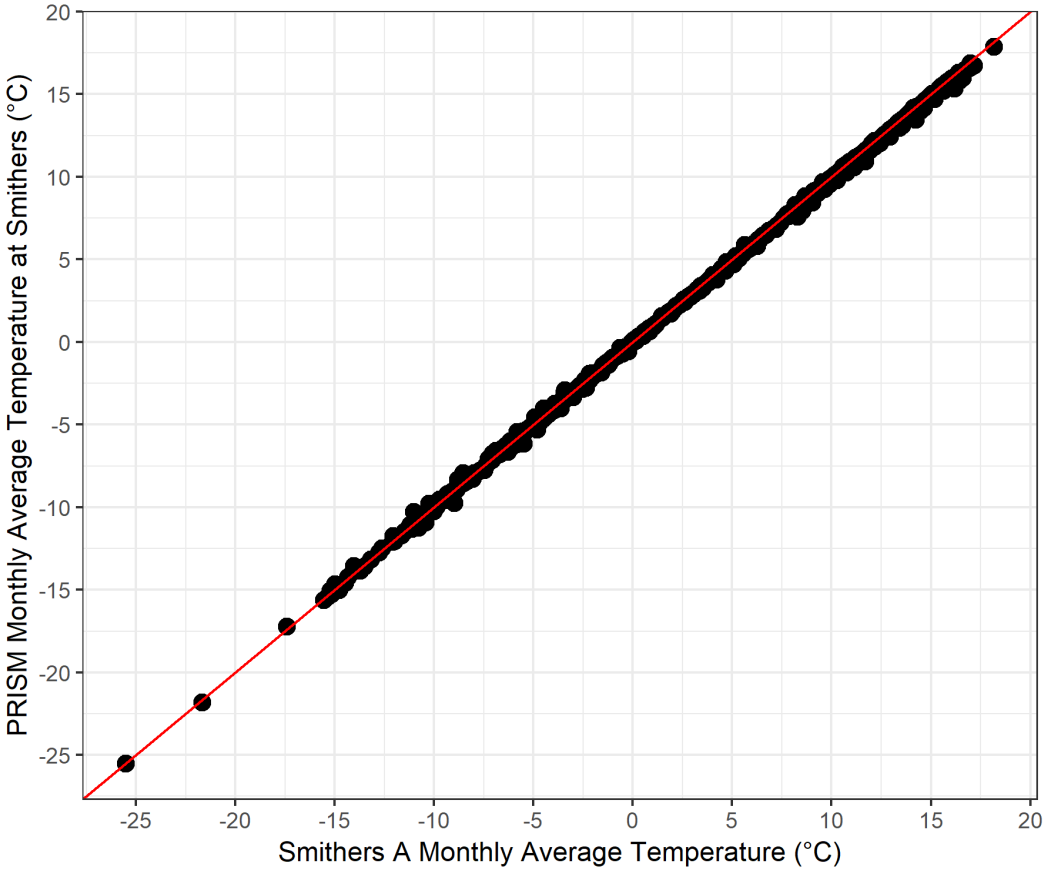


Figure 4-1: Smithers Airport vs PRISM Reanalysis

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\Rwork\Telkwa_EA_Temperature_1CT027.003_rev01.Rmd

Correction Factors and Expected Project Air Temperature

The correction factors presented in Table 4-1 were applied to the patched Smithers Airport Station temperature record to create a Project-adjusted long-term temperature record for design and modelling.

Table 4-1: Temperature Correction Factors

Month	Minimum Temperature			Average Temperature			Maximum Temperature		
	Smithers Airport (°C)	PRISM at Project (°C)	Absolute Temp. Ratio	Smithers Airport (°C)	PRISM at Project (°C)	Absolute Temp. Ratio	Smithers Airport (°C)	PRISM at Project (°C)	Absolute Temp. Ratio
January	-13.6	-13.5	1.000	-9.5	-9.9	0.998	-5.5	-6.3	0.997
February	-9.5	-10.2	0.997	-4.9	-6.0	0.996	-0.2	-1.7	0.994
March	-5.9	-7.6	0.993	-0.7	-2.8	0.992	4.5	2.0	0.991
April	-1.6	-3.3	0.994	4.3	1.9	0.991	10.1	7.1	0.989
May	2.5	0.3	0.992	8.9	6.3	0.991	15.4	12.3	0.989
June	6.0	4.4	0.994	12.5	10.4	0.992	19.0	16.3	0.991
July	8.1	6.5	0.994	14.7	12.6	0.993	21.1	18.6	0.991
August	7.5	6.1	0.995	14.1	12.1	0.993	20.6	18.1	0.991
September	3.9	2.9	0.996	9.8	8.1	0.994	15.7	13.4	0.992
October	0.1	-1.6	0.994	4.4	2.4	0.993	8.7	6.4	0.992
November	-5.6	-7.2	0.994	-2.5	-4.1	0.994	0.7	-1.1	0.994
December	-10.8	-11.2	0.998	-7.2	-7.9	0.998	-3.7	-4.5	0.997

Source compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\Rwork\Telkwa_EA_Temperature_1CT027.003_rev01.Rmd

Table 4-2 summarizes the expected monthly air temperatures at the Project and Figure 4-2 illustrates the modelled average monthly temperature compared to measured temperature at the Tenas Deposit Station.

Table 4-2: Expected Project Temperature Summary [°C] From Derived Long-term Time Series

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
Maximum	-5.8	-1.8	2.2	7.4	12.9	16.5	19.0	18.6	13.7	6.5	-0.8	-4.6	7.0
Average	-9.2	-6.1	-2.7	2.1	6.8	10.7	13.0	12.5	8.4	2.6	-3.8	-7.9	2.2
Minimum	-12.6	-10.4	-7.5	-3.1	0.8	4.7	6.9	6.4	3.1	-1.4	-6.8	-11.2	-2.6

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\Rwork\Telkwa_EA_Temperature_1CT027.003_rev01.Rmd

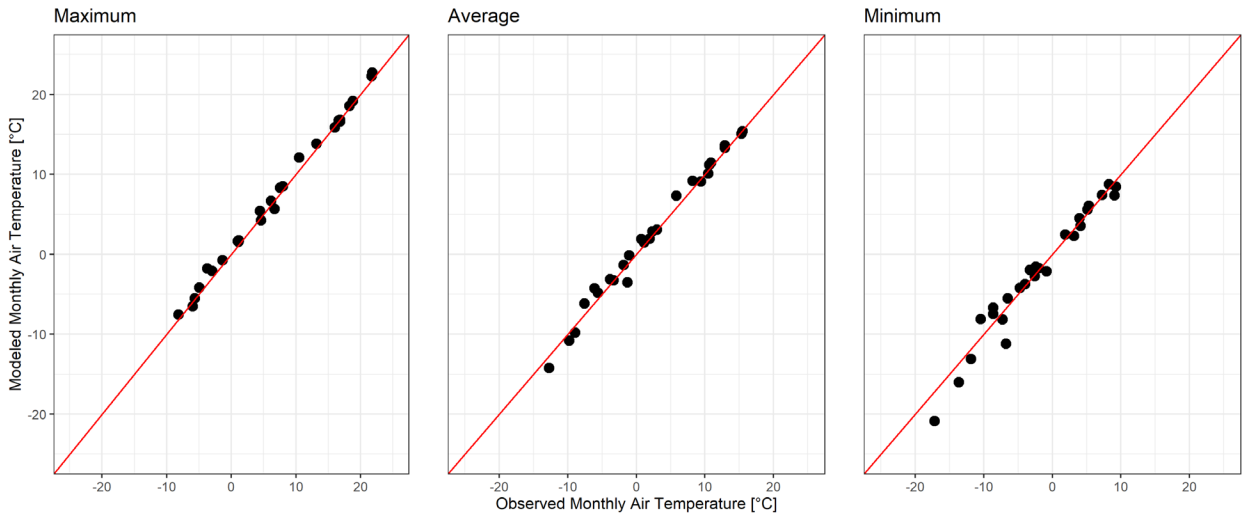


Figure 4-2: Comparison between Observed and Modelled Monthly Average Temperatures for October 2017 to December 2019

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Temperature_1CT027.003_rev01.Rmd

4.1.2 Precipitation

Figure 4-3 illustrates the monthly precipitation correlation between the 60 months of measured Project precipitation and patched precipitation records at Smithers for the overlapping period from October 2017 to September 2022. The total measured precipitation at the Tenas Deposit Station was approximately 34% greater than that at Smithers A over this period. The monthly precipitation difference ranged between -15 mm to +91 mm for Project data over the 60 months and suggests monthly correction factors are more appropriate to account for seasonality.

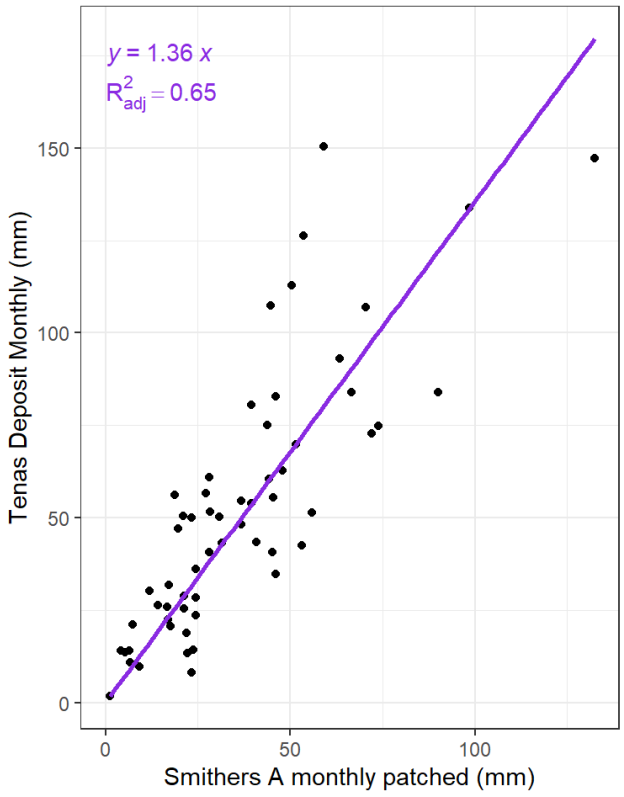


Figure 4-3: Comparison between Observed Total Precipitation at Tenas Deposit Station and Smithers A

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Typically, precipitation depths are expected to be greater at higher elevations. However, as previously demonstrated in Figure 2-10, there is a poor regional correlation between mean annual precipitation and elevation at the regional stations. Therefore, reanalysis datasets were evaluated against the patched Smithers A record to develop transposition factors to adjust the longer-term dataset to site (Table 4-3).

Table 4-3: Smithers A and Reanalysis Mean Monthly and Annual Precipitation Comparison [mm]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Smithers A (patched)	51	28	22	22	35	46	45	41	51	62	54	50	508
ERA 5	62	41	45	45	59	79	70	65	69	86	79	59	760
Merra 2	92	60	76	60	72	101	97	94	94	117	105	92	1059
PRISM	48	23	24	24	34	55	46	46	49	66	54	49	517

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Precipitation_1CT027.003_rev01.Rmd

The PRISM reanalysis data was found to best represent the spatial precipitation distribution across elevations. The PRISM mean annual precipitation for the region surrounding the Project, shown in Figure 4-4, demonstrates the spatial and orographic variability of precipitation in the region.

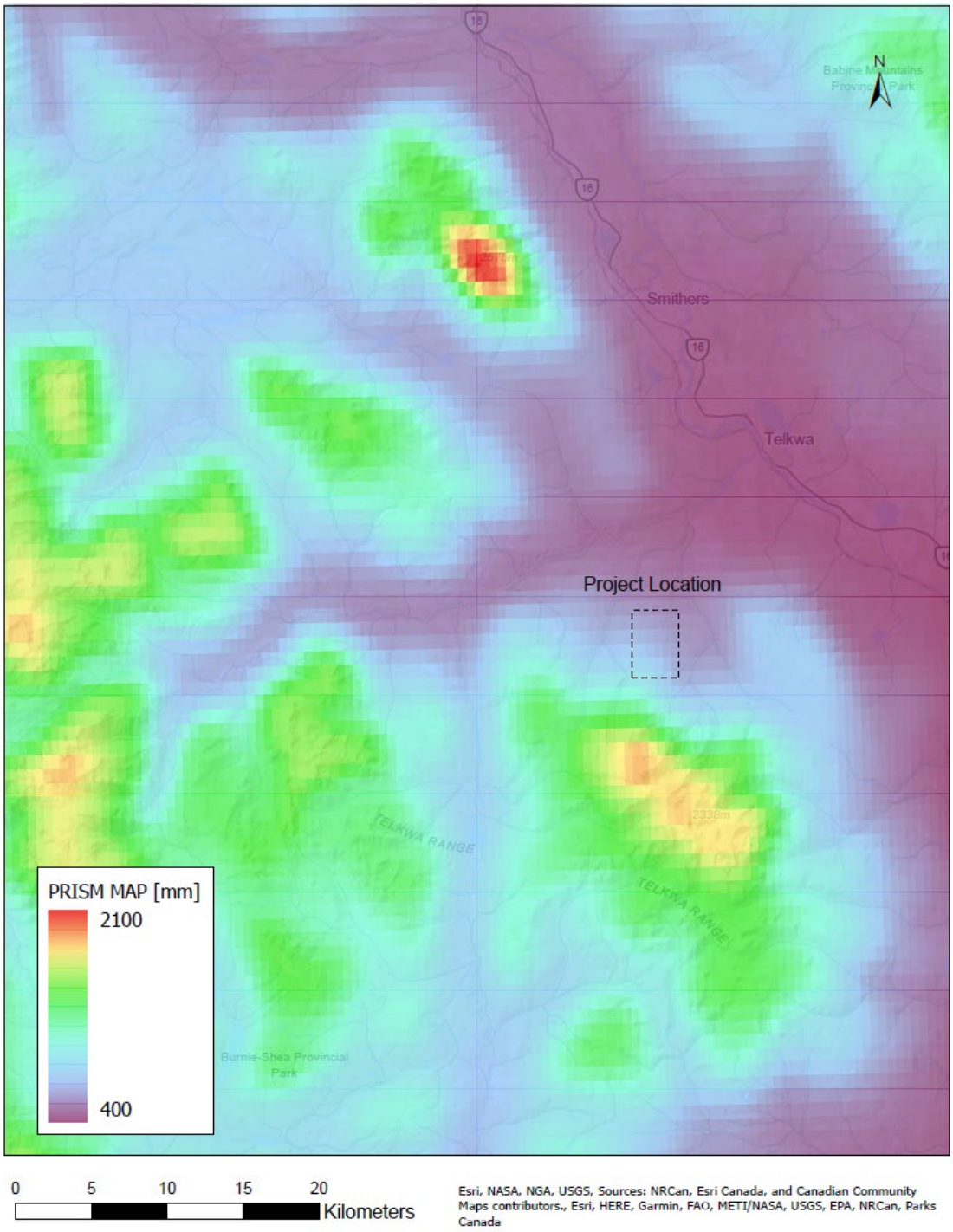


Figure 4-4: PRISM Mean Annual Precipitation in the project Area

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\!080_Deliverables\Hydromet Baseline Update\040_Figures\Figure4.4_PRISM_MAP.pdf

4.1.3 Synthetic Extended Project Precipitation

The Smithers A station record was gap-filled using the Smithers Airport Auto station. The Smithers A station was subsequently gap-filled using the Quick station and then a quantile-mapped ERA5 reanalysis product for the Smithers A location to generate a complete time series spanning 1946-2023. The 2017-2022 Tenas Deposit station records were assessed in relation to regional station records on a monthly and daily basis. This assessment was done for hourly, daily, and monthly precipitation totals as well as seasonally by lumping multiple months together. Ultimately, the gap-filled regional time series at Smithers A was adjusted to the Project area using the linear regression provided in Figure 4-3 developed from the monthly precipitation totals (R2 of 0.65). No bias correction was undertaken to avoid overfitting the data due to the length of the overlapping period.

Table 4-4 presents the monthly precipitation measured at the Tenas Deposit station relative to the monthly modelled precipitation using the linear regression with Smithers A.

Table 4-4: Total Precipitation Measured at Tenas Deposit Station and Modelled Precipitation using Linear Regression from Smithers Airport

Year	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2017	Total Measured Precipitation [mm]	M	M	M	M	M	M	M	M	M	147	134	10	291[1]
	Total Modelled Precipitation [mm]	-	-	-	-	-	-	-	-	112	180	134	12	439[1]
2018	Total Measured Precipitation [mm]	50	150	81	14	14	42	50	2	50	54	51	113	672
	Total Modelled Precipitation [mm]	42	81	54	7	32	72	28	2	32	54	76	69	549
2019	Total Measured Precipitation [mm]	60	19	8	13	26	57	83	21	47	93	73	22	522
	Total Modelled Precipitation [mm]	61	30	32	30	19	37	63	24	27	86	98	23	529
2020	Total Measured Precipitation [mm]	126	26	30	14	25	63	35	84	55	84	107	M	647[1]
	Total Modelled Precipitation [mm]	73	23	16	9	29	65	63	122	62	90	61	-	612[1]
2021	Total Measured Precipitation [mm]	M	M	12	14	56	51	61	24	75	31	107	29	460[1]
	Total Modelled Precipitation [mm]	-	-	33	6	26	39	38	33	100	23	96	29	423[1]
2022	Total Measured Precipitation [mm]	17	55	21	28	48	75	41	41	11	M	M	M	337[1]
	Total Modelled Precipitation [mm]	55	49	10	33	49	59	61	37	9	-	-	-	361[1]

Notes:
M denotes a month with greater than 10 (typically 20-25) days of missing data. – indicates that the synthetic data was removed over this period for meaningful comparison with measured Tenas Deposit data.

[1] Indicates that calculated annual total precipitation is for a partial year as one or more months had >10 days of missing data.

Source: compiled in text from \NA CAPR002055 Telkwa Project General EA Support - Internal\Surface Water IR Responses\Updated Responses_20230906\1CT027.003_Telkwa_ITT_SW_IRs_Round2_WaterBalanceOnly_20240603_njs_ccm df.docx

Finally, PRISM correction factors were applied to account for the elevation distribution across the Project Area. The correction factors are presented in section 4.2.5.

Table 4-5 summarizes expected average monthly precipitation at the Project based on the modelled time series. The mean annual precipitation (MAP) is estimated to be 675.9 mm which is approximately 19% greater than average precipitation recorded in the valley at the Smithers Airport station.

Table 4-5: Project Precipitation Summary [mm]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall	4.3	2.6	3.1	15.1	41.7	70.7	58.1	55.8	63.8	42.8	10.2	2.0	370.2
Snowfall	56.6	32.8	24.0	17.5	8.9	0.2	0.0	0.3	4.6	42.7	63.6	54.4	305.6
Total	60.9	35.4	27.2	32.6	50.5	70.9	58.1	56.1	68.4	85.6	73.8	56.4	675.9

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Figure 4-5 illustrates the average monthly precipitation as rain and snow. Precipitation typically falls as snow during the months of November to March. Annually, the average snowfall (306 mm) is approximately 45% of mean annual precipitation.

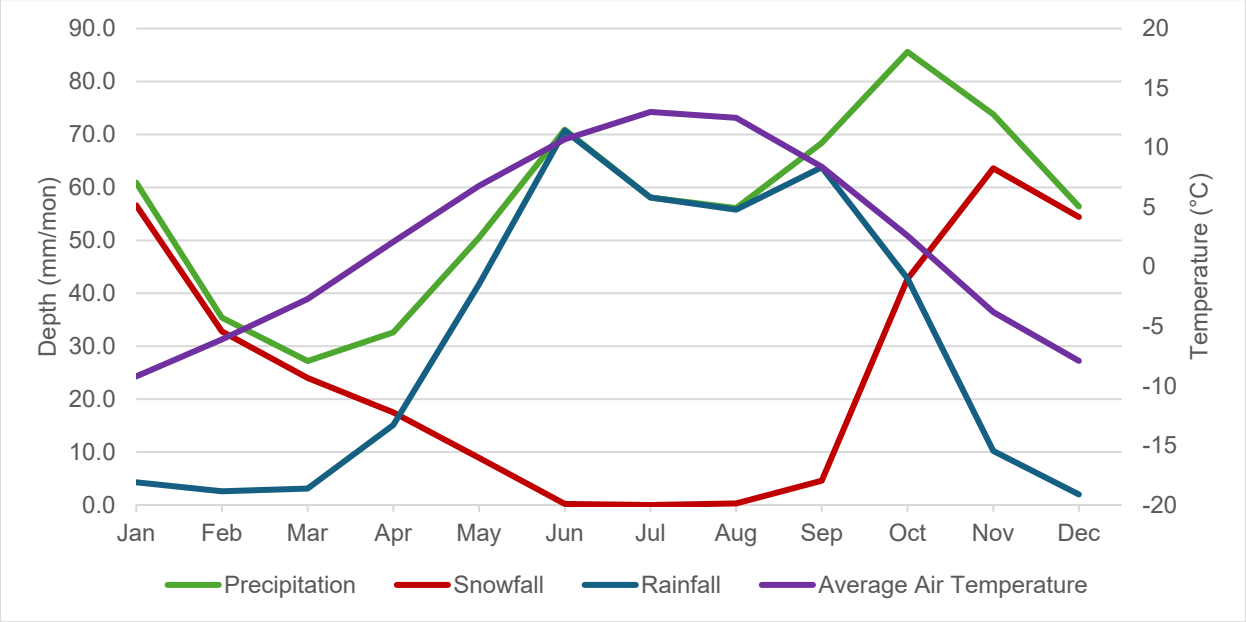


Figure 4-5: Monthly Precipitation as Snow and Rain

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\outputs\CAPR002055_average_climate_1981-2022.xlsx

4.1.4 Extreme Precipitation

4.1.5 Annual Frequency Analysis

A frequency analysis was performed using annual precipitation estimates derived from the long-term Project precipitation time series, developed using adjustments to Smithers Airport Station. The frequency analysis tested a range of probability distributions and found that a normal distribution provides the best fit to the long-term annual precipitation data for the Project.

The results of the annual frequency precipitation analysis are presented in Table 4-6 for extreme conditions ranging from a 1,000-year dry to a 1,000-year wet return periods.

Table 4-6: Annual Precipitation Frequency Analysis

Hydrological Condition	Return Period [years]	Annual Precipitation [mm]
Wet	1000	970.1
	500	950
	200	921.2
	100	897.4
	50	871.5
	25	842.6
	20	832.5
	10	798
	5	756.1
Mean Annual Precipitation (MAP)		676
Dry	5	595.8
	10	553.9
	20	519.4
	25	509.3
	50	480.4
	100	454.5
	200	430.7
	500	401.9
	1000	381.8

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

4.1.6 Short-Duration Extreme Precipitation

The annual maximum daily and 3-day precipitation depths were calculated following the Regional Frequency Analysis framework proposed by Hosking & Wallis (1997). This is a refined approach compared to local frequency analysis (one station) aimed to increase the accuracy of low probability events (e.g., 1,000-year precipitation), fundamental for engineering design and risk assessment. The RFA considered as homogeneous group the following stations:

Within the RFA framework, a range of probability distributions were tested and it was found that a Generalized Extreme Value distribution provided the best fit to both the 24-hour and 72-hour datasets.

Annual maximum 1-day and 3-day precipitations were converted to maximum 24-hour and 72-hour precipitation using a factor of 1.13 and 1.04, respectively (WMO, 2009).

Table 4-7 presents the 24-hour and 72-hour precipitation depths for a range of return periods based on the RFA of the long-term Project precipitation record.

Table 4-7: Extreme Project Precipitation for 24-hour and 72-hour Events

Return Period	24-hour Precipitation [mm]	72-hour Precipitation [mm]
2	41.7	56.2
5	54.8	73.8
10	64.9	87.4
25	79.4	107.0
50	91.7	123.6
100	105.3	141.9
200	120.5	162.4
500	143.2	193.0
1000	162.7	219.3

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

For durations less than 24-hours, the depth-duration-frequency curve data from the Smithers Airport station were obtained and modified to account for the 24-hour results presented in Table 4-7. Sub-daily annual maximum records from Smithers A stations were obtained from the IDF_CC Tool (Version 7.5). An IDF based on GEV distribution (Koutsoyiannis, Kozonis, & Manetas, 1998) was fitted to these records with the same shape parameter estimated in the regional approach described above for consistency. Frequency and duration factors were calculated based on the 24-hour precipitation depths for Smithers Airport, and were applied to the Project 24-hour depths presented in Table 4-7. Table 4-8 summarizes the baseline depth-duration-frequency curve for the Project.

Table 4-8: Project Baseline Precipitation-Duration-Frequency Curve

Storm Duration		Precipitation (mm)						
		Return Period (years)						
min	hours	2	5	10	25	50	100	200
5	0.08	3.5	4.7	5.5	6.7	7.8	9.0	10.2
10	0.17	4.8	6.3	7.5	9.1	10.5	12.1	13.8
15	0.25	5.7	7.5	8.9	10.9	12.6	14.4	16.5
30	0.5	7.7	10.2	12.0	14.7	17.0	19.5	22.3
60	1	10.5	13.7	16.3	19.9	23.0	26.4	30.2
120	2	14.1	18.6	22.0	26.9	31.1	35.7	40.8
360	6	22.8	30.0	35.5	43.4	50.2	57.6	65.9
720	12	30.8	40.5	48.0	58.7	67.8	77.9	89.1
1440	24	41.7	54.8	64.9	79.4	91.7	105.3	120.5
4320	72	56.2	73.8	87.4	107.0	123.6	141.9	162.4

Source: compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

4.1.7 Probable Maximum Precipitation

The probable maximum precipitation (PMP) was calculated using the Hershfield methodology (WMO 2009), and the Project-adjusted precipitation record. The Canadian Dam Association Guidelines (2007) recommends evaluating two Probable Maximum Floods (PMF):

Summer/autumn PMF, which is generated by the summer/autumn PMP

Spring PMF is defined as the maximum of two cases:

1. PMF computed with Spring PMP and snow accumulation with frequency of 100 year (Rainfall Dominated)
2. PMF computed with the Probable Maximum Snow Accumulation (PMSA) and a rainstorm with a frequency of 100 year (Snowmelt Dominated)

Two separate PMFs are estimated for the Spring season as it is not reasonable to assume that the PMSA and a Spring PMP, which are two independent phenomena, would occur simultaneously.

Based on the typical hydrograph for the Project (see Section , snow at the Project is expected to be present until as late as June.

Table 4-9 presents the Spring and Summer/Autumn PMPs for the Project where Spring was defined as April to June and summer was defined as July through October.

Table 4-9: Project 24-hour Probable Maximum Precipitation

Season	PMP (mm)
Spring	234
Summer/Autumn	283

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Precipitation_1CT027.003_rev01.Rmd

Results were verified using the British Columbia MetStorm Probable Maximum Precipitation webtool (DTN, 2020), which was developed in support of the BC Extreme Flood Project. This web-based tool provides an indication of potential precipititaion depths based on regionally available datasets at select points across the province. The maximum point PMP estimated from the webtool within the Project vicinity is 218 mm. The results in Table 4-9 are based on Project-specific precipitation datasets and present a more conservative PMP estimate. For this reason, the Project data were used for the purpose of infrastructure design.

4.1.8 Snow Depth and Snowmelt

The SNOW-17 snow accumulation and ablation model developed by the National Weather Service River Forecast System (NWSRFS) was implemented to model snowmelt for the Project. The main processes included in this model are dividing precipitation into rain or snow, accumulation of snowpack, energy exchange, heat deficit in the snowpack, ground melt and snowmelt as a snow water equivalent (Anderson 2006). Model inputs are average temperature and precipitation and input parameters to model a column of snow. The Project weather station recorded an accumulated depth of snow. Data collection at the Project did not include snow courses or snow density to convert snow depth to snow water equivalent (SWE) but regional estimates were used to check the SNOW-17 model accuracy.

Table 4-10 summarizes the model input parameters based on guidelines of initial estimates (Anderson 2002) and validation against the snow water equivalent records at Tsai Creek. Temperature and precipitation time series for the Tsai Creek elevation were developed using PRISM corrections. Figure 4 illustrates the measured and modelled snow water equivalent snow depths at Tsai Creek.

Table 4-10: SNOW-17 Model Input Parameters

Parameter	Description	Value
PXTEMP	Temperature threshold	Linearly interpolated between: 100% snowfall (and 0% rainfall) at 1.5 °C 0% snowfall (and 100% rainfall) at 5 °C
SCF	Loss coefficient during period of snow (i.e. sublimation)	1
UADJ	Average wind function during rain-on-snow events	0.04 mm/mbar/hr
MBASE	Temperature above which melt occurs	0 °C
MFMAX	Maximum melt factor	0.51 mm·°C·6hr^{-1}
MFMIN	Minimum melt factor	0.10 mm·°C·6hr^{-1}

Parameter	Description	Value
TIPM	Antecedent temperature index factor	0.1
NMF	Maximum negative maximum factor	0.25 mm·°C·6hr^{-1}
PLWHC	Percent liquid water holding capacity. Maximum amount of liquid water as a fraction of the ice portion of the snow	4%

Source: from snowmelt calibration model for Tsai Creek. \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\500_Water_Balance\Model\SnowmeltModel \ TsaiCreek_Snow17.gsm

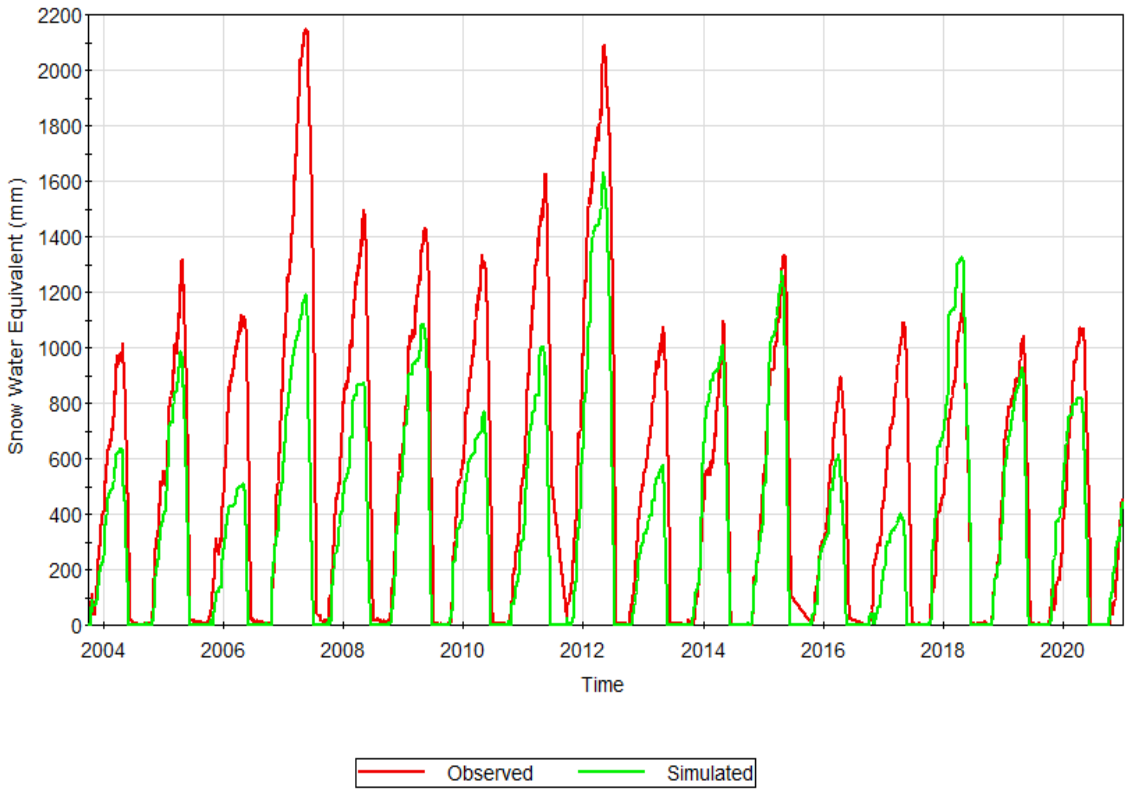


Figure 4-6: Tsai Creek Snowmelt Snow Water Equivalent Calibration

Source: from snowmelt calibration model for Tsai Creek. Z:\01_SITES\Telkwa Coal\1CT027.002 2017-18 permitting Support (Phase 2)\0200_SurfaceWater\Snowmelt Model\ TsaiCreek_Snow17.gsm

The validation with Tsai Creek suggests the snowmelt timing is well captured, with some understimations of maximum snowpack. This may be a result of inaccuracies in the precipitation record estimated for Tsai Creek. For the purpose of water management planning and design and water balance modeling, the SNOW-17 model and inputs were applied to the Project. Figure 4-7 illustrates the average snow water equivalent depths for the Project based on the adjusted precipitation and temperature records from 1942 to 2020.

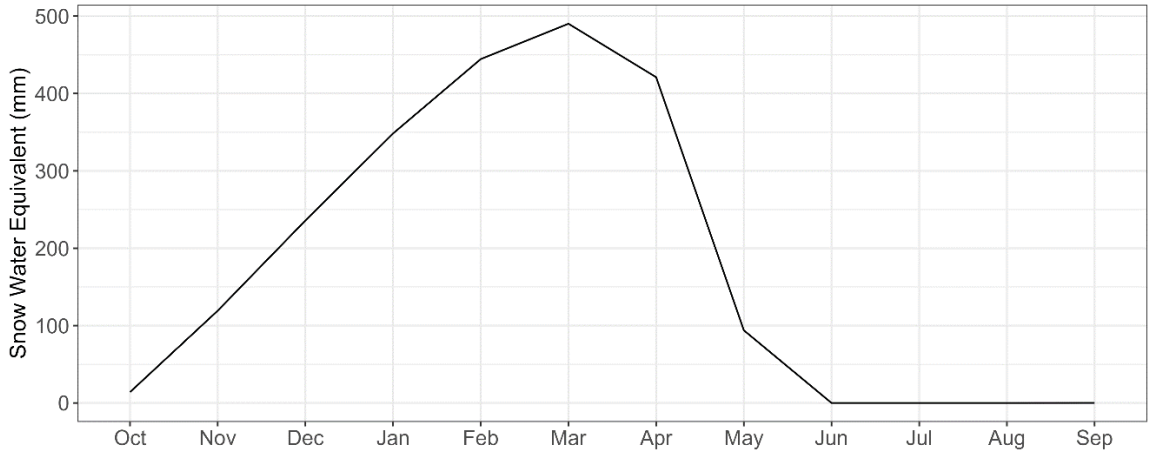


Figure 4-7: Project Snow Water Equivalent

Source: Compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

In addition to snow-water-equivalent, the snowmelt model produces a daily excess water term, which represents the sum of rainfall and snowmelt and can be interpreted as the daily depth of water available to generate runoff. Table 4-11 presents the monthly average excess water results for the Project, along with the monthly average distribution.

Table 4-11: Project Excess Water Monthly Average Summary [mm]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Total Excess Water	2	3	18	145	184	70	58	54	67	60	9	2	672
Monthly Excess Water Distribution	0%	0%	3%	22%	27%	10%	9%	8%	10%	9%	1%	0%	100%

Source: Compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

A frequency analysis was performed on the maximum 1-day and 3-day (72-hour) snow water equivalent results from the Project snowmelt model based on the adjusted record from 1981 to 2023. Results for return periods up to the 1000-year snowmelt event are presented in Table 4-12.

Table 4-12: Project Snowmelt Frequency Analysis

Return Period	24-hour Snowmelt [mm SWE]	72-hour Snowmelt [mm SWE]
2	34.0	57.5
5	43.3	73.3
10	50.9	86.1
25	62.8	106.4
50	74.0	125.4
100	87.7	148.5
200	104.4	176.8
500	132.4	224.3
1000	159.4	269.9

Source: Compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

4.1.9 Solar Radiation

Given the short period of record at the Tenas Deposit Station and large differences to Smithers Airport Station, the FAO model (Allen et al. 1998) was adopted to calculate historical baseline averages of solar radiation using the corrected temperature timeseries developed for the Project (Table 4-13). The appropriateness of the FAO model to approximate incoming solar radiation at the Tenas Deposit Station was illustrated from October 2017 to September 2022 in Figure 4-8.

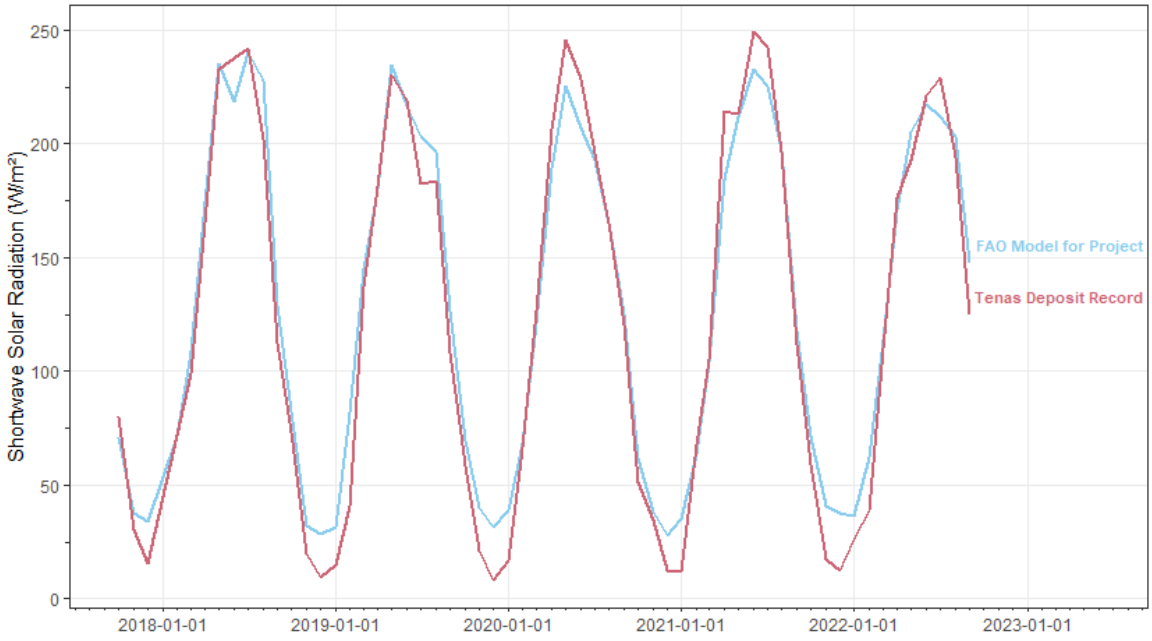


Figure 4-8: Solar Radiation – Modelled versus Measured (October 2017 to September 2022)

Source: Compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Table 4-13: Average Monthly Solar Radiation [W/m^2] at Project

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average	38	64	114	173	220	224	224	201	134	73	40	34	128

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Evaporation_1CT027.003_rev01.Rmd

4.1.10 Relative Humidity

Given the short period of record at the Tenas Deposit Station and the similarities observed between Smithers Airport Station records presented in Section 2.3.6, Smithers Airport station relative humidity was applied to the Project. Table 4-14 presents the monthly average relative humidity for the Project.

Table 4-14: Average Monthly Relative Humidity [%] at Project

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average (%)	83.6	79.3	71.2	63.3	61.3	65.7	68.8	72.1	79.5	82.1	85.9	85.4	74.8

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Evaporation_1CT027.003_rev01.Rmd

4.1.11 Evaporation

Large and shallow water bodies can experience direct water losses from evaporation. Lake surface evaporation for the Project was estimated using the Morton CRWE shallow lake evaporation method (Morton 1983). Table 2-18 summarizes the input parameters required for this method including the Project-specific solar radiation generated using the FAO model.

Based on the adjusted temperature record, modelled solar radiation and relative humidity and wind speeds from the Smithers Airport station, the estimated mean annual evaporation for the Project is 529 mm. Table 4-15 and Figure 4-9 demonstrate the mean open water evaporation rates for the Project. The potential evaporation estimates generated using the Morton CRWE results for the derived Project timeseries were closest to the Topley Landing Normals.

Table 4-15: Project Monthly Total Lake Evaporation [mm]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Evaporation	0	0	0	60	97	108	116	99	50	0	0	0	529

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Evaporation_rev02.Rmd

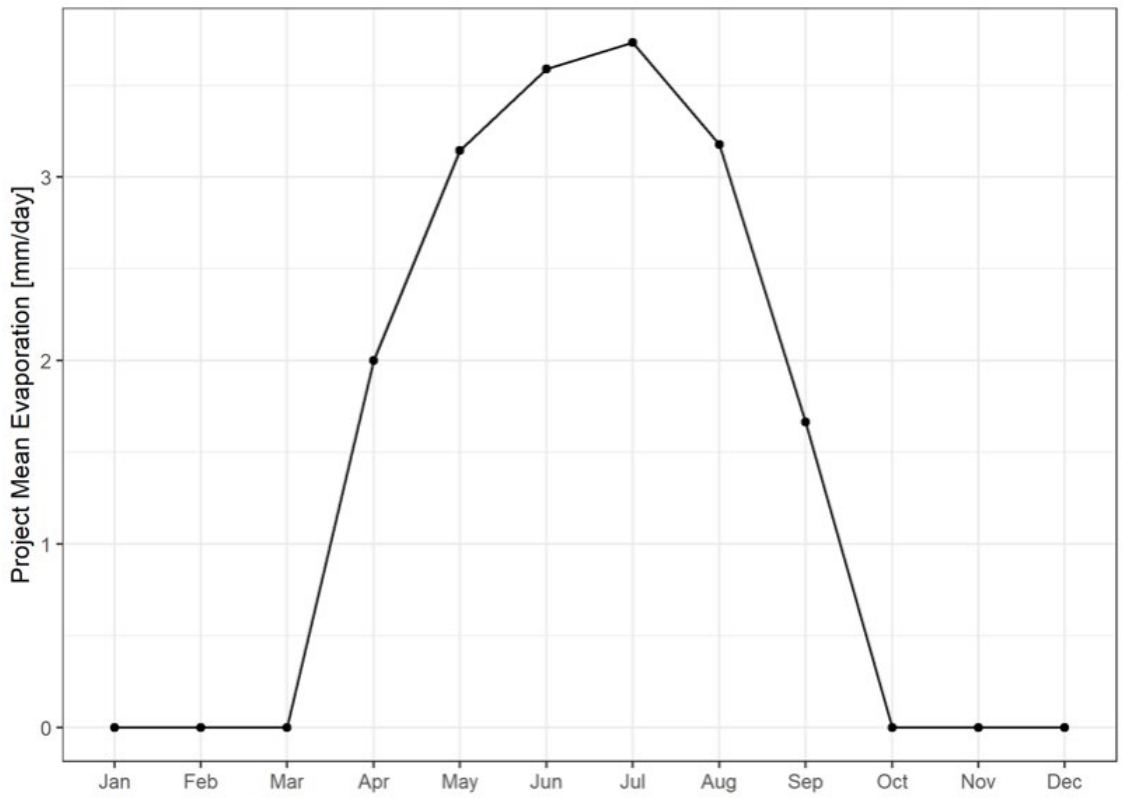


Figure 4-9: Mean Daily Open Water Evaporation Rates

Source: from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Evaporation_rev02.Rmd

4.2 Derived Hydrological Parameters

4.2.1 Time Series Comparison

Comparisons of the unit discharge at each Project hydrometric station with regional station data records led to pairing of the Project record with the most appropriate regional analogue (Table 4).

Regression approaches were used for the periods of overlap between each of the Project hydrometric stations and their respective regional analogue. In the case of Goathorn-Hydro, a catchment area scaling approach was used instead of regression methods. Time series of Project Area and regional station unit discharge records for Goathorn-Hydro and Goathorn Creek (08EE008), Telkwa-Hydro and Telkwa River (08EE020) Tenas-Hydro B and Goathorn Creek (08EE008), and Four-Hydro and Goathorn Creek (08EE008) are shown in Figure 4-10, Figure 4-11, Figure 4-12, and Figure 4-13, respectively. Additional comparisons for Four Creek based on 1999 baseline data are also described.

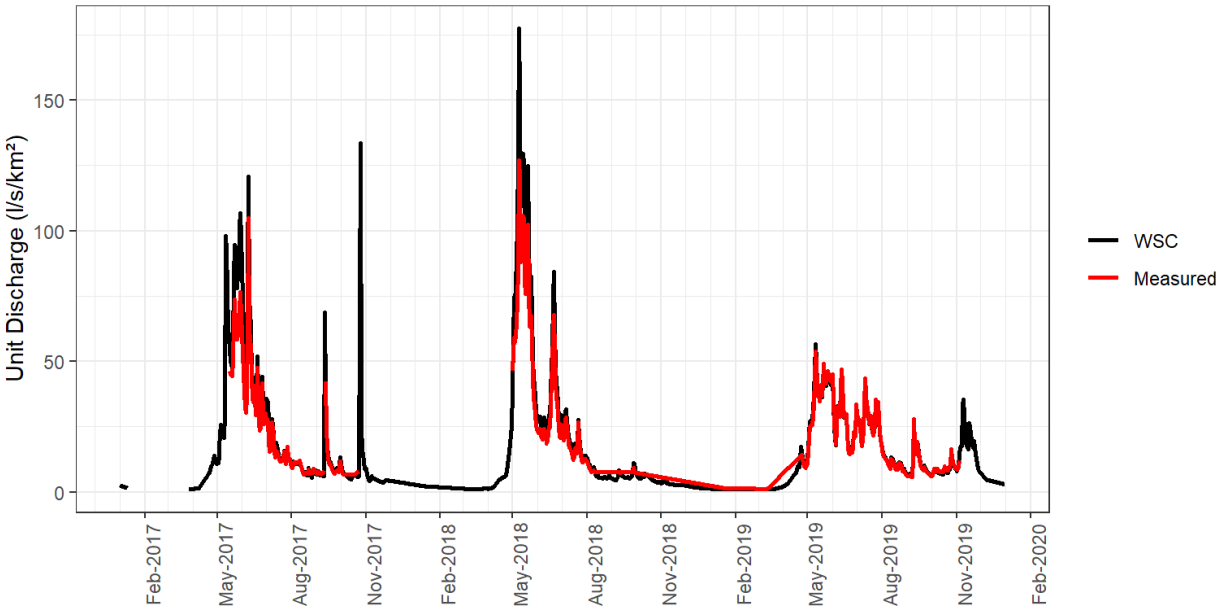


Figure 4-10: Project Hydrometric Station Goathorn-Hydro (red-Measured) and Water Survey of Canada Goathorn Creek Near Telkwa (08EE008) (black-WSC)

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

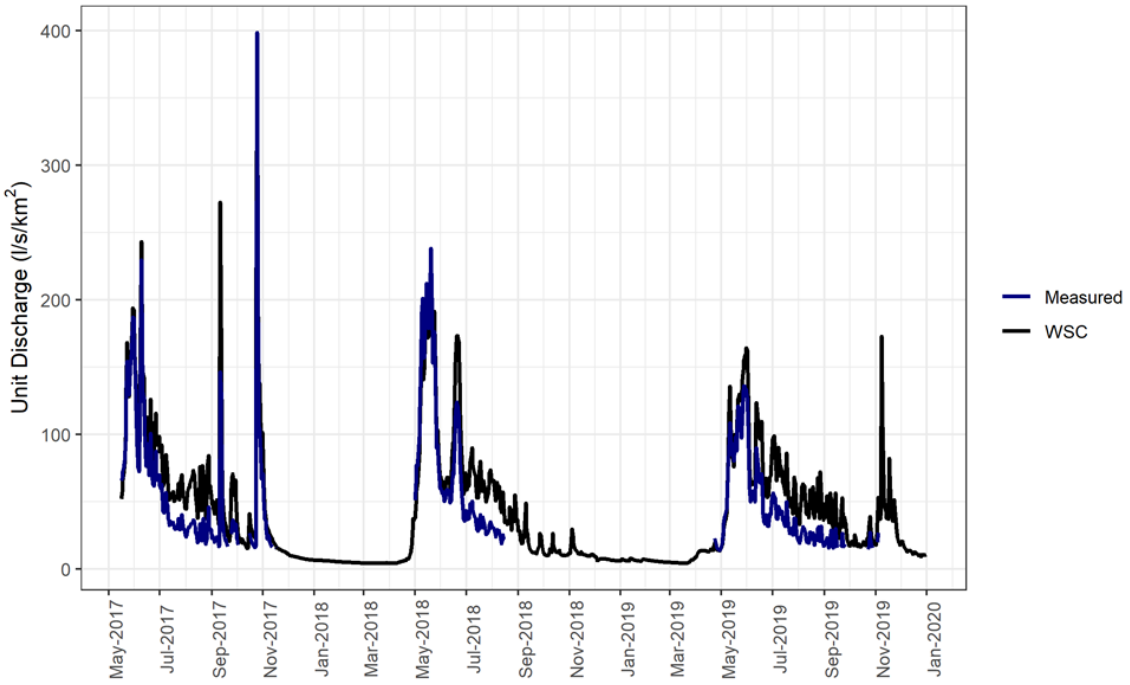


Figure 4-11: Project Hydrometric Station Telkwa-Hydro (blue-Measured) and Water Survey of Canada Telkwa River Below Tsai Creek (08EE020) (black-WSC)

Source: Compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\300_Hydrology_Update\Streamflow_regressions\Telkwa_flows.R

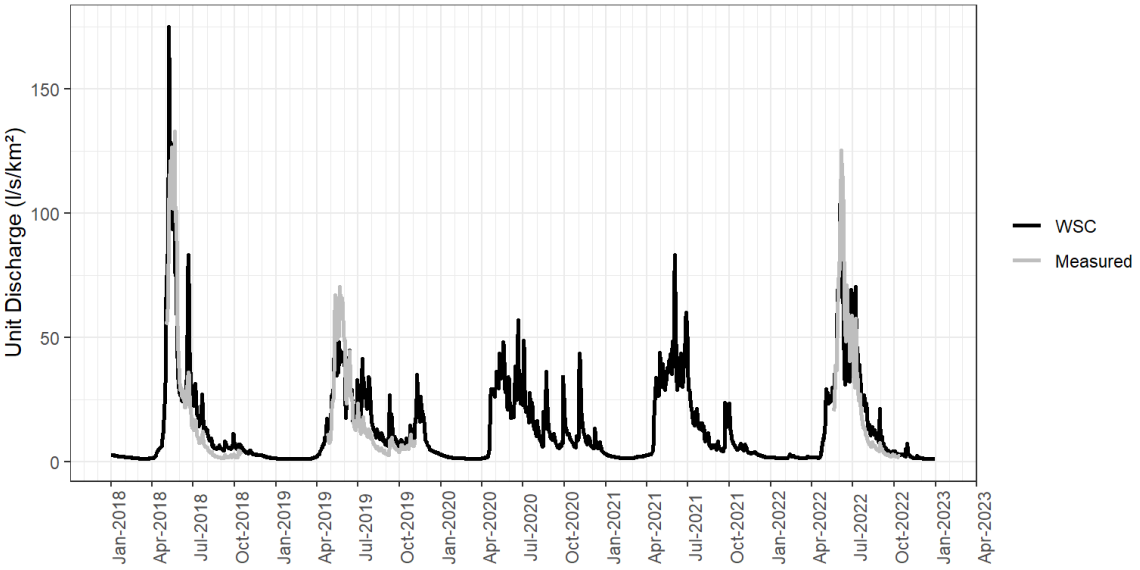


Figure 4-12: Project Hydrometric Station Tenas-Hydro B (grey-Measured) and Water Survey of Canada Goathorn Creek Near Telkwa (08EE008) (black-WSC)

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

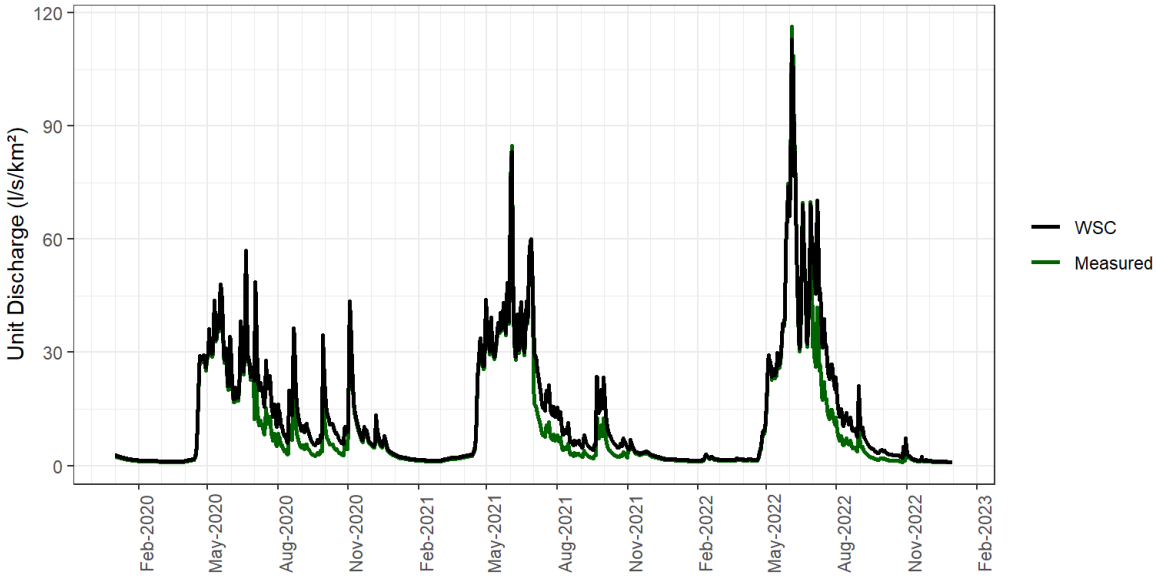


Figure 4-13: Project Hydrometric Station Four-Hydro (green-Measured) and Water Survey of Canada Goathorn Creek Near Telkwa (08EE008) (black-WSC)

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

A previous investigation into the hydrology of Four Creek was completed in 1997 (October to November) to 1998 (June to November) to support the Telkwa Coal Project 1999 Baseline Surface Flow and Water Quality Final Data Report (AGRA, 1999; Attachment A). The precise location of the AGRA hydrometric stations are not known, which limits the transferability of analyses using historical data. Based on the station descriptions in AGRA 1999, approximate locations were estimated and catchment areas were calculated.

Unit flows and monthly runoff rates were calculated based on assumed catchment areas and compared between Tenas, Four and Goathorn creeks, presented in Table 4-16 and Figure 4 and described in Attachment A and in tabular form in Attachment C. Runoff rates by month show a lower yield in Four Creek than in Tenas Creek, and higher rates in Goathorn Creek than in Tenas Creek during summer months of August and September. Unit flows in October 1997 show a storm response peak flow in all three streams, while 1998 records show a consistently lower yield in Four Creek than in Goathorn Creek.

Table 4-16: Comparison of Monthly Runoff Rates based on Hydrometric Data from AGRA 1999 at Goathorn, Tenas and Four Creeks (Attachment A, C)

Stream	Year	Runoff (mm/month)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tenas Creek	1997	ND	ND	ND	ND	ND	ND	ND	22	12	47	ND	ND
	1998	ND	ND	ND	ND	40	ND	ND	5	8	11	ND	ND
Four Creek	1997	ND	ND	ND	ND	ND	ND	ND	ND	ND	9	4	ND
	1998	ND	ND	ND	ND	ND	ND	3	1	1	2	ND	ND
Goathorn Creek	1997	4	5	5	49	166	142	88	54	32	46	16	6
	1998	3	3	4	28	145	68	50	25	16	27	12	6

Notes:
1. Monthly runoff is calculated for months containing greater than 25 days of runoff data
2. ND: No Data or less than 25 days with data in a month

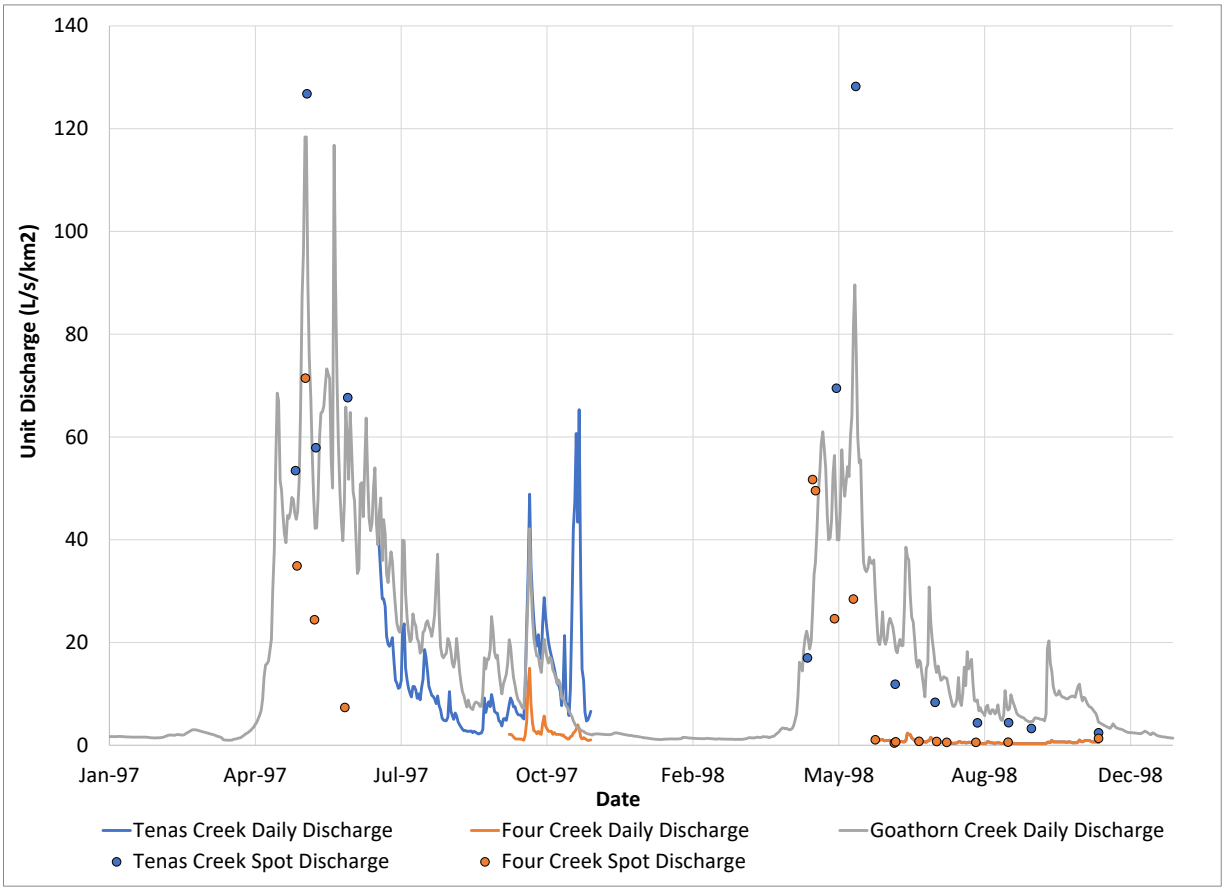


Figure 4-14: Comparison of Unit Flows based on Hydrometric Data from AGRA 1999 at Goathorn, Tenas and Four Creeks (Attachment A, C)

AGRA 1999 describes runoff ratios, based on annual runoff yield and annual precipitation data from Smithers Airport. The runoff ratios for WSC's Goathorn Creek station were calculated as 0.65 and 0.83 in 1997 and 1998, respectively, and 0.28 in both years for Four Creek. Note that results from Section 4.1.2 show that precipitation data from Smithers Airport is expected to be distinct from precipitation that falls near the Telkwa Project Area or within each stream's

catchment, limiting the applicability of these ratios. This discrepancy is also noted in AGRA 1999. AGRA 1999 stated that the difference in runoff ratios between Goathorn and Four Creek could be attributed to potential orographic gradients in precipitation and the difference in the altitude range between Goathorn Creek (1745 m, from 550 to 2295 masl) versus Four Creek (670 m from 700 to 1370 masl). The Four Creek basin generally faces the northeast, where as the Goathorn Creek basin faces northeast and northwest, which is expected to cause differences in snowpack accumulation and ablation (AGRA 1999). AGRA also concluded that groundwater baseflows would be more pronounced in Goathorn Creek as it extends lower in the basin than Four Creek, which may result in an increased occurrence of springs surfacing from fractures.

4.2.2 Model Development

The regression approach ultimately selected to develop regressions between measured, Project hydrometric records and regional analogues was chosen based on: (1) The simplicity of the regression, (2) the Nash-Sutcliffe Efficiency (NSE) between the estimated flows and the measured flows for the period of overlap and (3) the ability of the regression to approximate both high and low flows based on flow duration curves. The regressions were then used to generate synthetic flow records for each Project hydrometric stations using the long-term, regional records from Water Survey of Canada as a foundation. The time series generated from the developed regression equations for each hydrometric station were compared to the measured unit discharges at each station using tables.

In the previous version of the Tenas Project hydrology baseline, provisional data from Goathorn Creek Water Survey of Canada (WSC) (Station ID: 08EE008) had been used to develop regressions between site data and WSC Goathorn data and ultematly generate the site synthetic records. Provisional data previously used in the baseline study has been updated and published data is now available online through December 2021 while the 2018 record has been removed.

Table 4 summarizes the pairings between Project hydrometric stations and the most suitable regional analogue, catchment areas for each station and the NSE from the model. A catchment area scaling approach was used for Goathorn-Hydro instead of regression methods due to both stations measuring the same water course with similar catchment areas.

Table 4-17: Project and WSC Regional Prediction Type and Fit Parameter

Project Station ID	Project Station Catchment Area (km^2)	Regional Station ID	Regional Catchment Area (km^2)	Model	NSE
Goathorn-Hydro	123.5	Goathorn (08EE008)	125	Catchment area scaling	0.94
Tenas-Hydro B	46.8	Goathorn (08EE008)	125	Linear Regression, Chronological Pairing	0.85
Telkwa-Hydro	997.2	TelkwaBTC (08EE020)	367	Ranked Regression, Time-independent	0.96
Four-Hydro	11.0	Goathorn (08EE008)	46.8	Ranked Regression, Time-independent	0.54

Source: Compiled in text.

Goathorn-Hydro

A catchment area scaling approach was pursued to adjust the streamflow from WSC Goathorn station to Goathorn-Hydro station. The catchment area of WSC Goathorn station (125 km²) is 1.2% larger than the catchment area of the site station (123.5 km²), so its flows were reduced by 1.2%. The site data was extended with the adjusted WSC Goathorn data. The event recorded at Goathorn-Hydro on 25 October 2017 event was removed from the dataset as its occurrence was not supported by any similarly large discharge event recorded at the Water Survey of Canada Goathorn station. During the period when both stations had overlapping records, the recorded daily average unit flow at Goathorn-Hydro was 17.1 L/s/km^2 while the WSC Goathorn station recorded 18.5 L/s/km^2. Figure 4-15 shows the regression of the unit discharge between the two Goathorn stations.

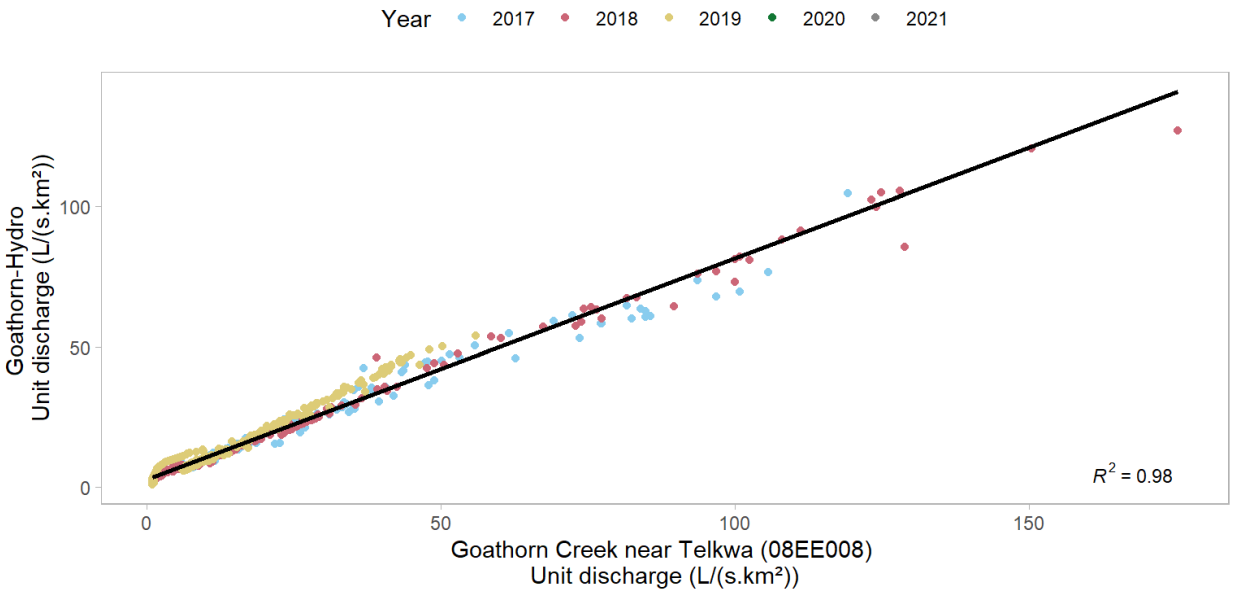


Figure 4-15: Linear regression showing measured Goathorn-Hydro unit discharge relative to WSC Goathorn Creek Near Telkwa (08EE008) unit discharge

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

Table 4-18 shows the unit discharge measured at Goathorn Hydro compared to the unit discharge calculated from the area scaling model for the same time period each year. The measured unit discharge and the estimated values are very similar with slight overestimation in 2017 and 2018 and some underestimation in 2019.

Exceedance probabilities of the measured and estimated unit discharge are presented in Figure 4-16, which shows that estimated flows are very similar in magnitude for average and high flows. The estimated unit discharge for high exceedace probabilities (low flows) is lower than the measured values.

Table 4-18: Measured and Estimated Unit Discharge Values at Goathorn-Hydro

Year	Month	Goathorn-Hydro Unit Discharge (L/s/km^2)	Annual Average (L/s/km^2)	Estimated Unit Discharge (L/s/km^2)	Annual Average (L/s/km^2)
2017	May	59.0	21.2	75.9	24.5
	Jun	41.3		48.8	
	Jul	16.3		18.3	
	Aug	9.0		8.9	
	Sep	10.5		10.6	
	Oct	7.2		6.4	
2018	May	70.4	18.6	87.4	20.7
	Jun	30.0		34.8	
	Jul	17.5		19.2	
	Aug	8.0		7.1	
	Sep	7.7		6.2	
2019	Apr	10.6	13.8	7.5	13.2
	May	37.2		37.3	
	Jun	26.9		26.4	
	Jul	27.3		26.7	
	Aug	10.5		10.9	
	Sep	10.3		10.6	
	Oct	9.0		8.4	
	Nov	9.9		10.1	

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

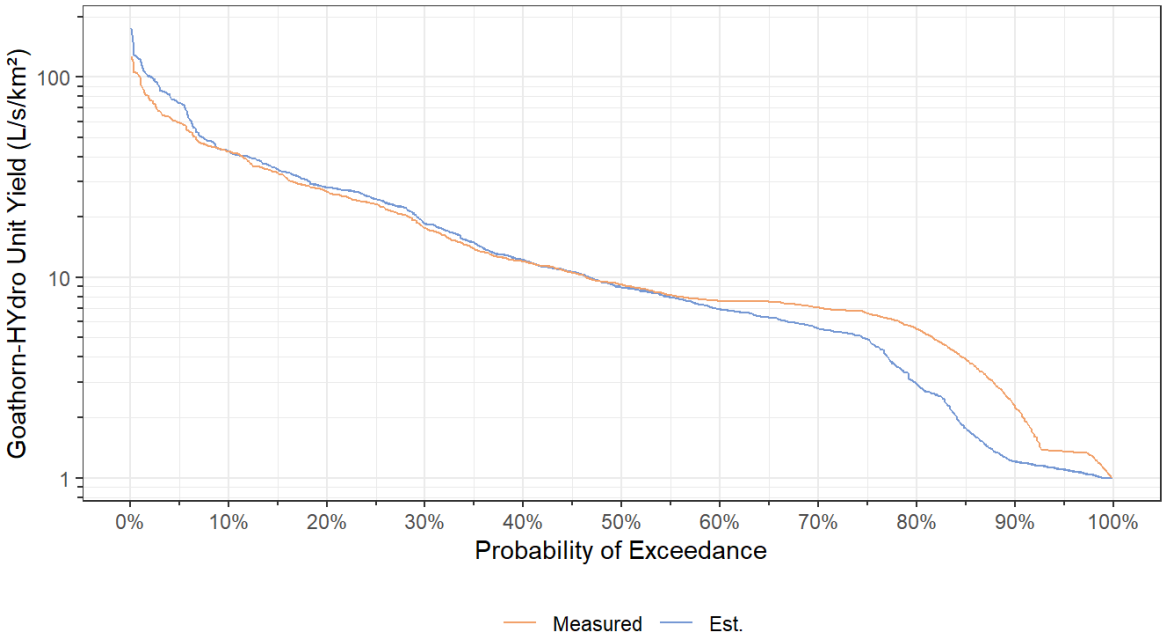


Figure 4-16: Probability Exceedance of Goathorn-Hydro Unit Discharge

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

Tenas-Hydro B

The Tenas-Hydro B station was paired with Goathorn Creek Near Telkwa (08EE008) for developing a regression to develop a synthetic time series. The linear regression was separated into two periods, based on the month, as shown in Figure 4-17.

Table 4-19 shows the unit discharge measured at Tenas Hydro compared to the unit discharge calculated from the regression equations for the same time period each year. Each year presents similar annual average flows.

Exceedance probabilities of the measured and regressed unit discharge are presented in Figure 4 which shows that estimate flows are very similar in magnitude for low and high flows, with extreme low flows being slightly overestimated in the synthetic dataset.

Table 4-19: Measured and Regressed Unit Discharge Values at Tenas-Hydro B

Year	Month	Tenas-Hydro B Unit Discharge (L/s/km^2)	Annual Average (L/s/km^2)	Regression Unit Discharge (L/s/km^2)	Annual Average (L/s/km^2)
2018	May	88.1	22.3	91.7	24.8
	Jun	25.7		34.2	
	Jul	10.0		10.3	
	Aug	2.9		3.5	
	Sep	1.9		3.0	
	Oct	2.7		3.0	
2019	Apr	9.4	16.5	11.5	14.9
	May	46.5		36.7	
	Jun	26.9		25.6	
	Jul	13.1		14.7	
	Aug	5.5		5.6	
	Sep	5.3		5.4	
	Oct	6.1		4..2	
	Nov	7.1		9.4	
2022	May	41.7	25.4	45.7	22.2
	Jun	71.5		60.0	
	Jul	26.4		21.2	
	Aug	6.4		6.4	
	Sep	3.1		2.7	
	Oct	2.1		1.5	

Source: Compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

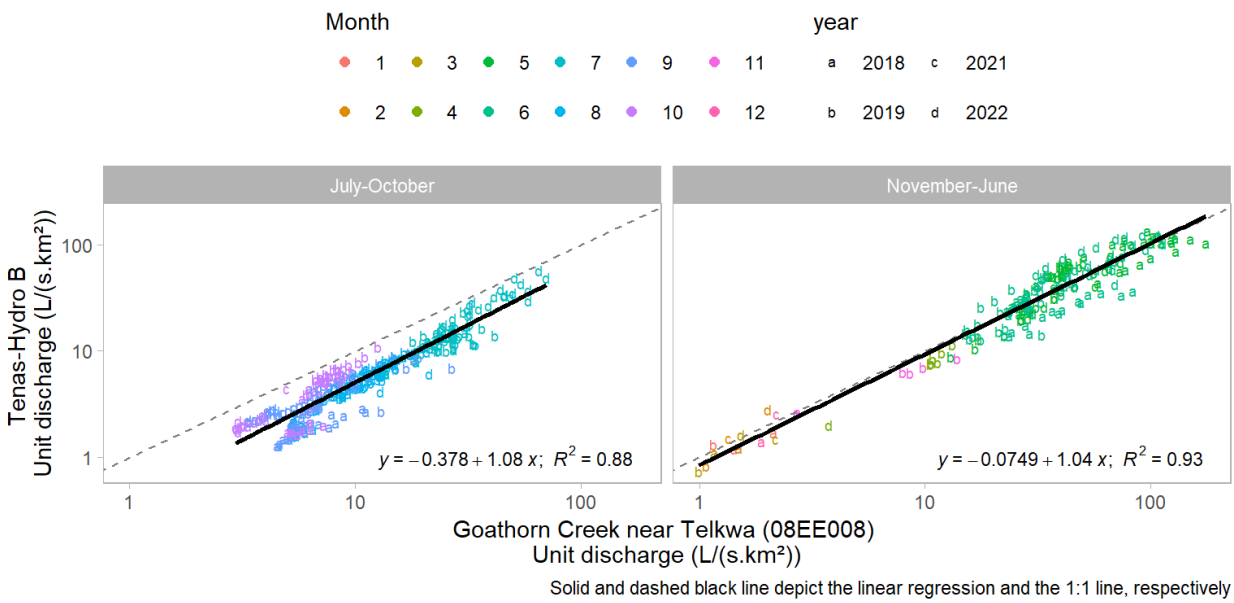


Figure 4-17: Linear regression between WSC Goathorn Creek Near Telkwa (08EE008) station and Tenas-Hydro B for the months of April, May, June, October and November (top) and July to September (bottom)

Source: Compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

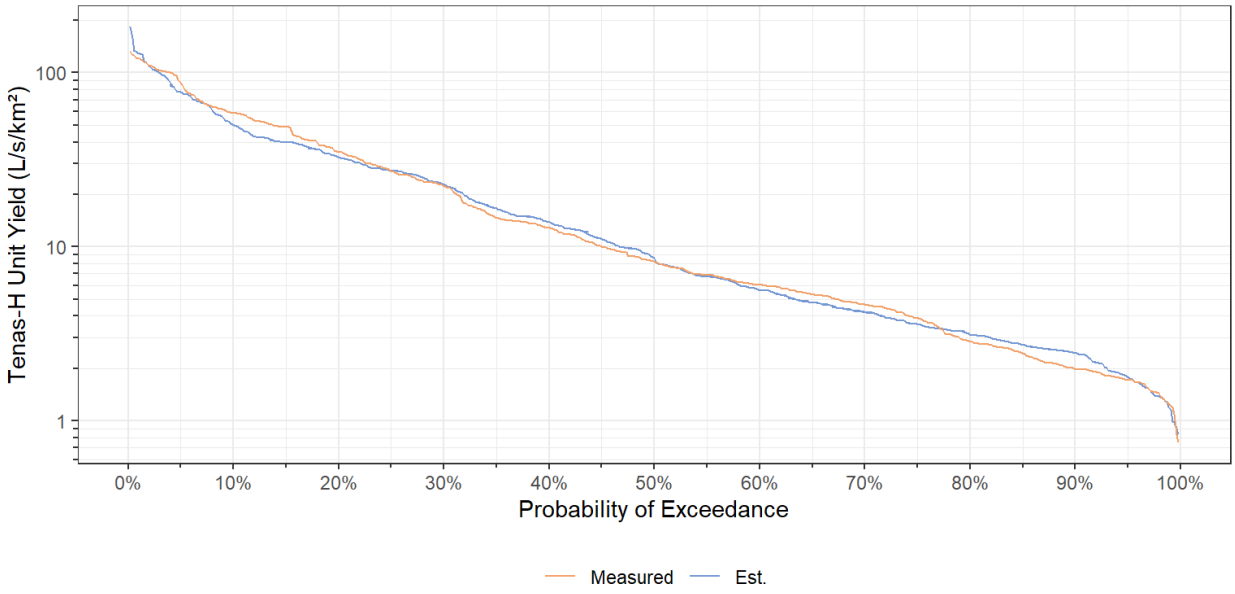


Figure 4-18: Probability Exceedance of Tenas-Hydro Unit Discharge

Source: Compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html elkwa-Hydro

Telkwa-Hydro

The Telkwa-Hydro hydrometric data was regressed against Water Survey of Canada Telkwa River Below Tsai Creek (08EE020) using ranked regressions, which uses paired discharge records independent of chronological order. Monthly ranked regression results are presented in Figure 4-19, and regression equations with goodness of fit indicators are presented in Table 4-20.

Table 4-21 presents the unit discharge measured at Telkwa Hydro compared to the unit discharge calculated from the monthly regressions with Telkwa River Below Tsai Creek for the same time period each year. The regressed values underestimated flow in 2017 but provided similar results for 2018 and 2019.

Exceedance probabilities of the measured and regressed unit discharge are presented in Figure 4-19 which shows that estimated flows are very similar in magnitude for average and high flows, but less accurate for low flows (higher exceedance probability results), where the estimated results are lower than the measured values.

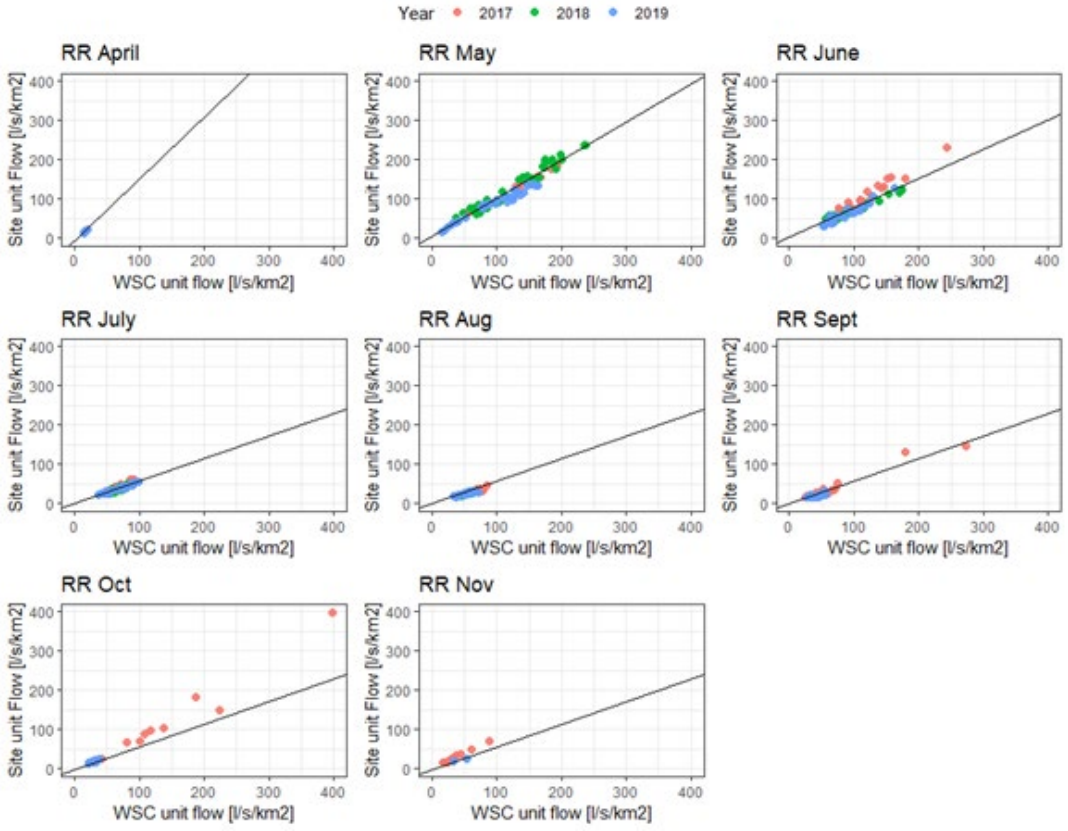


Figure 4-19: Monthly ranked regression between WSC Telkwa River Below Tsai Creek (08EE020) and Telkwa-Hydro stations

Source: Compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\300_Hydrology_Update\Streamflow_regressions\ Flows_update_rev12_monthlyregr.Rmd

Table 4-20: Monthly Ranked Regression Equations and R-squared Value

Month	April	May	June	July	Aug	Sept	Oct	Nov
Equation	1.58x-7.29	0.97x+4.69	0.75x+2.12	0.57x -0.73	0.43x+2.49	0.55x-1.95	0.96x-8.93	0.79x+0.93
R^2	0.84	0.88	0.81	0.75	0.76	0.83	0.95	0.85

Source: Compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\300_Hydrology_Update\Streamflow_regressions\ Flows_update_rev12_monthlyregr.Rmd

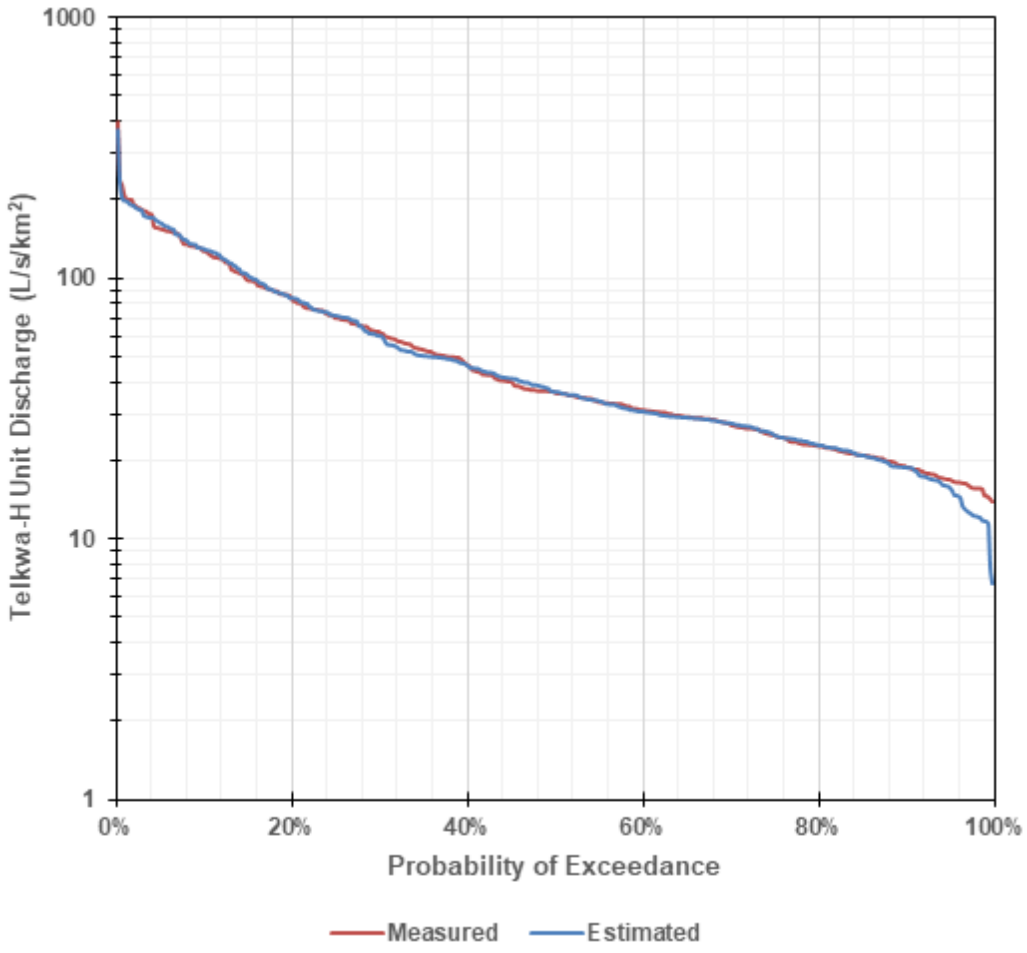


Figure 4-20: Probability Exceedance of Unit Discharge (L/s/km2) at Telkwa-Hydro

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\300_Hydrology_Update\Streamflow_regressions\Telkwa_regression_rev00_20200423_njs.xlsx

Table 4-21: Measured and Regressed Unit Discharge Values at Telkwa-Hydro

Year	Month	Telkwa-Hydro Unit Discharge (L/s/km^2)	Annual Average (L/s/km^2)	Regression Unit Discharge (L/s/km^2)	Annual Average (L/s/km^2)
2017	May	125.2	61	88.9	48
	Jun	97.1		86	
	Jul	38.9		35.2	
	Aug	29.3		28.1	
	Sep	34.7		29.5	
	Oct	75.6		50.3	
	Nov	28.3		16.7	
2018	May	140.1	58.5	135.3	55
	Jun	68.4		69.9	
	Jul	35.9		37.2	
	Aug	25		23	
	Sep	23.1		9.3	
2019	Apr	16.6	36	12.3	38
	May	87.8		98.1	
	Jun	58		63.4	
	Jul	37.6		37.2	
	Aug	24		23.6	
	Sep	20		18.2	
	Oct	19.3		11	
	Nov	23.5		35.9	

Source: Compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

Four-Hydro

The Four-Hydro hydrometric data was regressed against Water Survey of Canada Goathorn Creek Near Telkwa (08EE008) flows using ranked regressions (Figure 4-21), which uses paired discharge records independent of chronological order.

Linear chronological pairing was assessed, but a good relationship with regional stations was not obtained. A ranked regression was then developed without grouping the data by month, as done for Telkwa-Hydro. In fact, the low availability of flow records in some months hindered this more refined type of regression for Four-Hydro station. Despite this, the regression undertaken provides valuable insight that the unit flows measured in Four-Hydro are smaller than the other stations, so assuming other station as analog without a bias correction may impose an overestimation of flows in Four-Hydro.

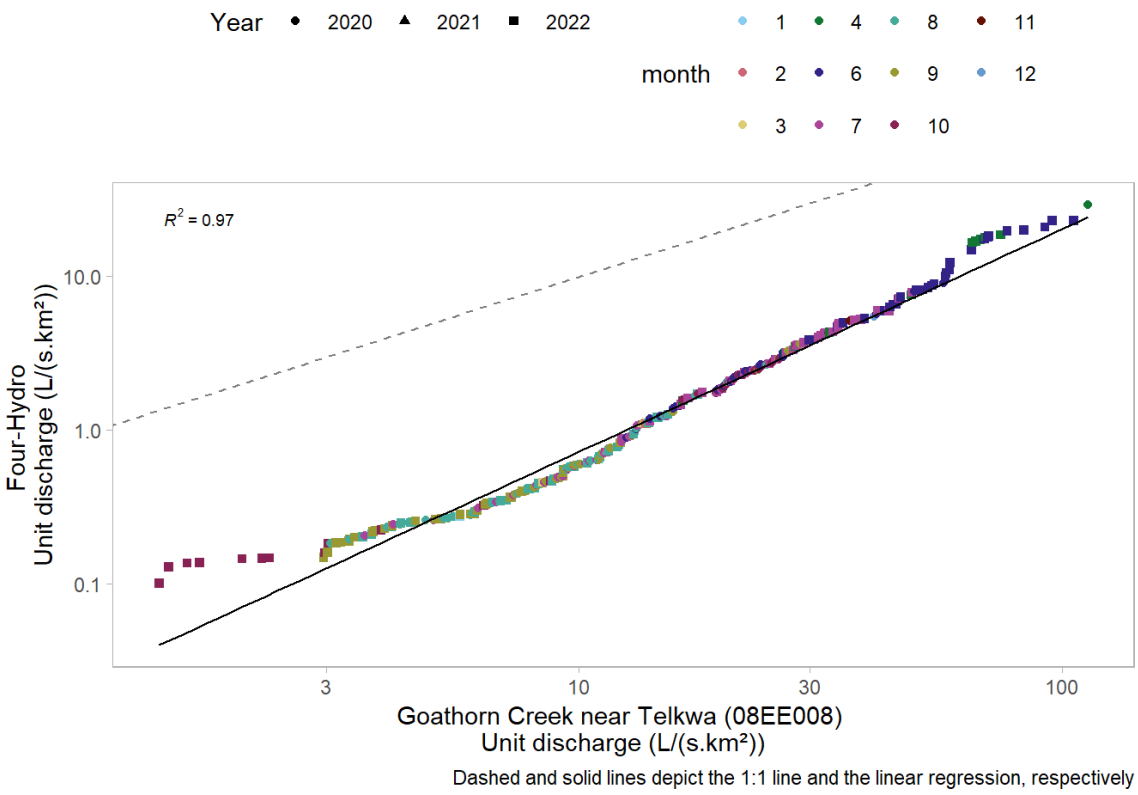


Figure 4-21: Ranked regression between WSC Goathorn Creek Near Telkwa (08EE008) station and Four-Hydro station

Source: Compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

Exceedance probabilities of the measured and regressed unit discharge at Four-Hydro are presented in Figure 4-22, which shows that estimated flows are representing well medium flows, but underpredicting high and low flows.

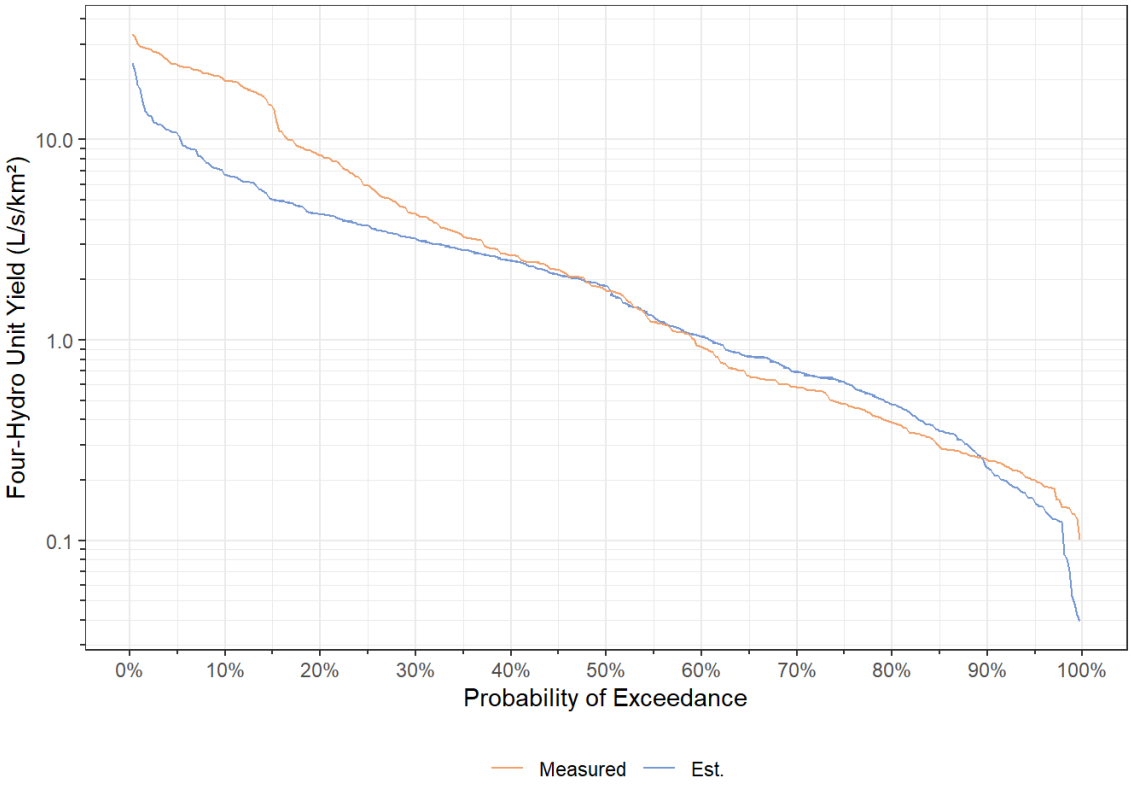


Figure 4-22: Probability Exceedance of Unit Discharge (L/s/km²) at Four-Hydro

Source: Compiled from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

Table 4-22 presents the unit discharge measured at Four Hydro compared to the unit discharge calculated from the regression with WSC Goathorn Creek (08EE008) for the same time period each year. The regressed values underestimated average and high flows, but remained close to the measured low flows.

Table 4-22: Measured and Regressed Unit Discharge Values at Four-Hydro

Year	Month	Four-Hydro Unit Discharge (L/s/km^2)	Annual Average (L/s/km^2)	Regression Unit Discharge (L/s/km^2)	Annual Average (L/s/km^2)
2020	May	11.1	3.3	4.3	2.1
	Jun	2.7		3.1	
	Jul	0.8		2.2	
	Aug	0.7		1.3	
	Sep	1.0		0.8	
	Oct	2.4		0.8	
2022	Apr	10.7	7.4	0.5	3.6
	May	23.7		4.5	
	Jun	11.1		10.0	
	Jul	3.6		5.1	
	Aug	0.6		1.0	
	Sep	0.3		0.3	
	Oct	0.2		0.1	

Source: Compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

4.2.3 Extended (Synthetic) Time Series for Project Hydrometric Stations

The regressions developed for Goathorn-Hydro, Telkwa-Hydro, Tenas-Hydro and Four-Hydro were used to generate a long-term, extended (synthetic) time series based on the Water Survey of Canada regional records. The synthetic unit discharge time series are shown in Figure 4-23 for Goathorn-Hydro, Figure 4-24 for Telkwa-Hydro, Figure 4-25 for Tenas-Hydro B and Figure 4-26 for Four-Hydro.

Table 4-23, Table 4-24, and Table 4-25 present the monthly average streamflow, unit flow, and runoff yield for each hydrometric station based on the extended time series results. These averages are based on a 30-year record, frin 1993 to 2022, consistent with best practice.

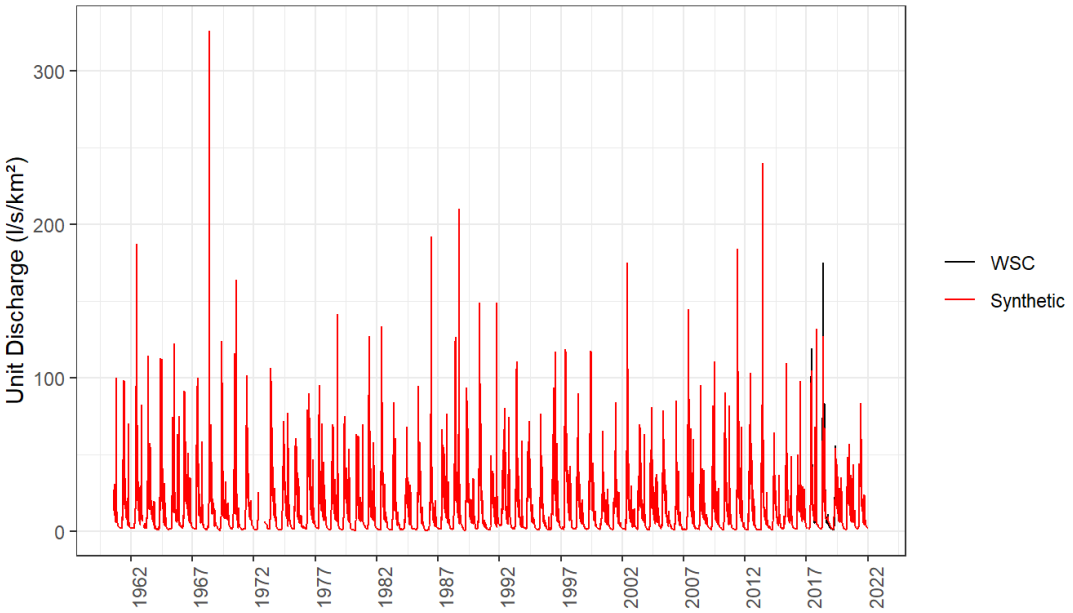


Figure 4-23: Synthetic time series for Goathorn Hydro (red – synthetic) and Water Survey of Canada Goathorn Creek Near Telkwa stations (black)

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

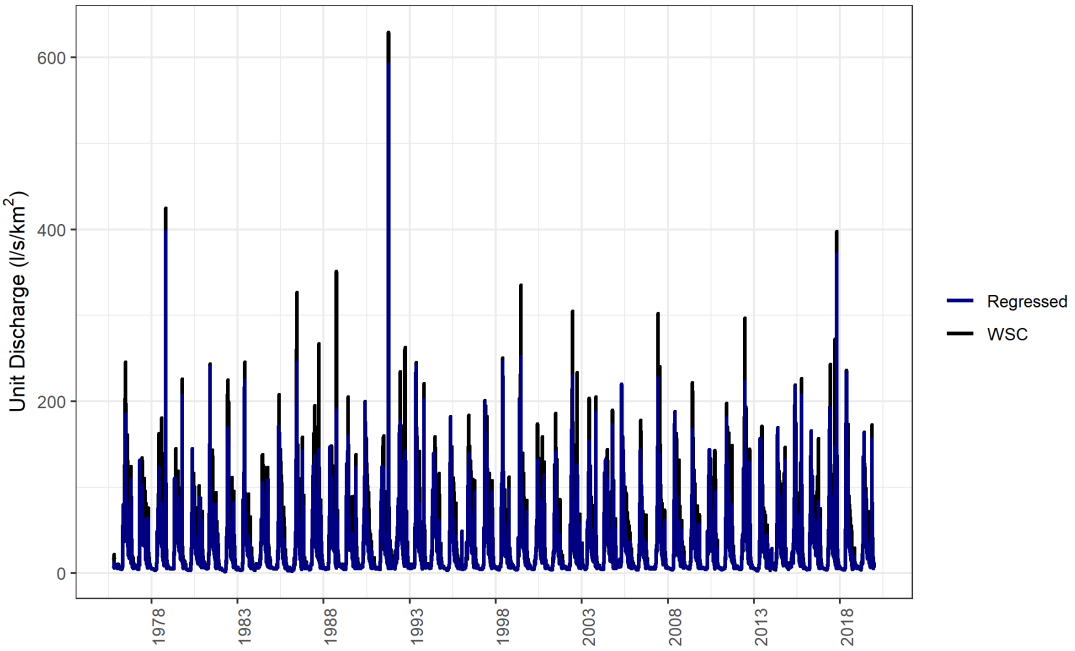


Figure 4-24: Synthetic time series for Telkwa-Hydro (blue-regressed) and Water Survey of Canada Telkwa Below Tsai Creek stations

Source: Compiled in R \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\300_Hydrology_Update\RegionalFlows\Telkwa_flows_1CT027003_Plots_njs.R

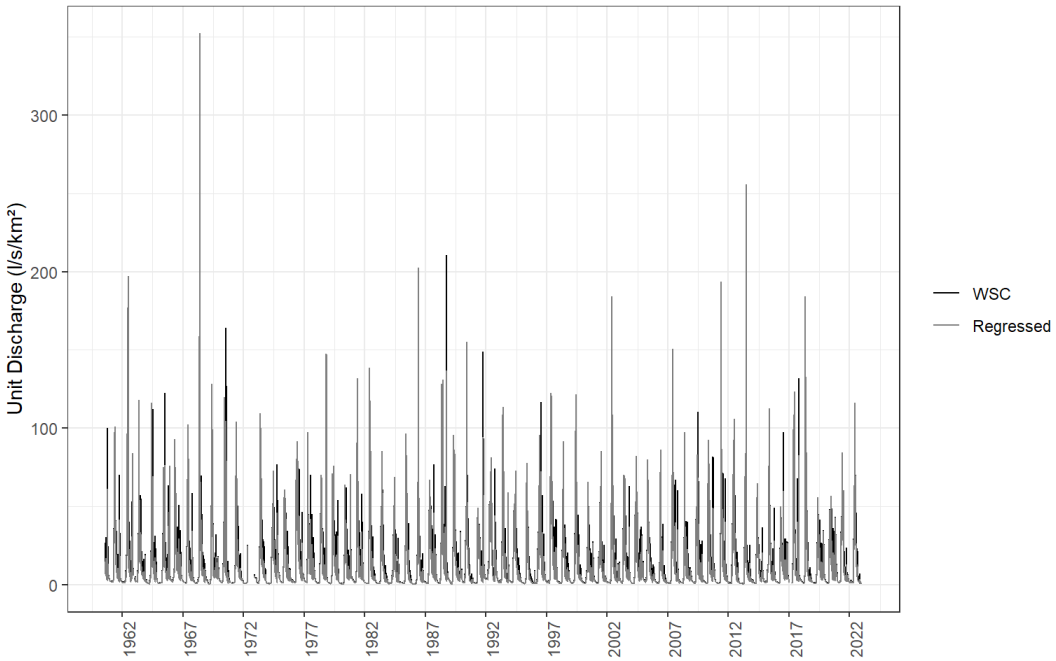


Figure 4-25: Synthetic time series for Tenas-Hydro B (grey-regressed) and Water Survey of Canada Goathorn Creek Near Telkwa stations

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

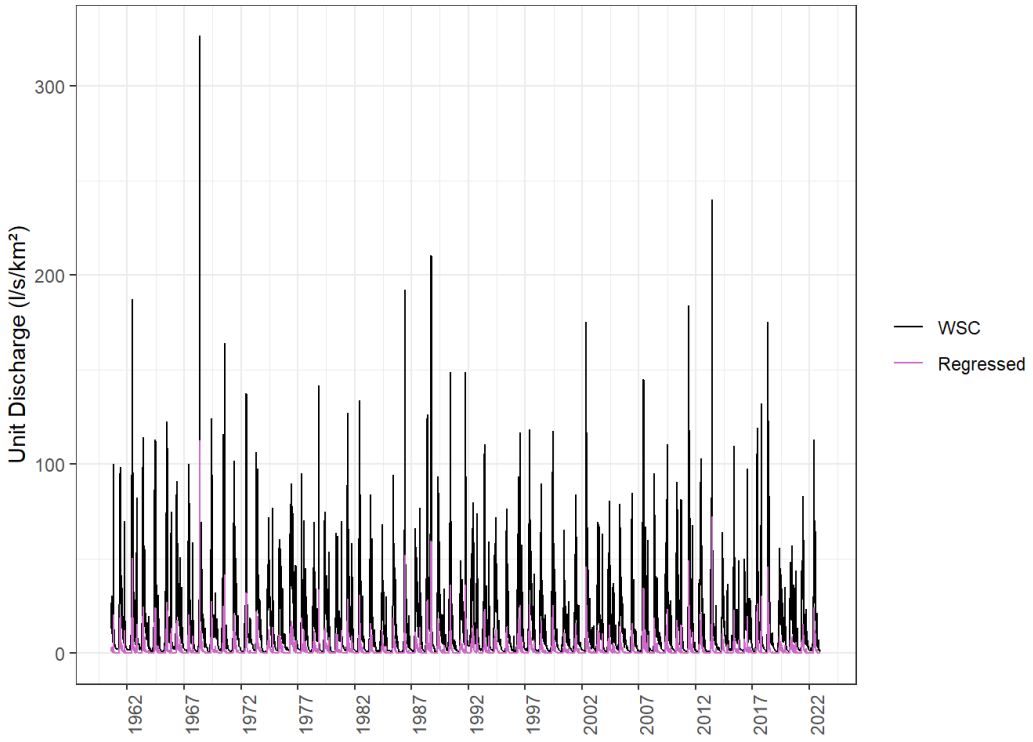


Figure 4-26: Synthetic time series for Four-Hydro (purple-regressed) and Water Survey of Canada Goathorn Creek Near Telkwa stations

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

Table 4-23: Average Monthly and Mean Annual Discharge (m^3/s)

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Goathorn-Hydro (Synthetic)	0.2	0.2	0.2	1.1	5.0	5.2	3.2	1.7	1.3	1.3	0.9	0.4	1.7
Telkwa-Hydro (Synthetic)	6.4	5.3	5.4	16.2	74.1	81.9	45.7	26.5	20.3	24.5	13.2	7.5	27.3
Tenas-Hydro B (Synthetic)	0.075	0.058	0.065	0.41	1.90	1.96	0.67	0.34	0.25	0.27	0.31	0.12	0.54
Four-Hydro (Synthetic)	0.0007	0.0005	0.0007	0.010	0.068	0.069	0.034	0.014	0.0094	0.011	0.0063	0.0015	0.019

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\300_Hydrology_Update\Streamflow_summaries\Telkwa_1CT027.003_FlowSummaries_Collated_njs.xlsx and NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

Table 4-24: Average Monthly and Annual Unit Discharge ($L/s/km^2$)

Station Name	Area (km^2)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Goathorn-Hydro (Synthetic)	123.5	1.9	1.5	1.6	9.3	40.5	42.0	25.8	13.7	10.2	10.9	7.1	2.9	14.0
Telkwa-Hydro (Synthetic)	966.9	6.6	5.5	5.6	16.8	76.6	84.7	47.3	27.4	21.0	25.3	13.7	7.8	28.2
Tenas-Hydro B (Synthetic)	46.8	1.6	1.2	1.4	8.8	40.6	41.9	14.3	7.2	5.2	5.7	6.6	2.5	11.4
Four-Hydro (Synthetic)	11.0	0.07	0.05	0.06	0.91	6.20	6.3	3.1	1.2	0.85	1.00	0.58	0.13	1.7

Source: NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

Table 4-25: Average Monthly and Annual Runoff Yield (mm)

Station Name	Area (km^2)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Goathorn-Hydro (Synthetic)	123.5	5.0	3.5	4.4	24.1	108.4	108.9	69.1	36.6	26.3	29.2	18.5	7.7	441.7
Telkwa-Hydro (Synthetic)	966.9	17.7	13.4	15.0	43.4	205.3	219.6	126.6	73.4	54.4	67.9	35.4	20.8	892.8
Tenas-Hydro B (Synthetic)	46.8	4.3	3.0	3.7	22.8	108.9	108.7	38.3	19.2	13.6	15.2	17.2	6.8	361.7
Four-Hydro (Synthetic)	11.0	0.2	0.1	0.2	2.4	16.6	16.3	8.3	3.3	2.2	2.7	1.5	0.4	54.0

Source: NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\External Analysis\EA_Reporting_SummaryResults_rev05_06252025.xlsx

4.2.4 Baseflow separation

The rate at which groundwater discharges into surface streams was characterized using a recursive digital filter to separate baseflow from surface runoff. A single filter parameter, typically ranging from 0.9 to 0.99 based on visual observations was incorporated to separate total streamflow into a baseflow component and surface runoff component for each of the local and regional hydrometric stations. In this method, the filter is passed over the data 1 to 3 times, where the more passes processed results in a more consistent seasonal baseflow value. Flow records from 2000 to 2019 were used in the separation model, and an upper range of filter parameters were incorporated to simulate a uniform baseflow regime with reduced peaks. A series of parameter combinations were tested, and select results are presented in Attachment B, showing baseflow and total flow from 2010 to 2015. A filter parameter of 0.99 was selected with three passes (n=3).

Monthly average baseflows were calculated over the 19-year modelled period for Four-Hydro, Tenas Hydro, Telkwa Hydro, Goathorn Hydro and Bulkley River at Quick (WSC) based on the selected filter parameter inputs. Unit baseflows were calculated by dividing by respective catchment areas and are presented in Table 4-26.

Table 4-26: Unit Baseflows (L/s/km^2) for Each Major Stream within Project Area

Month	Bulkley	Telkwa	Goathorn	Tenas	Four
1	3.24	4.65	1.82	1.50	0.051
2	3.02	4.43	1.42	1.20	0.038
3	2.95	4.38	1.39	1.10	0.031
4	3.06	4.52	2.45	1.90	0.046
5	3.94	5.85	3.88	3.10	1.187
6	6.22	9.41	6.00	4.70	2.469
7	7.94	11.57	7.25	5.00	1.260
8	7.95	10.01	6.81	4.10	0.597
9	6.78	7.49	5.92	3.50	0.433
10	5.78	6.24	5.13	3.30	0.342
11	4.62	5.38	3.89	3.20	0.148
12	3.57	4.97	2.49	2.10	0.068

Source: Compiled in text from Z:\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\300_Hydrology_Update\BaseflowSeparation\UpdatedBaseflows_07212020_sab.xlsx and \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\02 - Climate Review.html

4.2.5 Rainfall-Runoff Model Configuration

Surface runoff is defined as the total amount of surface water discharged from a watershed and is frequently presented as the depth of water distributed evenly throughout the watershed area. The Project is located within the Goathorn Creek, Tenas Creek and Four Creek watersheds.

A daily rainfall-runoff model was generated to support streamflow estimations in the water and load balance model and to provide Project-specific runoff rates. The runoff model for the Project Area was developed using a snowmelt model (see Section 4.2.4), a minimum baseflow function, a lag time, recession coefficient and monthly runoff coefficients for each of the main catchments. Monthly runoff coefficients were calibrated automatically within GoldSim by optimizing the Nash Sutcliffe Efficiency, based on the difference between observed and modelled daily flow.

The model required long-term precipitation and temperature inputs for the same period as the synthetic streamflow datasets. The long-term Project temperature and precipitation records were adjusted using PRISM datasets to estimate climate parameters for each of the hydrometric stations. An average monthly precipitation for each hydrometric station watershed was derived from the gridded PRISM monthly precipitation model. These monthly precipitation values were compared against the monthly precipitation estimates for the Project, and a ratio was calculated for each month and each station (Table 4-27).

Table 4-27: Monthly Precipitation Correction Factors applied to Project Precipitation based on PRISM

Month	Tenas Hydro	Four-Hydro	Goathorn Hydro	Telkwa Hydro	Bulkley Hydro
Jan	2.26	1.30	1.92	2.07	1.71
Feb	2.05	1.19	1.74	1.89	1.81
Mar	2.45	1.42	2.07	2.29	2.06
Apr	2.15	1.39	1.93	2.05	1.81
May	1.42	1.04	1.25	1.31	1.12
Jun	1.25	1.15	1.27	1.19	1.08
Jul	1.15	1.13	1.20	1.10	1.02
Aug	1.45	1.03	1.29	1.31	1.14
Sep	1.83	1.09	1.55	1.60	1.30
Oct	1.85	1.09	1.59	1.79	1.70
Nov	2.34	1.37	1.97	2.20	1.93
Dec	2.35	1.36	2.00	2.22	1.90

Source: SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\Runoff Models\Rev2_Nov 2023\Summary_Models_20241105_rev0_jls.xlsx

A similar process was employed for temperature. A monthly average temperature for each hydrometric station watershed was derived from the gridded PRISM monthly temperature model. These monthly temperature values were compared against the monthly temperature estimates for the Project, and a correction addend was calculated for each month and each station (Table 4-28).

Table 4-28: Monthly Average Temperature Correction Addends (in degrees Celsius) applied to Project Average Temperature based on PRISM

Month	Tenas Hydro	Four-Hydro	Goathorn Hydro	Telkwa Hydro	Bulkley Hydro
Jan	-0.45	-0.24	-0.57	-0.45	-0.13
Feb	-0.88	-0.37	-1.07	-1.03	-0.69
Mar	-1.27	-0.43	-1.75	-1.66	-0.90
Apr	-1.64	-0.68	-2.21	-2.14	-1.32
May	-1.74	-0.78	-2.25	-2.30	-1.55
Jun	-1.81	-0.74	-2.26	-2.46	-1.41
Jul	-1.77	-0.80	-2.19	-2.34	-1.25
Aug	-1.48	-0.51	-1.89	-2.01	-1.06
Sep	-1.28	-0.43	-1.68	-1.73	-0.62
Oct	-1.17	-0.55	-1.68	-1.50	-0.76
Nov	-0.93	-0.30	-1.21	-1.16	-0.43
Dec	-0.32	-0.04	-0.40	-0.37	-0.28

Source: SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\Runoff Models\Rev2_Nov 2023\Summary_Models_20241105_rev0_jls.xlsx

Using the daily temperature and precipitation time series adjusted for each streamflow station, the remaining runoff model inputs were calibrated in order to mimic the long-term synthetic streamflow records. Calibrated inputs included monthly runoff coefficients, baseflow, lag time and recession value.

Figure 4-27 illustrates the observed and modelled flows at the Goathorn-Hydro station from August 1990 to December 2021. Results produced an average Nash Sutcliffe Efficiency (NSE) of approximately 0.42 . The modelled flow resembles the synthetic record derived from the Water Survey of Canada station flows, however, peaks in modelled flows occasionally exceed the peaks observed in the synthetic and Water Survey of Canada observed flow record.

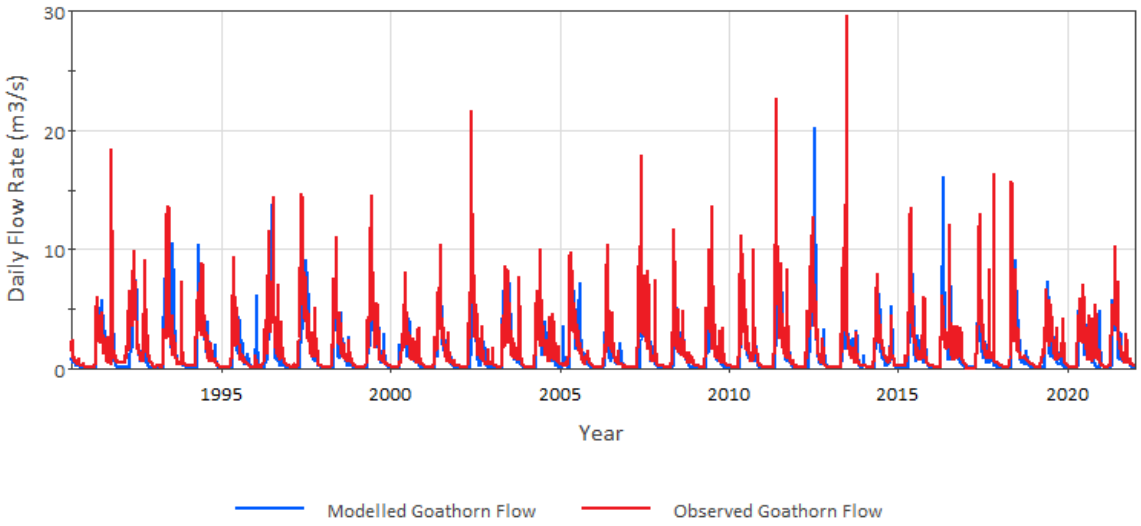


Figure 4-27: Rainfall-Runoff Model Calibration for Goathorn Creek

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\Runoff Models\Rev2_Nov 2023\Telkwa_FlowCalibrationModel_Goathorn_v6_20231124

This process was repeated for Tenas Creek. Monthly runoff coefficients were calibrated automatically within GoldSim by optimizing the Nash Sutcliffe Efficiency, based on the difference between observed and modelled daily flow.

Figure 4-28 illustrates the measured and modelled flows at the Tenas-Hydro B station from 2017 to November 2022. Results produced an average Nash Sutcliffe Efficiency (NSE) of approximately 0.47. At this location, observed data is superimposed atop modelled flow with records from Tenas-Hydro and Tenas-Hydro B. The modelled flow record shows an underestimation of synthetic and measured flow at the Tenas-Hydro B location along Tenas Creek. Derivation of runoff coefficients was tested over multiple periods to ensure that the rainfall-runoff model flow results were as representative as possible. The rainfall-runoff model currently underestimates flows and should be revisited once more flow data is available from the Tenas-Hydro station.

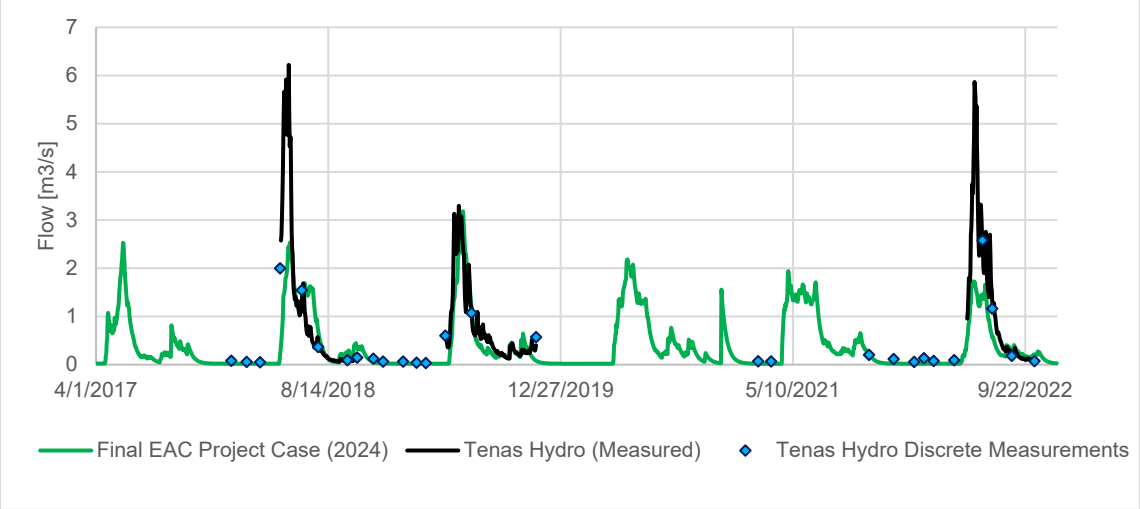


Figure 4-28: Rainfall-Runoff Model Calibration for Tenas-Hydro B

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\Runoff Models\Rev2_Nov 2023\Updated RainfallRunoff Results_20231124_rev01_njs.xlsx

The Bulkley River rainfall-runoff model for 2000 to 2018 resulted in a NSE value of 0.74 (Figure 4-29). The flows produced by the Bulkley River rainfall-runoff model show good correspondence with the observed flows at the Water Survey of Canada hydrometric station. For most of the observed flow record spanning 2000 to 2018, the modelled flows match or exceed peak flows. In some years, the model underestimates peak flows although the hydrograph shape remains similar despite the difference in magnitudes.

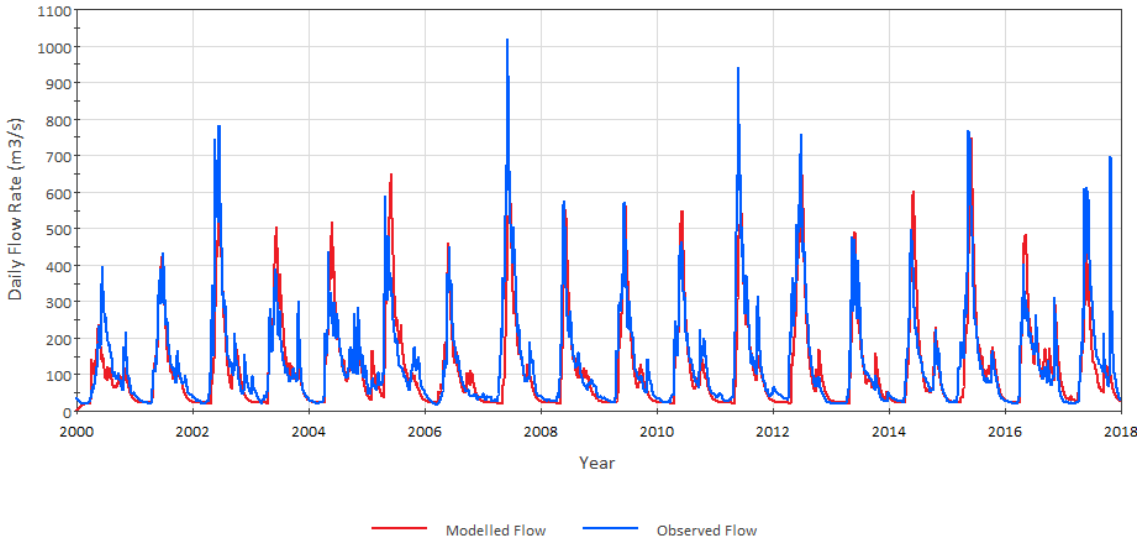


Figure 4-29: Rainfall-Runoff Model Calibration for Bulkley River

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\Runoff Models\Rev2_Nov 2023\Telkwa_FlowCalibrationModel_Bulkley_v2_2000-2018_20200421.gsm

The Telkwa-Hydro rainfall-runoff model is shown in Figure 4-30 for 2016 to 2022 with a NSE of 0.55. The modelled flows correspond well with the observed flow record generated for the Telkwa-Hydro station. The observed and modelled flows are typically similar in both magnitude and shape although the modelled flow can recede more quickly post-freshet than the synthetic record leading to lower flows in early summer.

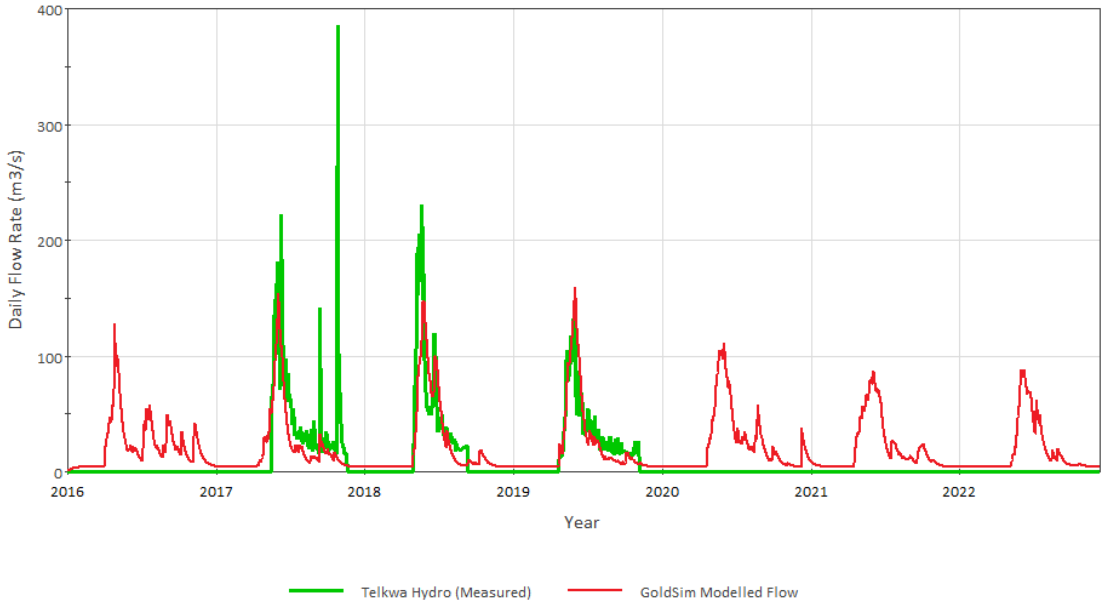


Figure 4-30: Rainfall-Runoff Model Calibration for Telkwa River

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\Runoff Models\Rev2_Nov 2023\Telkwa_FlowCalibrationModel_Telkwa-Hydro_v3_20200430_20240211.gsm

Calibration of Four-Hydro was conducted using the available 2020 and 2022 records. The continuous flow record in Four Creek from 1997 and 1998 did not include spring freshet (October and November 1997 and July through October 1998). For this reason, the data was not used in the model calibration. With only few flow records available, the monthly runoff coefficients are specific to the period used for calibration. Figure 4-31 presents the modelled and measured Four-Hydro flows. The calibration resulted in a NSE value of 0.64.

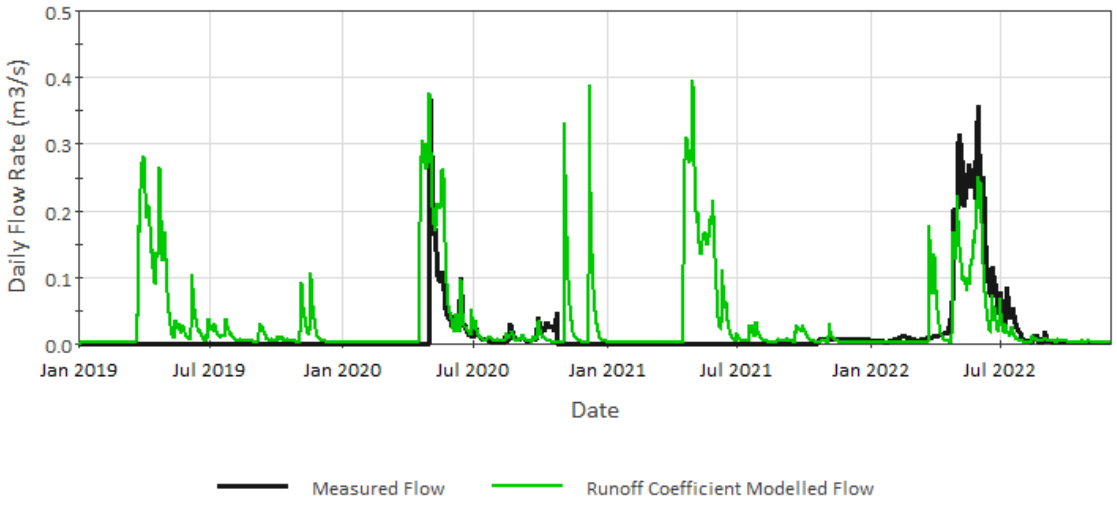


Figure 4-31: Rainfall-Runoff Model Calibration for Four Creek

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\Runoff Models\Rev2_Nov 2023\Telkwa_FlowCalibrationModel_Four_v3_20231212.gsm

Table 4-29 presents the calibrated parameters for each catchment with the average of Tenas, Four and Goathorn results for runoff coefficients, recession value and baseflow parameters applied to the Project Area.

Table 4-29: Rainfall-Runoff Model Inputs

Location		Goathorn	Telkwa	Tenas	Bulkley	Four	Project
Minimum Unit Baseflow [L/s/km^2]		1.4	4.1	0.43	3.5	0.3	0.69
Lag Time [days]		1	1	1	1	1	1
Recession		0.90	0.92	0.91	0.96	0.77	0.86
Runoff Coefficient	January	1	1	1	1	1	1
	February	1	1	1	1	1	1
	March	0.45	1	1	1	0.82	1
	April	0.91	1	0.67	0.34	0.75	0.43
	May	0.26	0.78	0.54	0.10	0.22	0.30
	June	0.21	0.28	0.34	0.10	0.14	0.18
	July	0.76	0.92	0.53	0.04	0.31	0.28
	August	0.28	0.54	0.26	0.02	0.17	0.18
	September	0.14	0.28	0.35	0.04	0.09	0.24
	October	0.37	0.49	0.39	0.02	0.18	0.28
	November	0.14	0.98	0.90	0.50	0.51	0.72
	December	1	1	1	0.4	0.80	1

Source:https://srk.sharepoint.com/sites/NACAPR002055/Internal/200_Review%20New%20Climate%20and%20Streamflow%20Data/Runoff%20Models/Rev2_Nov%202023/Summary_Models_20241105_rev0_jls.xlsx

The synthetic long-term Project precipitation and temperature records were incorporated to the snowmelt and runoff model to generate Project-specific runoff rates using the calibrated values from Tenas, Four and Goathorn Creek. Figure 4-32 presents the monthly average runoff distribution based on the 41-year synthetic record (1981-2021), which produced a mean annual runoff (MAR) of 242 mm. Based on the mean annual precipitation calculated for the Project, the annual runoff coefficient is equal to 0.36.

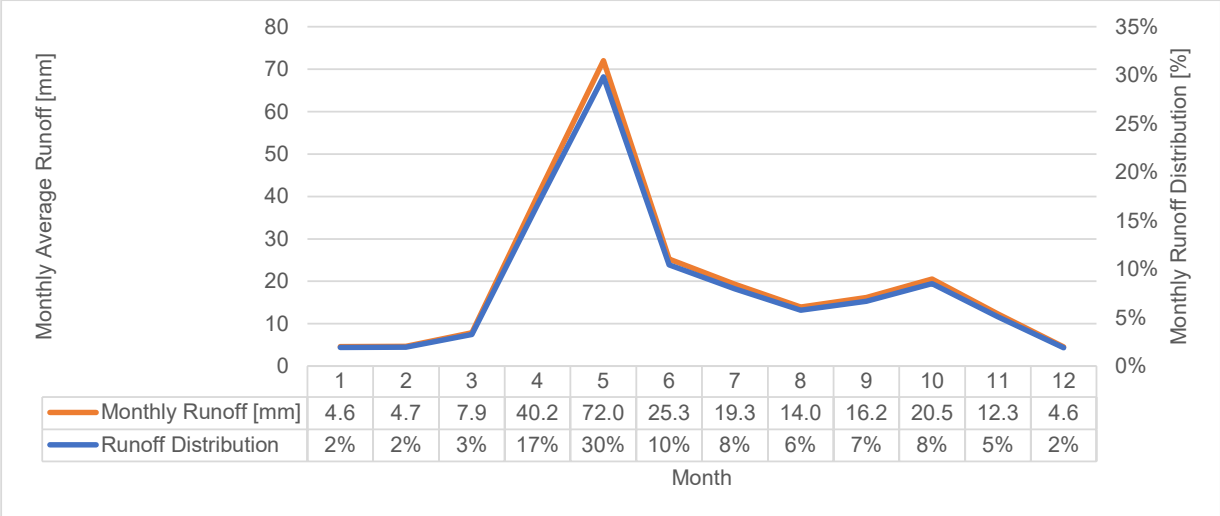


Figure 4-32: Project Area Monthly Average Runoff Depth [mm] and Distribution

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\Runoff Models\Rev2_Nov 2023\Summary_Models_20241105_rev0_jls.xlsx

A frequency analysis was performed using the time series of annual runoff rates generated from the model, producing annual runoff rates associated with a range of exceedance probabilities. Multiple distributions were tested against the historical data, including the Normal, Log Normal, Gumbel, Gamma, Pearson III, Log Pearson III, and GEV distributions, and the Gamma distribution was selected as the best statistical fit to observed data. Results of annual runoff for a range of return periods are presented in Table 4-30.

Table 4-30: Return Periods Calculated for Mean Annual Runoff

Hydrological Condition	Return Period [years]	Annual Runoff [mm]
Wet	1000	361
	500	351
	200	338
	100	328
	50	316
	25	304
	20	300
	10	286
	5	270
Mean Annual Runoff (MAR)		240
Dry	5	212
	10	199
	20	188
	25	185
	50	177
	100	169
	200	163
	500	155
	1000	150

Source: Compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

4.2.6 Baseflow Review

The calibrated rainfall-runoff model incorporates a constant baseflow value for each stream. Results of the calibration were compared against the monthly baseflow estimates calculated from the baseflow separation technique described in Section 4.2.4 and are presented in Figure 4-33.

Points on the plot represent the constant and calibrated unit baseflow estimates for each stream, while lines show the monthly results from the baseflow separation model.

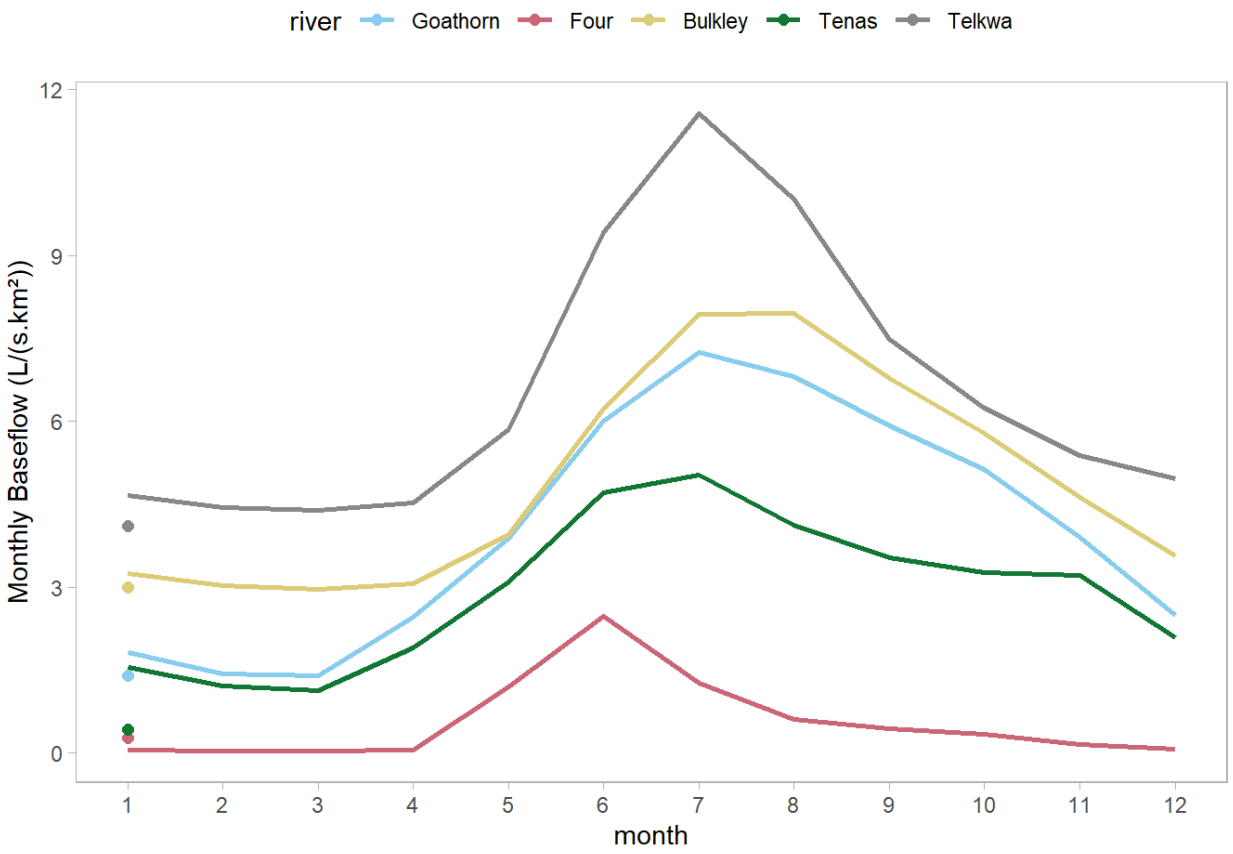


Figure 4-33: Comparison of Calibrated Unit Baseflows and Monthly Baseflow Separation Results

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

The constant calibrated baseflow estimates are representative of the winter and low flow monthly baseflow results from the baseflow separation. Based on the rainfall-runoff model used, the only time of year where the constant baseflow input is used is during winter months without rainfall or snowmelt. This is reasonable since the monthly runoff coefficients are calibrated to match flows in the open water season, and therefore account for baseflow contributions in their development.

The calibrated constant baseflow selected for Four-Hydro was compared against the available low-flow manual measurements collected since 2020 and presented in AGRA 1999, in the development of station rating curves. Measurement statistics are presented in Table 4-31 and show that the selected model baseflow for Four Creek, selected as 0.30 L/s/km^2, is approximately the minimum of winter baseflow measurements collected from Four Creek in 2020-2022.

Table 4-31: Four Creek Baseflow and Available Measurements Comparison

Type	Date	Statistic	Unit Flow [L/s/km^2]
Manual Measurement	All year	Minimum	0.18
Manual Measurement	All year	25th percentile	0.59
Manual Measurement	All year	50th percentile	1.08
Manual Measurement	All year	Average	1.71
Manual Measurement	Winter	Minimum	0.27
Manual Measurement	Winter	25th percentile	0.73
Manual Measurement	Winter	50th percentile	1.18
Manual Measurement	Winter	Average	1.94
SRK Rainfall-Runoff Model	n.a	n.a	**0.30**

Source: Compile in text from \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\2024_FourCreek-GW\data\Telkwa_NACAPR002055_FourCreek_flow_rev02_njs.xlsx

The calibrated constant unit baseflows were used in groundwater modeling calibration to develop base case estimates of baseflow.

4.2.7 Peak Flows

A peak flow analysis was performed for Tenas Creek, Goathorn Creek, Telkwa River and Four Creek based on the synthetic records detailed in section 4.2.3. The Bulkley River peak flow analysis was based on the extended records from WSC Bulkley River at Quick 08EE004 hydrometric station. Table 4-32 presents the unit peak-flows for each identified stream.

Table 4-32: Unit Peak Flows from Extended Records [L/s/km^2]

Return Period [years]	Goathorn-Hydro (Synthetic)	Telkwa-Hydro (Synthetic)	Tenas-Hydro B (Synthetic)	Four-Hydro (Synthetic)	WSC Bulkley River at Quick 08EE004
1000	388	620	506	173	165
500	356	516	441	147	160
200	313	404	363	117	153
100	280	336	311	97	147
50	248	278	264	79	140
25	215	230	221	63	133
20	205	216	208	59	130
10	172	178	171	46	122
5	140	144	137	34	111
2	98	105	96	21	91

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Flows_update_rev11.Rmd and \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

4.2.8 Low Flows

A low flow analysis was performed for Tenas Creek, Goathorn Creek, Telkwa River and Four Creek based on the synthetic records detailed in section 4.2.8. The Bulkley River low flow analysis was based on the extended records from WSC Bulkley River at Quick 08EE004 station. Table 4-33 presents the day low-flows for each identified stream.

Table 4-33: 7-Day Low Flows from Extended Records [L/s]

Return Period [years]	Goathorn-Hydro (Synthetic)	Tenas-Hydro B (Synthetic)	Telkwa-Hydro (Synthetic)	Four-Hydro (Synthetic)	WSC Bulkley River at Quick 08EE004
2	128.5	40.9	4,220	0.302	22,743
5	95.5	29.5	3,655	0.192	17,373
10	78.2	24.5	3,381	0.145	15,090
20	66.9	20.9	3,166	0.110	13,413
25	63.8	19.9	3,105	0.101	12,955
50	55.6	17.2	2,934	0.075	11,711
100	48.9	15.1	2,785	0.054	10,671
200	43.3	13.3	2,653	0.036	9,778
500	37.1	11.3	2,499	0.015	8,761
1000	33.2	10.0	2,393	0.001	8,087

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Flows_update_rev11.Rmd and \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

Seven-day low flows for a 10 year return period (7Q10) were also computed for Tenas Creek, Goathorn Creek,Telkwa River and Four Creek during each month of the synthetic records. Table 4-34 and Table 4-35 present the 7Q10 results for these series as low flows and unit low flows respectively.

Table 4-34: 7-day Low Flows for 10-year Return Period for Synthetic Records

Station Name	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Ann.
Goathorn-Hydro (Synthetic) (m^3/s)	0.10	0.09	0.08	0.12	1.00	2.02	1.19	0.69	0.47	0.40	0.19	0.12	0.08
Telkwa-Hydro (Synthetic) (m^3/s)	4.2	3.7	3.4	3.7	15	40	25	15	6.7	6.8	5.6	3.4	3.4
Tenas-Hydro B (Synthetic) (m^3/s)	0.032	0.028	0.025	0.037	0.354	0.665	0.232	0.125	0.082	0.070	0.058	0.038	0.025
Four-Hydro (Synthetic) (L/s)	0.21	0.18	0.17	0.25	6.04	16.40	6.70	3.18	1.96	1.40	0.50	0.27	0.14

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Flows_update_rev11.Rmd and \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

Table 4-35: 7-day Unit Low Flows for 10-year Return Period Flows for Synthetic Records (L/s/km^2)

Station Name	Area (km^2)	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Ann.
Goathorn-Hydro (Synthetic)	123.5	0.82	0.72	0.63	0.93	8.13	16.36	9.67	5.58	3.85	3.21	1.51	1.00	0.63
Telkwa-Hydro (Synthetic)	966.9	4.34	3.83	3.52	3.83	15.5	41.4	25.9	15.5	6.93	7.03	5.79	3.52	3.52
Tenas-Hydro B (Synthetic)	46.75	0.69	0.60	0.52	0.80	7.56	14.21	4.96	2.67	1.76	1.51	1.25	0.81	0.52
Four-Hydro (Synthetic)	11	0.82	0.72	0.64	0.95	1.59	0.87	0.1	0.08	0.19	0.24	1.43	0.96	0.04

Source: Compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Flows_update_rev11.Rmd and \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

5 Climate Change

Climate change is considered one of human civilization's many challenges as it has the potential to impact current social and ecological systems. Estimating potential variation in future climate conditions to identify vulnerability, assess risk and develop adaptive management strategies is in the best interest of mine developers and operators.

The section below discusses climate change trends and effects that may impact the Project. This analysis was completed for temperature and precipitation, and incorporated into the evaporation and streamflow models discussed in Section 4.

5.1 Contextual Framework

While observed historical datasets have traditionally been used to investigate climate patterns and trends, global circulation models (GCMs, aka climate change models) are better suited to generate synthetic datasets with which to investigate the potential range of impacts of climate change into the future on a global or continental scale. GCM results can be scaled to local weather station datasets or gridded climate datasets to provide localized, site-specific projections.

The Coupled Model Intercomparison Project (CMIP) is organized under the support of the World Climate Research Program's (WCRP) working group on coupled modelling. It coordinates experiments on coupling computer-based models of the Earth's climate such as GCMs. The objective of CMIP is to better understand past, present, and future climate change arising from natural unforced variability or in response to changes in radiative forcing in a multi-model context (Eyring 2016). The CMIP is currently in its sixth phase (CMIP6) and its outcomes contribute to the most recent assessments and reports from the International Panel on Climate Change (IPCC, 2023).

CMIP6 includes the most up to date, peer-reviewed models for the simulation and projection of various aspects of climate change. The CMIP6 models include new and better representations of physical, chemical, and biological processes at higher resolution than its previous phases. This has improved the simulation of the recent mean state of most large-scale indicators of climate change and many other aspects across the climate system.

This climate change assessment was based on results from GCMs included in CMIP6 and the corresponding IPCC Sixth Assessment Report (AR6) (IPCC, 2021). The data compilation and subsequent analysis was conducted in the R Software environment.

5.2 Climate Change Methodology

Climate change scenarios were evaluated considering Shared Socioeconomic Pathways (SSP). SSPs are a set of scenarios that describe potential future developments in the absence of climate policy intervention. These pathways are used to explore the possible impacts of different socioeconomic trends on climate change and to assess the challenges associated with mitigation and adaptation strategies. Figure 5-1 shows possible combinations of SSPs with different radiative forcing levels. Four scenarios (Tier 1) are generally recommended for climate change assessments - SSP 1-2.6, SSP 2-4.5, SSP 3-7.0 and SSP 5-8.5 (O'Neill, et al., 2016)-, which span the range of radiative forcing levels and SSPs.

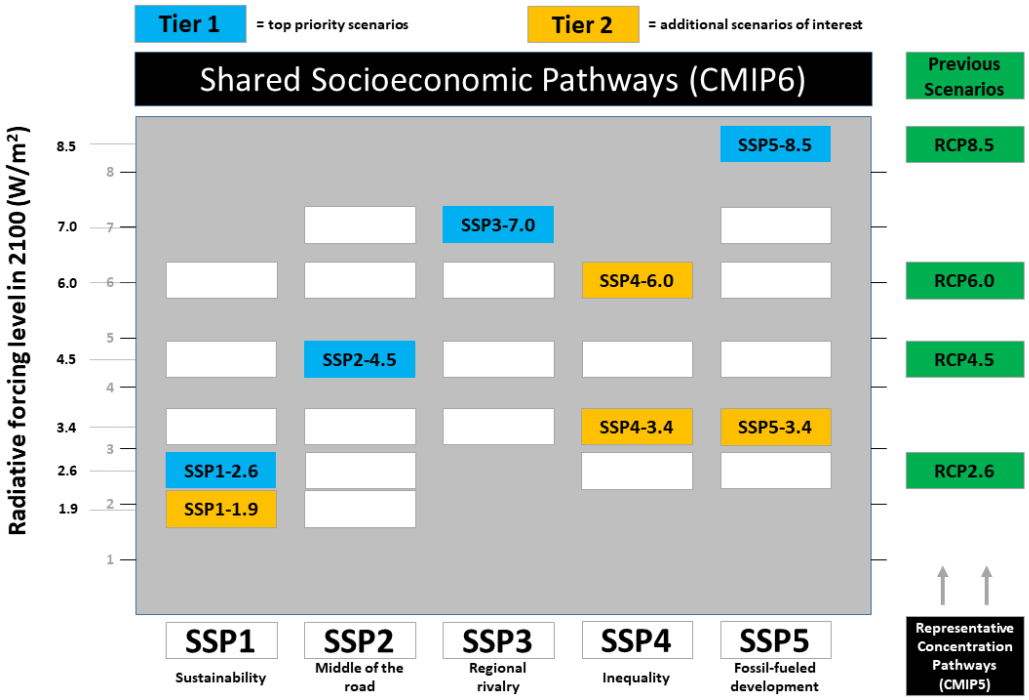


Figure 5-1: Shared Socio-economic Pathways and year 2100 radiative forcing combinations

Source: https://climate-scenarios.canada.ca/?page=cmip6-overview-notes

A short description of these scenarios is provided below.

- SSP5-8.5: With an additional radiative forcing of 8.5 W/m² by the year 2100, this scenario represents the upper boundary of the range of scenarios described in the literature. It can be understood as an update of the CMIP5 scenario RCP8.5, now combined with socioeconomic reasons.
- SSP3-7.0: With 7 W/m² by the year 2100, this scenario is in the upper-middle part of the full range of scenarios. It was newly introduced after the RCP scenarios, closing the gap between RCP6.0 and RCP8.5.
- SSP2-4.5: As an update to scenario RCP4.5, SSP245 with an additional radiative forcing of 4.5 W/m² by the year 2100 represents the medium pathway of future greenhouse gas emissions. This scenario assumes that climate protection measures are being taken.
- SSP1-2.6: This scenario with 2.6 W/m² by the year 2100 is a remake of the optimistic scenario RCP2.6 and was designed with the aim of simulating a development that is compatible with the 2°C target. This scenario, too, assumes climate protection measures being taken.

National Aeronautics and Space Administration (NASA, 2017) provides access to gridded global climate data NEX-GDDP-CMIP6 (Thrasher, et al., 2022), which comprises 26 CMIP6 models for the period of 1950 – 2100, with historical results from 1950 to 2014 and forecast results from 2015 to 2100. Data for the Tenas Project location were obtained and processed by SRK to evaluate predicted trends up to year 2100, deemed the maximum reasonable prediction range (IPCC, 2023).

Once the Global Circulation Models (GCM) are developed in a coarse spatial resolution, a bias correction procedure is required to adjust their estimates to represent local climate conditions of a specific site considering its microclimate. In this work, GCM historical and forecasted data are bias corrected with Quantile Delta Mapping (QDM) referencing the derived historical timeseries introduced in Section 4 as the observed variables. QDM is applied to the meteorological variables grouped by month – i.e., the bias correction preserves month-specific variability.

Each model under each different SSP represents one possible future climate scenario. Summarizing the models' results by the median or average may facilitate the interpretation and provide insights into agreement among models, but it may hinder extreme conditions that are usually of interest to stakeholders for risk assessment. Thus, SRK chose to show the results for four conditions that will encompass extreme cases of high and low water availability, as well as an average case that will represent the midpoint trend of the GCMs.

Projected climate change effects were evaluated relative to a defined baseline period for three consecutive 30-year forecast periods, defined as follows:

- Baseline period from 1985 to 2014 (CMIP6)
- First forecast period from 2015 to 2040 (CMIP6)
- Second forecast period from 2041 to 2070 (CMIP6)
- Third forecast period from 2071 to 2100 (CMIP6)

One model within the GCM/SSP ensamble was selected to represent each of the following four conditions for each forecast period:

- Minimum long term net water balance (precipitation - evaporation) – $min_{(P-E)}$
- Maximum long term net water balance – $max_{(P-E)}$
- Midpoint condition (median precipitation with median evaporation) – $med_P med_E$
- Lowest long term Precipitation – min_P

These conditions were selected based on the critical components of the Project, and aim to cover climate change related uncertainty during the life of the Project.

The following sections present the climate change analysis for mean annual and monthly air temperature as well as mean annual and monthly precipitation. Changes to lake evaporation and streamflow were also assessed based on the climate change forecasts.

5.3 Model Selection

For each time period, the models were assessed by comparing rates of change for precipitation and evaporation in order to identify extreme and average conditions. Figure 5.2 showcases these rates of change envelope for modelled climate outcomes from the GCM's for all scenarios. Models selected by SRK to illustrate the range of climate change outcomes are highlighted (thick circle lines). The selected models are also presented in Table 5-1.

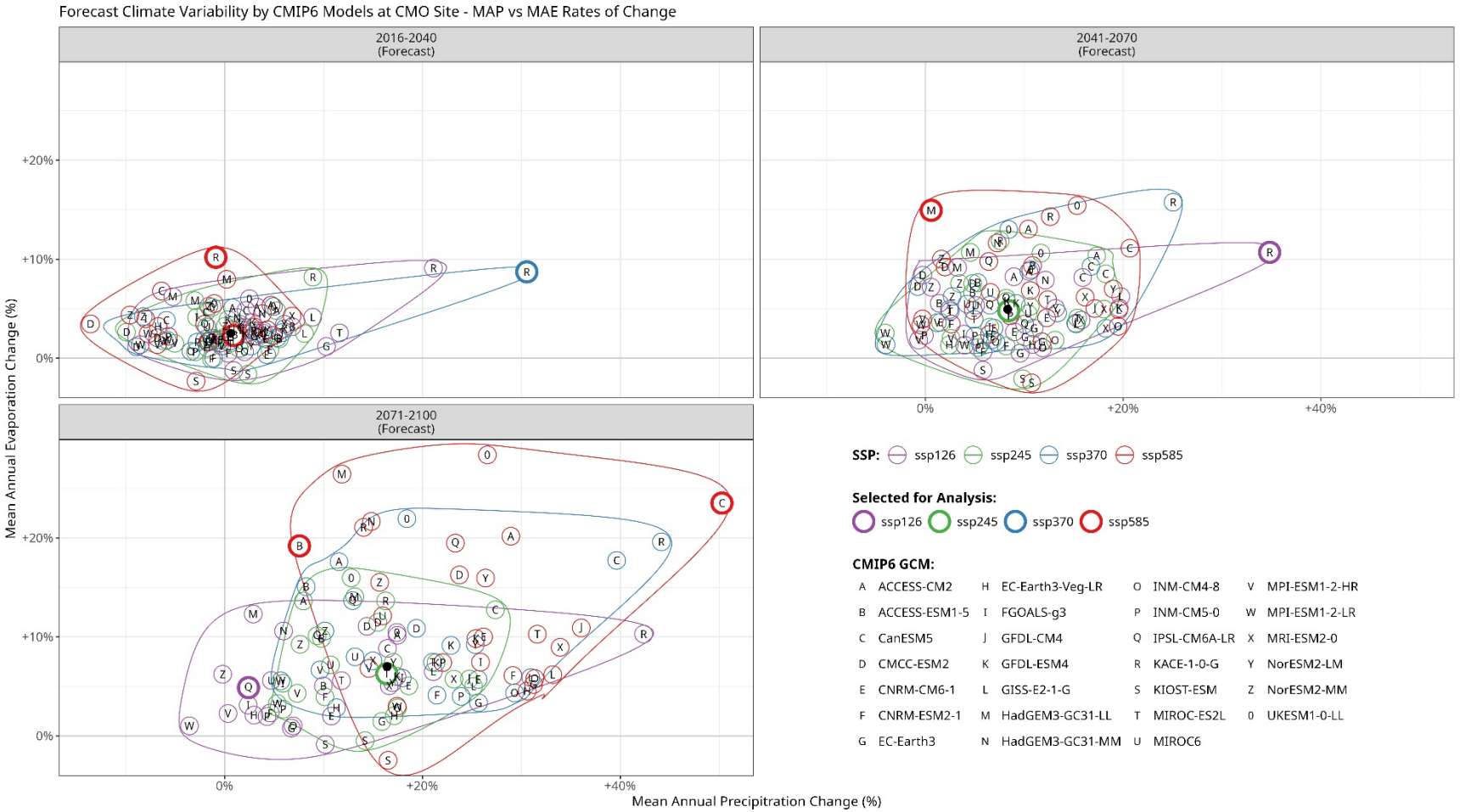


Figure 5.2: Model selection per forecast period

Source: SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\Climate Change Update\figures\cc_model_prcp_evap.tif

Table 5-1: Adopted models for each forecast period

Forecast Period	Condition	Model (SSP)
2015 – 2040	$med_P med_E$	MIROC-ES2L (SSP5-8.5)
	$max_{(P-E)}$	KACE-1-0-G (SSP3-7.0)
	$min_{(P-E)}$	KACE-1-0-G (SSP5-8.5)
	min_P	CMCC-CM2-SR5 (SSP2-4.5)
2051 – 2070	$med_P med_E$	GISS-E2-1-G(SSP2-4.5)
	$max_{(P-E)}$	KACE-1-0-G(SSP1-2.6)
	$min_{(P-E)}$	HadGEM3-GC31-LL(SSP5-8.5)
	min_P	IITM-ESM(SSP3-7.0)
2071 – 2100	$med_P med_E$	MIROC-ES2L(SSP2-4.5)
	$max_{(P-E)}$	CanESM5(SSP5-8.5)
	$min_{(P-E)}$	ACCESS-ESM1-5(SSP5-8.5)
	min_P	IPSL-CM6A-LR(SSP1-2.6)

5.4 Climate Change Effects to Temperature

5.4.1 Annual Temperature Trends

Figure 5-3 presents the mean annual air temperature (MAAT) from the Project record during the baseline period, as well as the historical CMIP6 ensemble results over the same period and the forecasted MAAT for the four different SSPs.

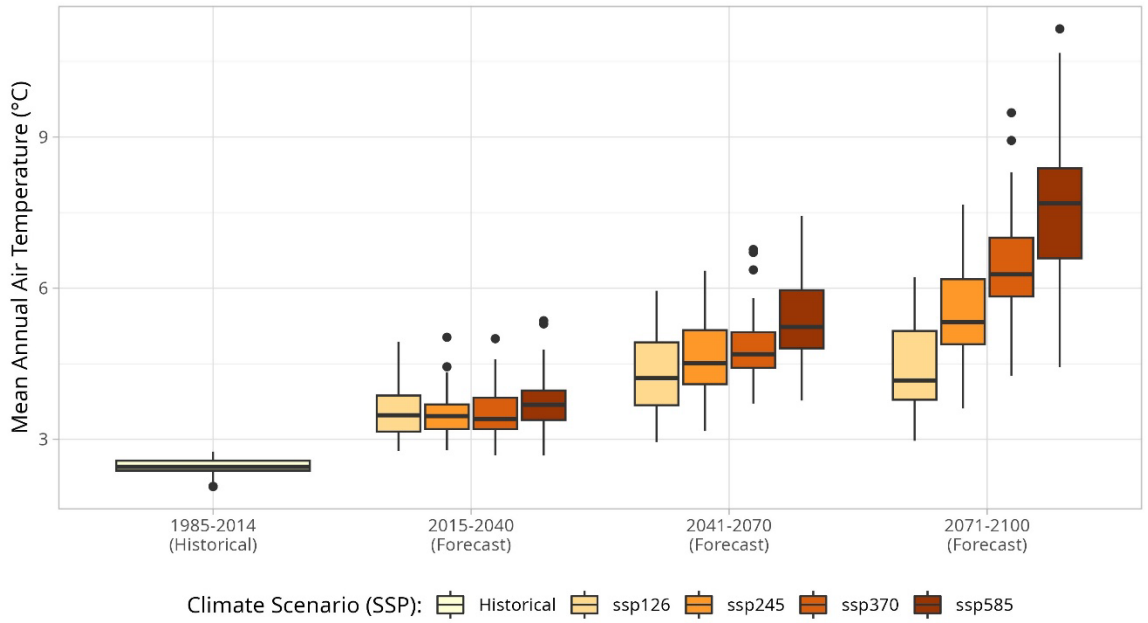


Figure 5-3: Forecast of Climate Change Effect on Mean Annual Air Temperature

Source: SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\Climate Change Update\figures\cc_periods_tavg.tiff

Table 5-2 presents the rates of change relative to the historical results for the four conditions up to year 2100 using CIMP6 data.

Table 5-2: Mean Annual Air Temperature Increase from Baseline (in °C)

Timeframe	$med_P med_E$	$max_{(P-E)}$	$min_{(P-E)}$	min_P
2015-2040	1.0	2.5	2.8	0.4
2041-2070	2.2	3.1	4.1	1.3
2071-2100	2.3	8.2	5.7	1.7

Source: compiled in text from R code SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\Climate Change Update\report\climate_change_rev0.html

Based on the selected scenarios, the mean annual temperature for the Project is expected to increase by 2°C to 8°C by year 2100.

5.4.2 Monthly Temperature Rates of Change

Monthly impacts to temperature as a result of climate change were evaluated using the same methodology as described above. The projections are shown below in Table 5-3 for the four conditions and three time periods.

Table 5-3: Monthly Average Temperature Increase from Baseline (in °C)

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
$med_P med_E$													
2015-2040	0.9	1.0	1.0	1.2	1.0	1.5	1.0	0.9	1.0	0.9	1.3	0.1	1
2041-2070	4.0	-0.4	2.4	1.6	1.2	1.6	2.5	3.6	2.4	2.0	2.7	2.3	2.2
2071-2100	2.6	1.9	1.5	2.1	2.0	2.2	2.4	2.4	2.5	1.6	3.3	2.5	2.3
$max_{(P-E)}$													
2015-2040	1.7	2.1	2.4	1.4	1.3	3.3	3.7	3.2	2.3	1.3	3.0	4.8	2.5
2041-2070	3.1	2.5	2.1	1.9	2.4	3.8	4.5	3.8	3.0	2.1	3.5	4.7	3.1
2071-2100	10.8	8.8	6.3	7.1	9.4	8.0	7.6	8.8	8.2	7.8	8.2	7.8	8.2
$min_{(P-E)}$													
2015-2040	1.6	2.5	3.2	2.1	2.2	3.6	3.6	3.4	2.5	1.5	3.3	4.5	2.8
2041-2070	4.4	3.8	3.5	3.4	4.7	4.6	4.9	4.4	3.4	3.9	4.7	3.0	4.1
2071-2100	5.3	5.2	3.9	5.1	6.2	4.6	7.6	7.1	6.4	6.0	4.9	5.5	5.7
min_P													
2015-2040	-1.4	-0.1	-0.4	0.2	0.8	1.2	2.3	1.3	1	0.3	0.8	-1.3	0.4
2041-2070	-0.4	1.4	1.1	1.5	1.3	1.5	1.3	1.2	1.3	1.2	2.0	1.8	1.3
2071-2100	0.4	2.9	1.6	1.5	2.3	2.3	1.6	1.8	1.9	1.6	1.4	1.5	1.7

Source: compiled in text from R code SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\Climate Change Update\report\climate_change_rev0.html

5.5 Climate Change Effects to Precipitation

5.5.1 Annual Precipitation Trends

Figure 5-4 illustrates the mean annual precipitation (MAP) from the Project record during the baseline period, as well as the historical CMIP6 ensemble results over the same period, and the forecasted forecast MAP for the four different SSPs.

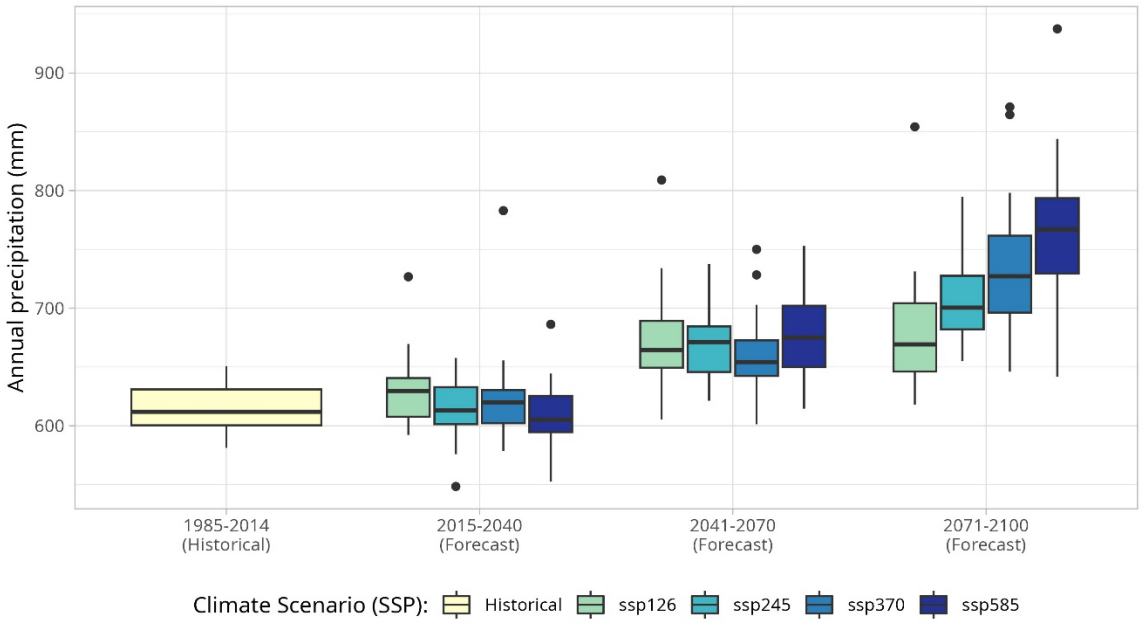


Figure 5-4: Forecast of Climate Change Effect on Mean Annual Precipitation

Source: R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\Climate Change Update\report\climate_change_rev0.html

Table 5-4 presents the percent increase of mean annual precipitation for the three RCPs up to 2100.

Table 5-4: Mean Annual Precipitation Percent Increase from Historical Baseline Average

Timeframe	$med_P med_E$	$max_{(P-E)}$	$min_{(P-E)}$	min_P
2015-2040	1%	31%	-1%	-13%
2041-2070	8%	35%	1%	-5%
2071-2100	16%	50%	8%	2%

Source: R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\Climate Change Update\report\climate_change_rev0.html

5.5.2 Monthly Precipitation Rates of Change

Monthly impacts to precipitation as a result of climate change were evaluated using the same methodology as described above. The projections are shown below in Table 5-5 for the four conditions and three time periods.

Table 5-5: Monthly Average Precipitation Percent Increase from Baseline

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
$med_P med_E$												
2015-2040	14%	-29%	10%	-21%	3%	13%	-2%	-5%	17%	-2%	-8%	15%
2041-2070	18%	-15%	5%	-2%	16%	13%	3%	-15%	30%	19%	5%	10%
2071-2100	46%	-36%	28%	-8%	29%	28%	17%	4%	33%	2%	16%	30%
$max_{(P-E)}$												
2015-2040	83%	1%	34%	9%	35%	92%	38%	-13%	87%	5%	-5%	4%
2041-2070	69%	18%	69%	17%	80%	103%	38%	-13%	69%	4%	8%	-5%
2071-2100	63%	49%	66%	51%	61%	14%	6%	-8%	49%	75%	85%	62%
$min_{(P-E)}$												
2015-2040	19%	-3%	26%	-26%	-18%	-19%	-15%	-28%	-6%	-6%	22%	15%
2041-2070	0%	15%	-19%	-2%	27%	6%	-18%	-31%	5%	27%	3%	-15%
2071-2100	-4%	-17%	36%	58%	26%	-18%	-47%	1%	32%	1%	49%	8%
min_P												
2015-2040	-8%	-19%	-17%	-5%	-17%	-30%	-6%	1%	-6%	-16%	-5%	-19%
2041-2070	-17%	-22%	-14%	-5%	-10%	-15%	-2%	7%	9%	12%	-13%	6%
2071-2100	-6%	21%	9%	-10%	23%	32%	17%	1%	-18%	8%	-20%	4%

Source: compiled in text from R code SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\Climate Change Update\report\climate_change_rev0.html

5.5.3 Extreme Precipitation with Climate Change

Rates of change for extreme precipitation under climate change conditions were estimated for each time period. Rates of change are expressed by the ratio between future and historical precipitation for a set of return periods. For this, the Generalized Extreme Value (GEV) distribution was fitted using L-moments method (Hosking, 2023) to bias corrected historical and future annual maximum daily rainfall to represent extreme precipitation frequency under historical and projected future conditions. The rates of change are provided in Table 5-6 in terms of percentiles. Depth-Duration-Frequency can be obtained by multiplying the historical quantiles (Table 4-8) by the rates of change presented in this section.

Table 5-6: Rates of change for Project Depth-Duration-Frequency Curves with Climate Change

Percentile	Return Period							
	2	5	10	25	50	100	200	1000
Period 2015 – 2040								
10	−9%	−12%	−12%	−15%	−18%	−21%	−24%	−30%
25	−4%	−2%	−3%	−6%	−7%	−10%	−12%	−15%
50	4%	5%	4%	6%	7%	6%	4%	4%
75	11%	13%	15%	18%	22%	25%	29%	34%
90	18%	23%	25%	32%	39%	50%	57%	66%
Period 2041 – 2070								
10	−3%	−5%	−5%	−8%	−10%	−14%	−18%	−24%
25	3%	2%	1%	−1%	−5%	−8%	−10%	−12%
50	11%	10%	10%	9%	12%	14%	14%	15%
75	18%	21%	21%	26%	29%	31%	36%	43%
90	28%	33%	35%	40%	46%	56%	62%	82%
Period 2071 – 2100								
10	2%	2%	2%	−1%	−4%	−5%	−9%	−14%
25	11%	9%	10%	10%	9%	8%	6%	3%
50	20%	20%	21%	23%	24%	25%	26%	28%
75	29%	32%	32%	38%	46%	54%	64%	75%
90	38%	43%	47%	56%	65%	74%	87%	118%

Source: Compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\Climate Change Update\report\climate_change_rev0.html

5.6 Climate Change Effects to Lake Evaporation

Changes to lake evaporation were assessed by updating the Morton CRWE methodology described in Section 2.3.7 with the temperature changes obtained for RCP 4.5 and presented in Table 5-6. The maximum temperature, minimum temperature and dew temperature Project time series were updated using the same net increase rates. Note that the model did not apply a climate change adjustment to solar radiation. Table 5-7 presents the monthly and annual rates of change relative to the baseline lake evaporation.

Table 5-7: Monthly Lake Evaporation Percentual Variation from Baseline

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
$med_P med_E$													
2015-2040	0%	2%	-1%	3%	2%	5%	3%	2%	3%	1%	2%	-0%	**2%**
2041-2070	2%	-0%	2%	4%	1%	3%	6%	13%	6%	1%	1%	1%	**5%**
2071-2100	2%	3%	3%	7%	5%	6%	8%	9%	5%	2%	2%	2%	**6%**
$max_{(P-E)}$													
2015-2040	2%	3%	1%	-1%	2%	14%	16%	15%	6%	0%	4%	4%	**9%**
2041-2070	3%	3%	-0%	1%	3%	15%	21%	15%	12%	3%	4%	4%	**11%**
2071-2100	9%	13%	4%	9%	22%	25%	30%	34%	30%	39%	4%	6%	**24%**
$min_{(P-E)}$													
2015-2040	2%	4%	-1%	2%	1%	18%	19%	15%	9%	2%	5%	4%	**10%**
2041-2070	3%	6%	10%	7%	8%	18%	24%	22%	14%	3%	7%	3%	**15%**
2071-2100	10%	13%	6%	10%	14%	18%	32%	25%	24%	9%	4%	9%	**19%**
min_P													
2015-2040[1]	1%	2%	6%	1%	4%	2%	4%	5%	6%	3%	2%	2%	**3%**
2041-2070[2]	3%	3%	4%	2%	5%	6%	8%	7%	9%	0%	2%	3%	**6%**
2071-2100	1%	3%	1%	1%	4%	7%	5%	7%	9%	1%	2%	2%	**5%**

Source: Compiled in text from R code \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\Climate Change Update\report\climate_change_rev0.html

Notes:
1. Not able to calculate lake evaporation with the selected model. Replaced by the model with second lowest precipitation – CMCC-ESM2 (SSP5-8.5)
2. Not able to calculate lake evaporation with the selected model. Replaced by the model with second lowest precipitation – ACCESS-ESM1-5 (SSP126)

5.7 Climate Change Effects to Streamflow

The calibrated rainfall-runoff model was updated to include the projected rates of change to temperature and precipitation. Calibrated monthly runoff coefficients and baseflow values were incorporated for each major stream. Monthly flows from historic climate were compared against monthly flows projected in 2100 based on the monthly climate change variability.

The runoff model was simulated for 100 realizations under historic conditions and projected climate change conditions (year 2100). The 50th percentile (median), 10th percentile (low flow) and 90th percentile (high flow) statistics were extracted from the realization record, and are compared in each creek for historic conditions versus 2100 climate change conditions.

Historic monthly streamflow for each percentile and both historic and climate change conditions are presented in Figure 5-5 for Goathorn Creek, Figure 5-6 for Tenas Creek, Figure 5-7 for Telkwa River, Figure 5-8 for Bulkley River and Figure 5-9 for Four Creek, where the solid lines represent the median results and dashed lines the 10th and 90th percentiles.

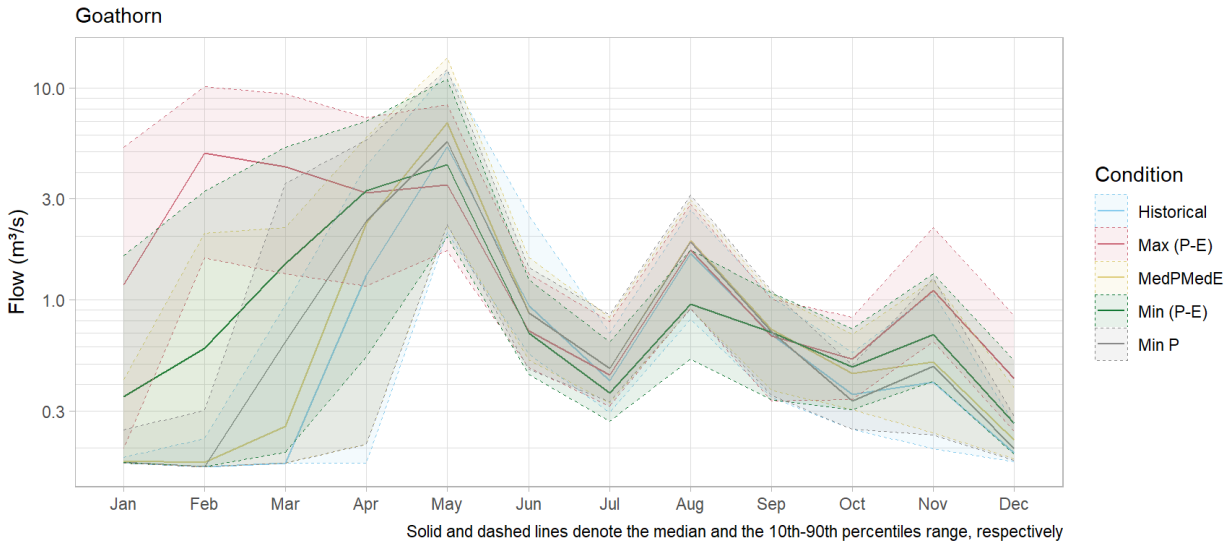


Figure 5-5: Goathorn Creek Monthly Streamflow Summary for Historical Conditions and Climate Change Conditions in 2100

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

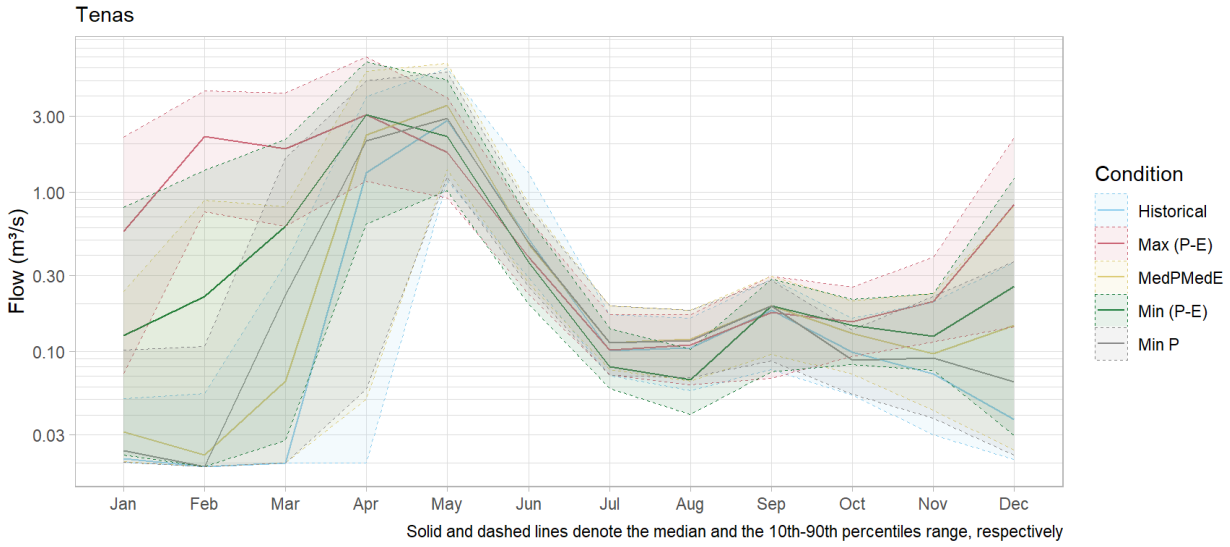


Figure 5-6: Tenas Creek Monthly Streamflow Summary for Historical Conditions and Climate Change Conditions in 2100

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

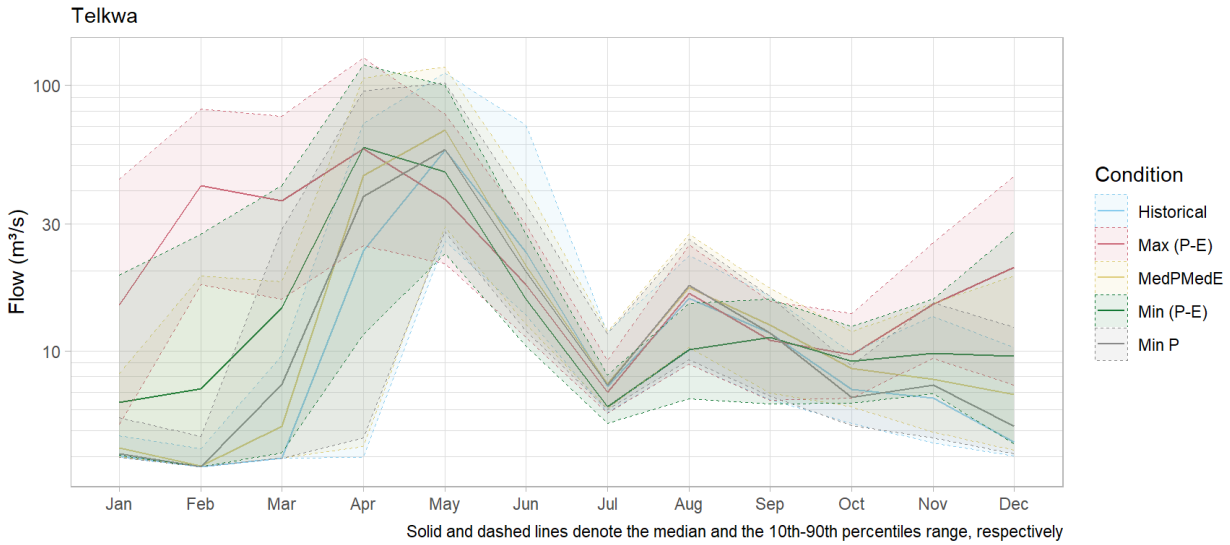


Figure 5-7: Telkwa River Monthly Streamflow Summary for Historical Conditions and Climate Change Conditions in 2100

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

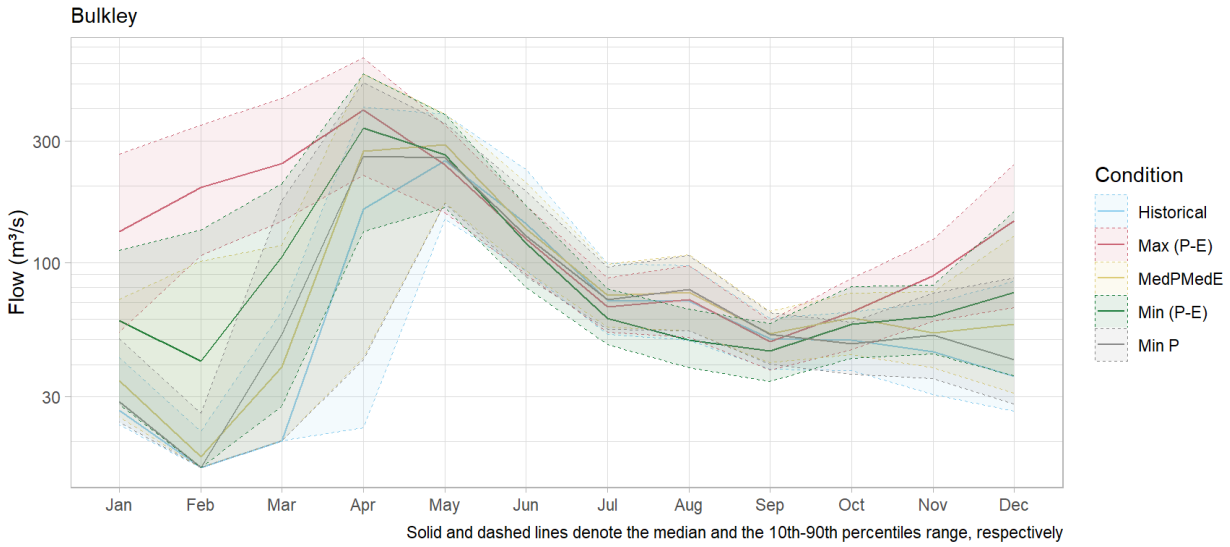


Figure 5-8: Bulkley River Monthly Streamflow Summary for Historical Conditions and Climate Change Conditions in 2100

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

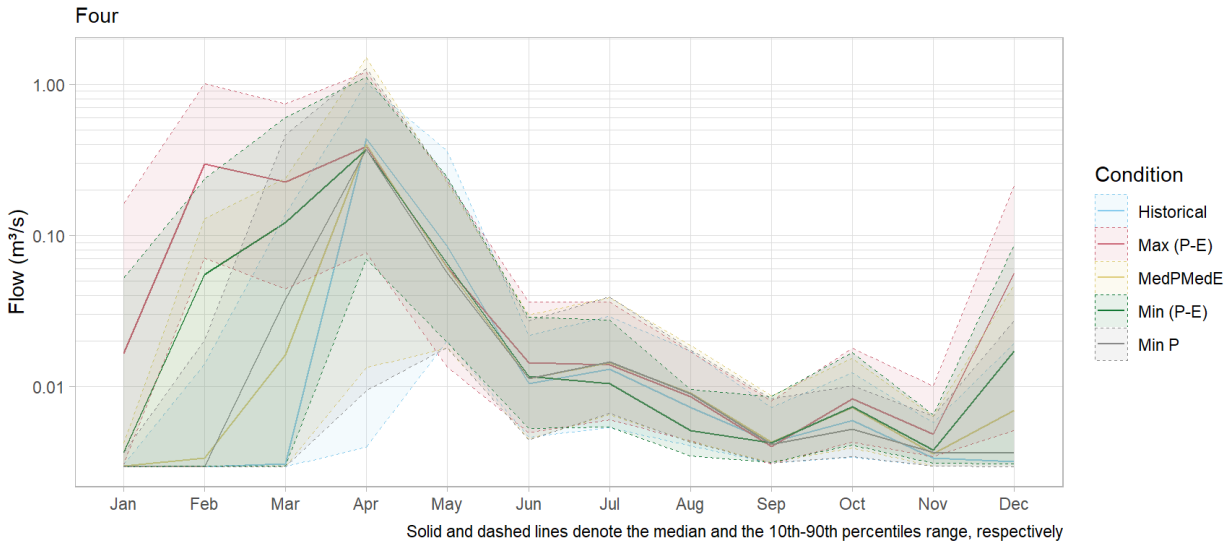


Figure 5-9: Four Creek Monthly Streamflow Summary for Historical Conditions and Climate Change Conditions in 2100

Source: \SRK Consulting\NA CAPR002055 Telkwa Project General EA Support - Internal\200_Review New Climate and Streamflow Data\R_work\reports\01 - Flow Review.html

The general tendency when comparing historic and climate change monthly streamflow is an overall increase in flow magnitude and a shift to an earlier spring freshet. These observations coincide with the climate change projections in Table 5-5, showing even a 2% in annual precipitation by 2100, and a 23% increase in precipitation in May under the model with lowest precipitation increase.

Note that the runoff model relies on a constant unit baseflow value for each river, which was not adjusted for climate change in these predictions. Precipitation is anticipated to decrease during the drier summer months (namely July), which, in combination with the higher evaporation rates in Table 5-7, would be expected to decrease streamflow during the low-flow summer period.

In addition, the changes to seasonality and snowmelt timing would also affect the runoff coefficients. The calibrated runoff coefficients were based on the historical flow regime, which coincides with a spring freshet in May. The monthly runoff coefficients could also be affected by climate change and are an additional limitation of this evaluation approach.

5.7.1 Peak Flow Trends

A trend analysis was carried out by SRK to identify trends and significance of trends for the peak flows from historical records. Ordinary least squares method, and quantile regression method were employed for statistical evaluation of the data. The non-parametric Mann-Kendall (MK) (1945) and Theil-Sen methods, the Prewhitening MK (Zhang 2000) method, and the Prewhitening MK (Yue et al. 2002) method were used for trend analysis. Where a trend was observed (upward or downward), its significance was evaluated. Trends with a significance greater than 95% are accepted as significant.

Goathorn Creek Peak Flow Historical Trend Analysis

Figure 5-10 represents yearly peak flows at the Goathorn WSC station from the extended timeseries, and its linear approximation equation obtained with the ordinary least squares method. Table 5-8 summarizes the results of the Goathorn peak flow trend statistical significance Mann-Kendall tests. No significant trend is observed for all three tests.

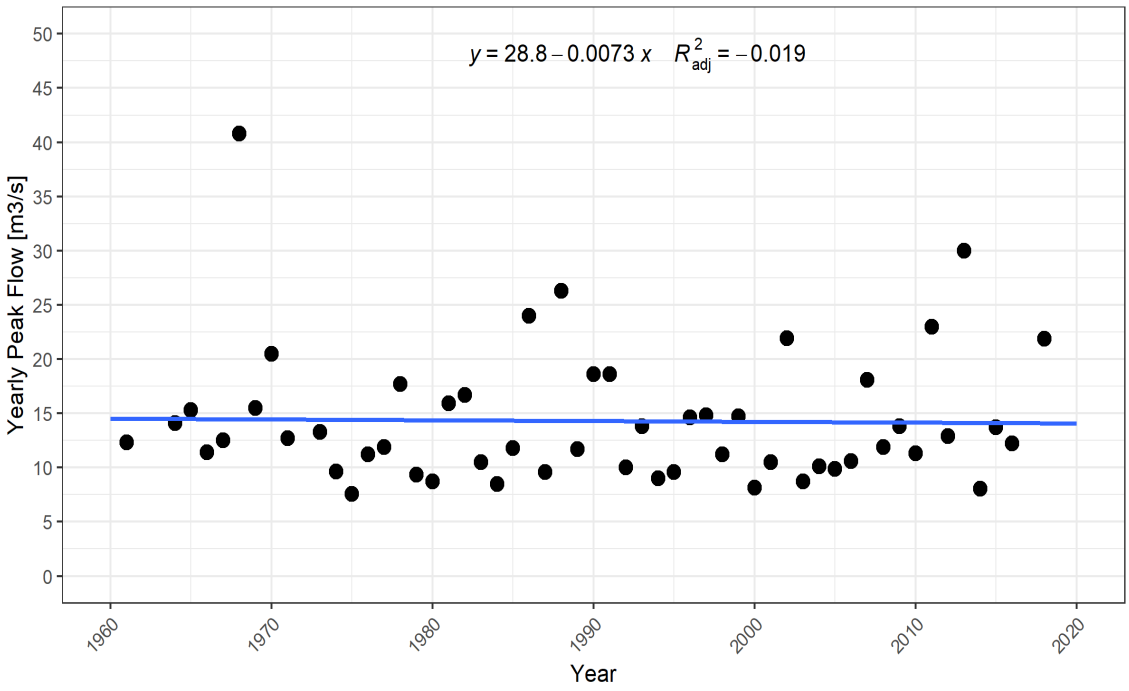


Figure 5-10: Goathorn Peak Flows Trend from 1960 to 2018

Source: from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\Rwork\Telkwa_EA_Flows_Climate_Change.html"

Table 5-8: Mann-Kendall Significance test results for Goathorn Peak Flows

Method	Comment	Significance (%)
MK & Theil-Sen	No Significant Trend	53.3
Prewhit. MK, Zhang	No Significant Trend	53.3
Prewhit. MK, Yue & Pilon	No Significant Trend	59.9

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\Rwork\Telkwa_EA_Flows_Climate_Change.html"

Telkwa River Peak Flow Historical Trend Analysis

Figure 5-10 represents yearly peak flows at the Telkwa WSC station from the extended timeseries, and its linear approximation equation obtained with the ordinary least squares method. Table 5-9 summarizes the results of the Telkwa peak flow trend statistical significance Mann-Kendall tests. No significant trend is observed for all three tests.

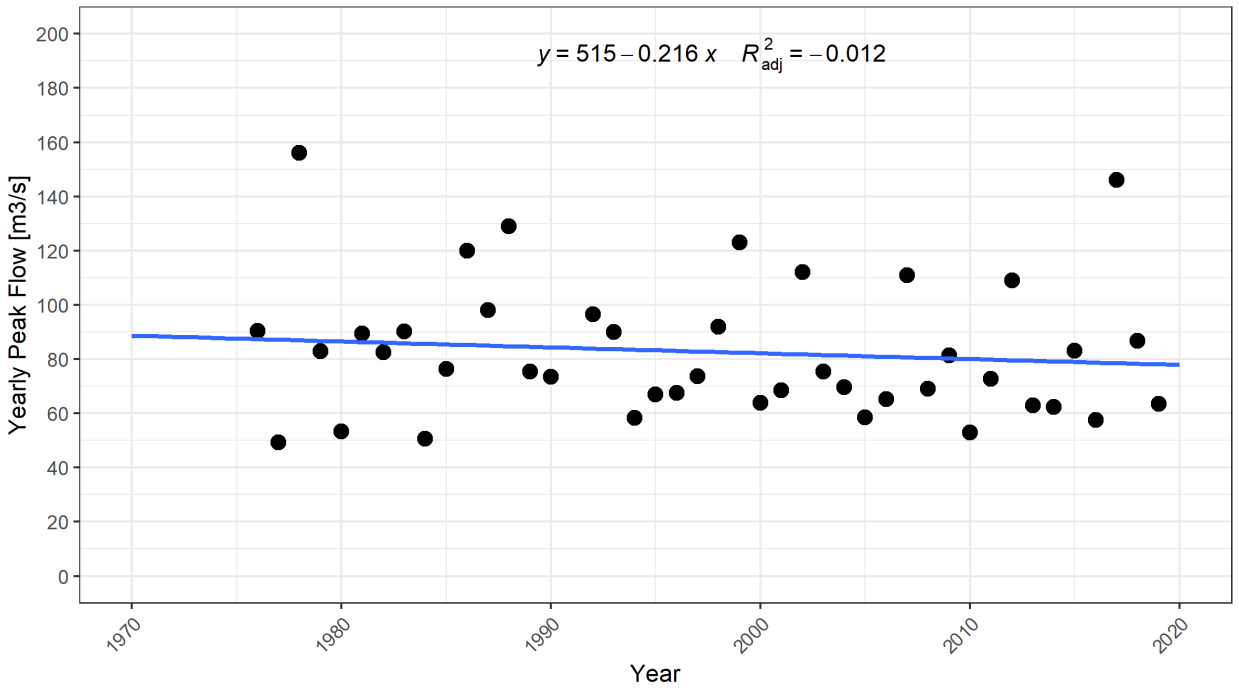


Figure 5-11: Telkwa Peak Flows Trend from 1976 to 2019

Source: from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Flows_Climate_Change.html"

Table 5-9: Mann-Kendall Significance test results for Telkwa Peak Flows

Method	Comment	Significance (%)
MK & Theil-Sen	No Significant Trend	88.4
Prewhit. MK, Zhang	No Significant Trend	88.4
Prewhit. MK, Yue & Pilon	No Significant Trend	83.7

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Flows_Climate_Change.html"

Bulkley River Creek Peak Flow Historical Trend Analysis

Figure 5-10 represents yearly peak flows at the Bulkley River at Quick WSC station from the extended timeseries, and its linear approximation equation obtained with the ordinary least squares method. Table 5-10 summarizes the results of the Bulkley River peak flow trend statistical significance Mann-Kendall tests. No significant trend is observed for all three tests.

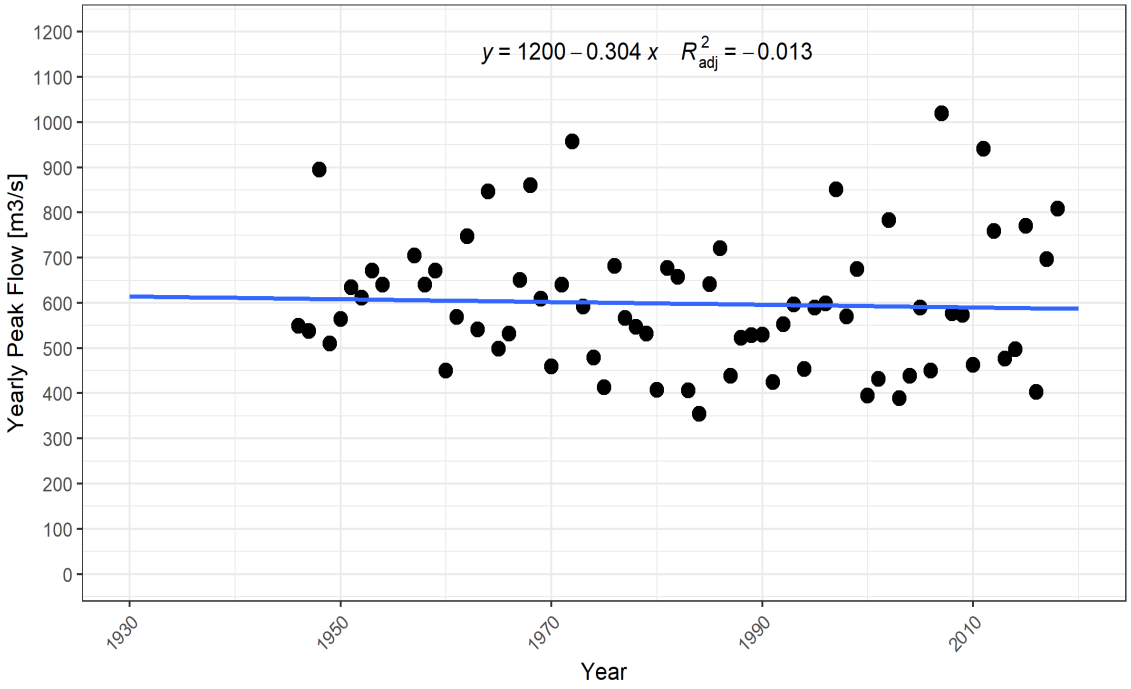


Figure 5-12: Bulkley River Peak Flows Trend from 1976 to 2019

Source: from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Flows_Climate_Change.html"

Table 5-10: Mann-Kendall Significance test results for Bulkley River Peak Flows

Method	Comment	Significance (%)
MK & Theil-Sen	No Significant Trend	77.5
Prewhit. MK, Zhang	No Significant Trend	77.5
Prewhit. MK, Yue & Pilon	No Significant Trend	78.6

Source: compiled in text from R code \\srk.ad\dfs\na\van\Projects\01_SITES\Telkwa Coal\1CT027.003_2020 EA Water Management\200_Meteorology_Update\R work\Telkwa_EA_Flows_Climate_Change.html"

In all streams evaluated, no significant change in peak flow magnitude has been observed historically. This is not to say that a change in peak flows may not occur with projected climate change. Variations with respect to snowmelt timing and rainfall depth may result in higher peaks in the future, however the effects of a thinner snowpack should also be considered. Peak flow models for the purpose of engineering design should incorporate both snowmelt events and climate change depth-duration-frequency rainfall tables presented in Table 5-6.

6 Conclusions and Limitations

Regional analyses coupled with a compilation of Project-specific meteorological and hydrometric datasets were used to develop Project specific hydrometeorological baseline parameters, including long-term temperature and precipitation records. Climate change analysis was updated with CMIP6 data. Climate change effects on temperature, precipitation, evaporation and streamflow are presented as monthly and annual rates of change for three future periods. Results from this study may be used to further advance Project designs and update EA modeling, including the water and load balance model, groundwater model, and design of water management infrastructure.

Available Four Hydro data for 2020, 2021 and 2022 were analysed, along with data collected as part of baseline monitoring in 1997 and 1998. Due to the limited period of record, there is still significant uncertainty regarding Four Creek hydrology. Ongoing monitoring and validation of presented hydrologic indices is required.

The calibrated rainfall runoff model established to support the water and load balance model and runoff estimates for the hydrometric stations underestimates flows in Tenas Creek. This model should be revisited once more flow data is available at Tenas Hydro. However for the purpose of the EA, an underestimated runoff result is more conservative in terms of dilution capacity. Review of the Four-Hydro regressions with Goathorn Creek (08EE008) and calibration model should be performed after an additional year of monitoring data become available.

It is strongly suggested that this study be revisited and that the model be recalibrated when longer Project data records are available from the meteorological station as well as the hydrometric stations, and when all WSC flow data are published. The correlations between meteorological parameters measured at the Tenas Deposit Station and the regional stations should be improved by assessing a longer period of Project record from the Tenas Deposit Station. An initial analysis of the precipitation record showed that recent years were drier than average, which may create bias in the extended Project precipitation record. Complete water years (from October to September of the following year) are critical in any assessment of the hydrological regime and longer flow data series will improve streamflow regressions and provde a robust calibration dataset.

This report, Tenas Project – Hydrometeorological Baseline and Model Development Report (update 2025), was prepared by

This signature has been scanned with the express approval of the author for exclusive use on this document; no other use is authorized

Julio Lobo,
Consultant

and reviewed by



Samantha Barnes, PEng
Principal Consultant

EGBC Permit to Practice Reg. No.: EGBC 1003655

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

Disclaimer—SRK Consulting (Canada) Inc. has prepared this document for Telkwa Mining Ltd. Any use or decisions by which a third party makes of this document are the responsibility of such third parties. In no circumstance does SRK accept any consequential liability arising from commercial decisions or actions resulting from the use of this report by a third party.

The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

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Attachment A AGRA 1999 Report

received April 5/2000

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental Limited
Box 3966
#3, 3167 Tatlow Road
Smithers, BC
Canada V0J 2N0
Tel (250) 847-8783
Fax (250) 847-9049

March 28, 2000
KS00076

Luscar Ltd.
1600 Oxford Tower
10235 – 101 Street
Edmonton, A.B. T2P 3V4

Attention: Mr. Allan Flemming

Dear Mr. Flemming:

RE: TELKWA COAL PROJECT 1999 BASELINE SURFACE FLOW AND WATER QUALITY FINAL DATA REPORT

AGRA Earth & Environmental Limited (AGRA) is pleased to submit two copies of the *Telkwa Coal Project 1999 Baseline Surface Flow and Water Quality Final Data Report*. The report presents the results of the 1999 field monitoring program conducted by AGRA for Luscar Ltd. on the proposed Telkwa Coal Project.

AGRA understands that the recent state of the coal industry has put the proposed Telkwa Coal Project on hold. AGRA looks forward to working with Luscar Ltd. on the proposed Telkwa Coal Project when the decision to proceed with the project is made. Should you have any questions or comments regarding this report, or require any support on this, or other projects, please do not hesitate to contact the undersigned at (250) 847-8783.

Respectfully submitted,

AGRA Earth & Environmental Limited

Scott Davidson, P.Geo., M.Sc.
Geomorphologist

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental Limited
Box 3966
#3, 3167 Tatlow Road
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Fax (250) 847-9049

March 27, 2000
KS00076

Luscar Ltd.
1600 Oxford Tower
10235 - 101 Street
Edmonton, Alberta T2P 3V4

Attention: Mr. Allan Flemming, P.Eng. Fax: (780) 420-5875

Dear Mr. Flemming:

RE: TELKWA COAL PROJECT 1999 BASELINE DATA REPORT

1.0 INTRODUCTION

AGRA Earth & Environmental Limited is pleased to present the 1999 Baseline Surface Water Flow and Water Quality Monitoring Report for the Telkwa Coal Project (TCP). The TCP is a proposed open pit coal mine located near Telkwa, B.C. and owned by Luscar Inc. (Luscar). The location of the mine is illustrated on Figure 1. This report contains the data collected during the 1999 baseline monitoring program and updates the rating curves for sites where discharge measurements were conducted.

2.0 SCHEDULE OF 1999 SITE VISITS

The schedule of site visits for the 1999 field monitoring program is contained in the March 3, 1999 AGRA proposal to conduct the TCP baseline monitoring. A copy of the AGRA proposal is contained in Appendix A for reference. The dates of actual site visits and a listing of the work conducted during the site visits is contained in Table 1.

TABLE 1: 1999 MONITORING SITE VISITS

Week of:	Feb 1	Aug 1	Sept 19	Nov 14
Telkwa River	WQ		WQ	
Upper Tenas Creek	No site access		SM, WQ, Q	S
Lower Tenas Creek	WQ, Q	S	SM, WQ, Q	S
Bulkley River	WQ		WQ	
Hubert Creek	WQ, S	S	WQ, S	S
Four Creek	WQ	S	WQ, Q	S
Upper Goathorn Creek	WQ, Q		SM, WQ, Q	S
Lower Goathorn Creek	WQ		WQ	

Q = Discharge and stage measurements conducted
S = Stage measurements conducted
WQ = Water quality sampling conducted
SM = Site Maintenance Visit

The purpose of the August field trips was to collect peak flow information from the crest gauges at each site.

3.0 SURFACE WATER MONITORING RESULTS

This section contains a summary of the five sites where surface water monitoring was conducted during the 1999 field season. Summary field data for the site visits is contained in Appendix B.

3.1 LOWER TENAS CREEK SITE

The Lower Tenas Creek site was visited four times as part of the 1999 monitoring program. The station was operated as a manual sampling with no installation of the automated equipment used in previous years.

The two low flow discharge measurements conducted during February and September yielded discharges of 0.041 m^3/s and 0.163 m^3/s respectively. These discharge measurements have been added to the rating curve and a revised rating curve for this site is shown in Figure 2.

An initial crest gauge installed in late 1998 at the site was replaced during the 1999 sampling season. Level surveys conducted at the site during the 1999 field season did not show significant shift of the benchmarks or the staff gauge. There was evidence of sand deposition noted near the gauge during the November 1999 field visit.

3.2 UPPER TENAS CREEK SITE

The upper Tenas Creek was visited twice during the 1999 monitoring program. There was no site access during the February 1999 field trip. As the crest gauge for this site was not checked and reset during February, this site was not visited during the August field trip.

The crest gauge was checked during September and the maximum stage was observed to be 0.70 m. This value would translate to a discharge of 8.43 m^3/s and is expected to be due to the spring freshet which consistently produces greater discharges than the fall peak flows. The low flow measurement from September 20th was 0.134 m^3/s. An updated rating curve for this site is shown in Figure 3.

The September field visit to this site showed that the braces for the staff gauge had snapped but that the staff gauge did not appear to have shifted (based on a review of previous site photographs). Braces at the site were replaced and a third benchmark was added on the right bank side of the stream. Levelling checks showed that there was no significant shift of the benchmarks or the staff gauge during 1999. The breakage of the braces resulted in slight downstream leaning of the staff gauge mounting but this was corrected during the site maintenance visit.

3.3 UPPER GOATHORN CREEK SITE

The Upper Goathorn Creek site was visited four times during the 1999 monitoring program. The station was monitored as a manual station with a staff gauge and crest gauge.

The two low flow discharge measurements conducted during February and September yielded discharges of 0.097 m^3/s and 0.337 m^3/s respectively. These discharge measurements have been added to the rating curve and a revised rating curve for this site is shown in Figure 4.

Maintenance of the gauge equipment was conducted during the September visit. The bracing for the staff gauge was reinforced and the staff gauge was lowered by a distance of 0.19 m. A second staff gauge was added to the top of the first staff gauge to allow for visual measurement of peak flow levels during the freshet period. The level check of benchmarks showed that there were no changes in the elevations of the benchmarks. The staff gauge did not show any significant shift during the 1999 season.

3.4 FOUR CREEK SITES

Two sampling locations were operated on Four Creek during the 1999 field season. The low flow discharge measurements were made at the lowest culvert crossing of Four Creek on the 120 Road. Other stage measurements and water quality sampling were conducted at the original stream flow sampling site located approximately 1,800 m upstream of the culvert crossing on Four Creek.

Discharges for the low flow periods were determined by calculation of the discharge through the culvert based on the known inlet water levels and the culvert characteristics. The February low flow measurement revealed that there was only a small quantity of baseflow (< 1L/min) during the sampling trip. The culvert was almost completely iced up. The September low flow discharge for the culvert was calculated to be 0.077 m^3/s.

3.5 HUBERT CREEK SITE

The Hubert Creek site was visited four times during the 1999 monitoring program. Readings for the staff gauge are available from two of the site visits. Visits conducted during September and November did not yield useful data on flow levels due to numerous partial blockages of the culvert inlet by debris.

The crest gauge at the site indicated that there was a recorded stage greater than 1.23 m during the spring 1999 freshet period. This high stage is believed to be partially due to beaver debris blockage of the inlet of the Hubert Creek culvert.

4.0 WATER QUALITY MONITORING RESULTS

In 1999, baseline water chemistry was sampled during the two low flow periods at ten sites in the proposed Telkwa Coal Project area. The data for the February 1999 water quality monitoring was forwarded directly to Luscar as previously arranged. The laboratory results for

the September water quality trip are included in Appendix C of this report. No analysis of the testing data, other than to identify specific stations where the BC Water Quality Criteria (Nagpal, 1995) were exceeded. A summary of metals and stations where exceedances occurred are summarized in Table 2. Due to operator error, no replicate sampling was conducted during the September water quality monitoring trip.

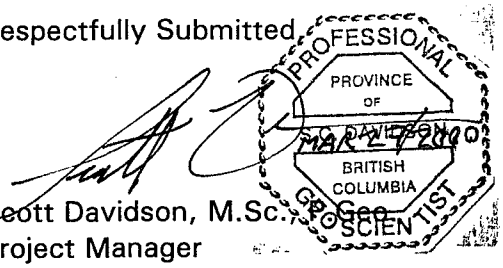
TABLE 2: B.C. WATER QUALITY CRITERIA EXCEEDANCE INFORMATION FOR THE SEPTEMBER 20, 1999 SAMPLING TRIP

METAL	B.C. WATER QUALITY CRITERIA	STATIONS WITH TOTAL METALS CONCENTRATIONS GREATER THAN THE B.C. CRITERIA	STATIONS WITH TOTAL METALS CONCENTRATIONS EQUAL TO THE B.C. CRITERIA
Cr	2.0 ug/L	Telkwa River (2.5)	Upper Goathorn Creek, Lower Goathorn Creek, Bulkley River, Hubert Creek, Lower Tenas, Four Creek
Cu	2.0 ug/L	Telkwa River (2.4)	
Fe	0.3 mg/L	Telkwa River (0.8), Hubert Creek (1.03), Bulkley River (0.33)	
Zn	3.0 ug/L	Telkwa River (3.5)	

5.0 CLOSURE

AGRA Earth Environmental Limited is pleased to present this 1999 data summary to Luscar Ltd. AGRA looks forward to continuing to work with Luscar on the Telkwa Coal project over the 2000 season. Should you have any questions concerning this project please do not hesitate to contact the undersigned at (250) 847-8783.

Respectfully Submitted,

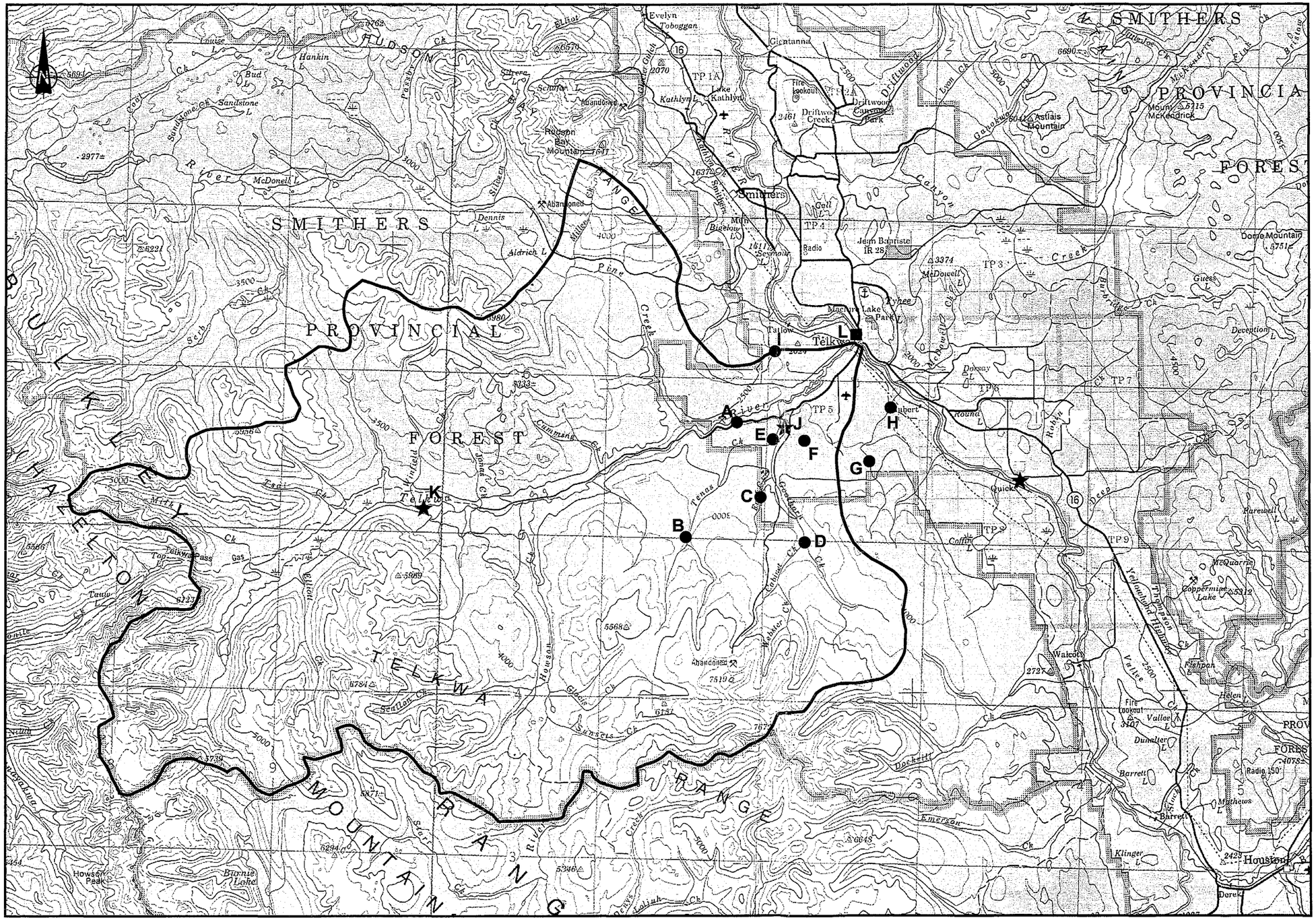


Scott Davidson, M.Sc., Geo.
Project Manager

Reviewed by,

Gary R.E. Beckstead, M.Sc., P.Eng.
Senior Water Resource Engineer

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SCD\SCD



0 5 10 15 20 25 Kilometres

Scale 1 : 250 000

LEGEND

- Telkwa River Watershed
- ★ Existing WSC Station
- ■ Water Quality Station
- ● Hydrometric & Water Quality Site
  - A Lower Telkwa River
  - B Upper Tenas Creek
  - C Four Creek
  - D Upper Goathorn Creek
  - E Lower Tenas Creek
  - F Tailings Pond Drainage
  - G Helps Creek
  - H Hubert Creek
  - I North Site
  - J Lower Goathorn Creek
  - K Upper Telkwa River
  - L Bulkley River

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

CLIENT:	LUSCAR LTD.
PROJECT:	TELKWA COAL PROJECT

APPROXIMATE LOCATIONS HYDROMETRIC AND WATER QUALITY SITES

DATE:	MAR. 2000
JOB No.:	KS00076
COREL FILE:	N/A
FIGURE 1	REV. -

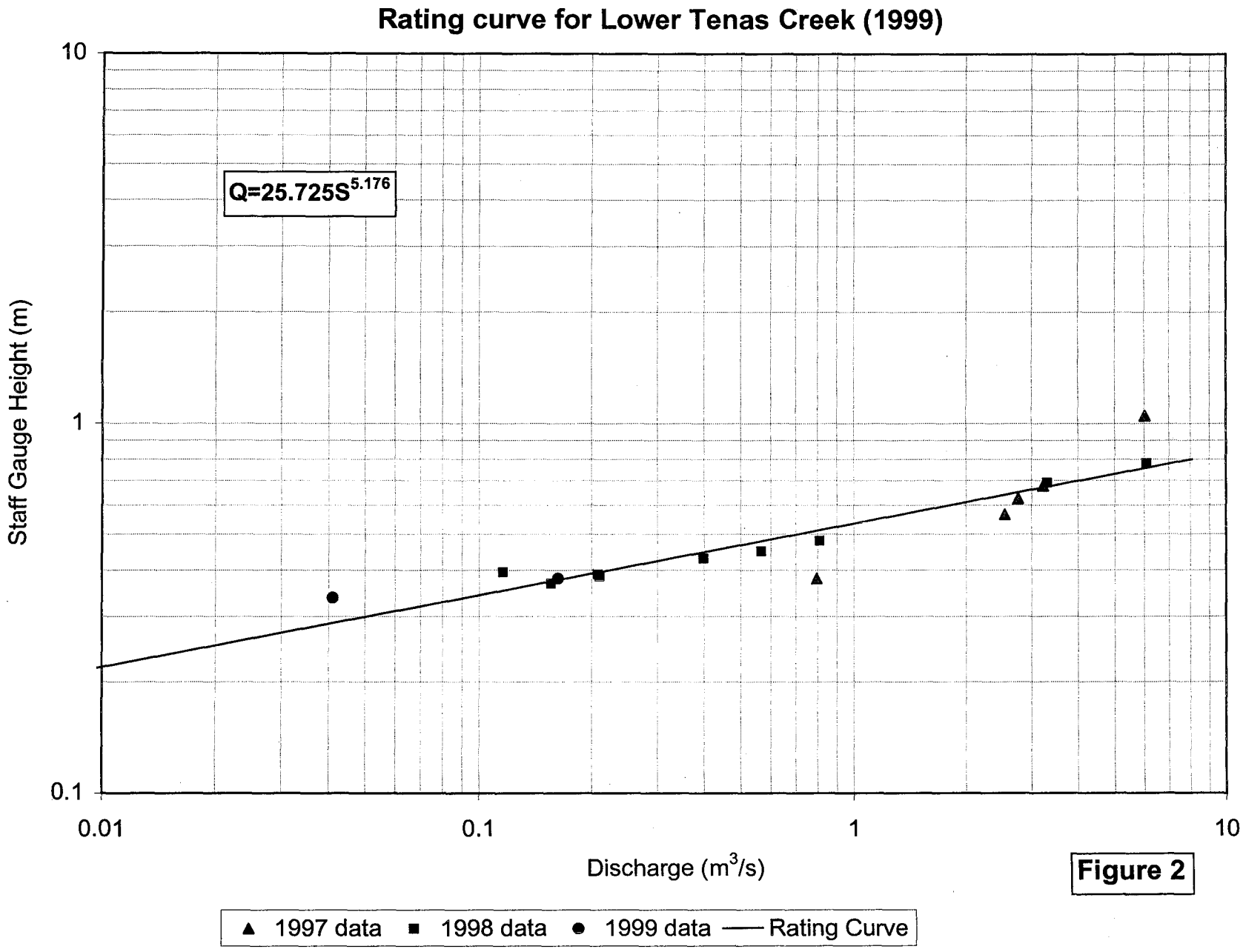

Rating curve for Lower Tenas Creek (1999)
Q=25.725S^5.176
Staff Gauge Height (m)
10
1
0.1
0.01
0.1
1
10
Discharge (m3/s)
1997 data
1998 data
1999 data
Rating Curve

Figure 2

Rating Curve for Upper Tenas Creek (1999)

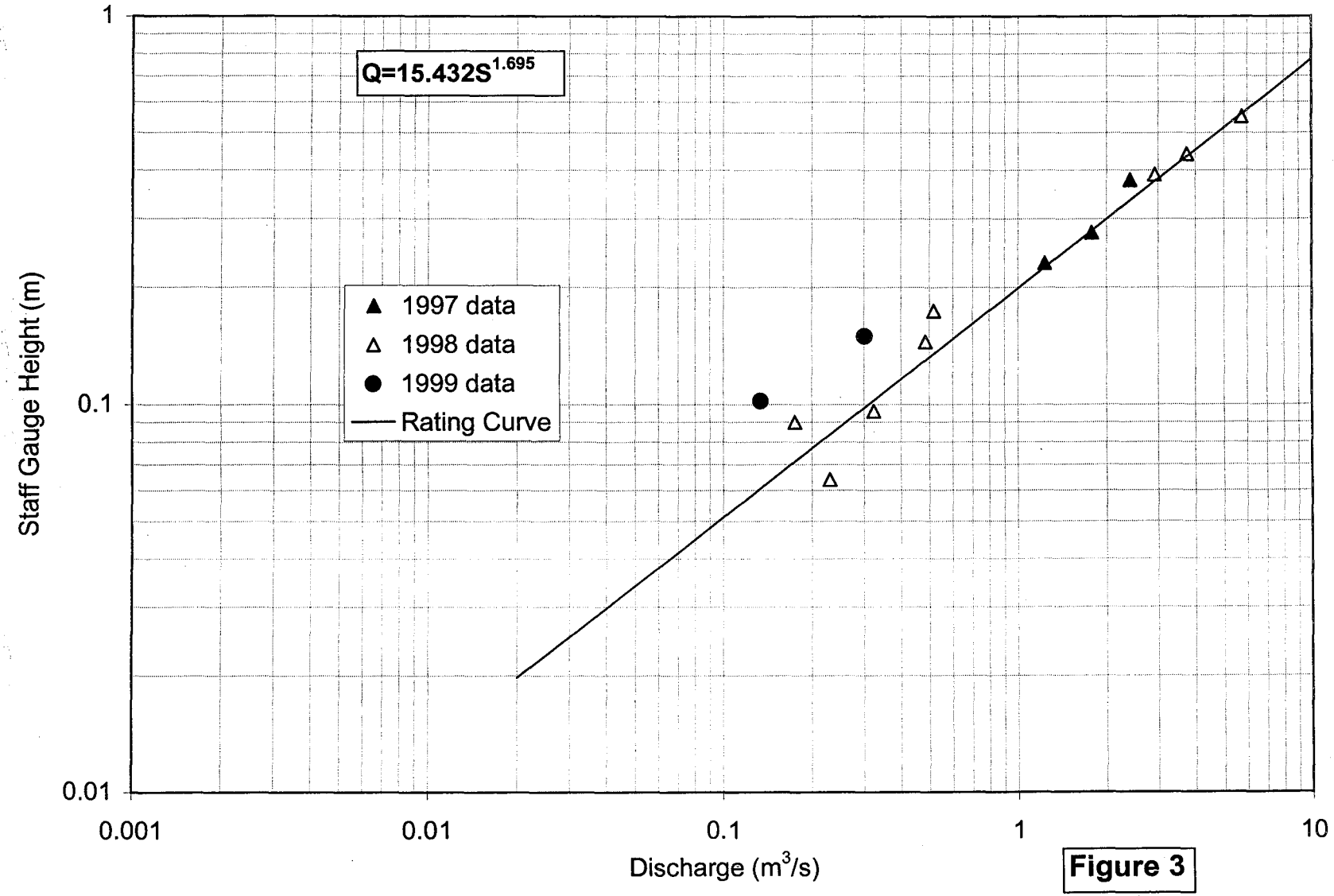


Figure 3

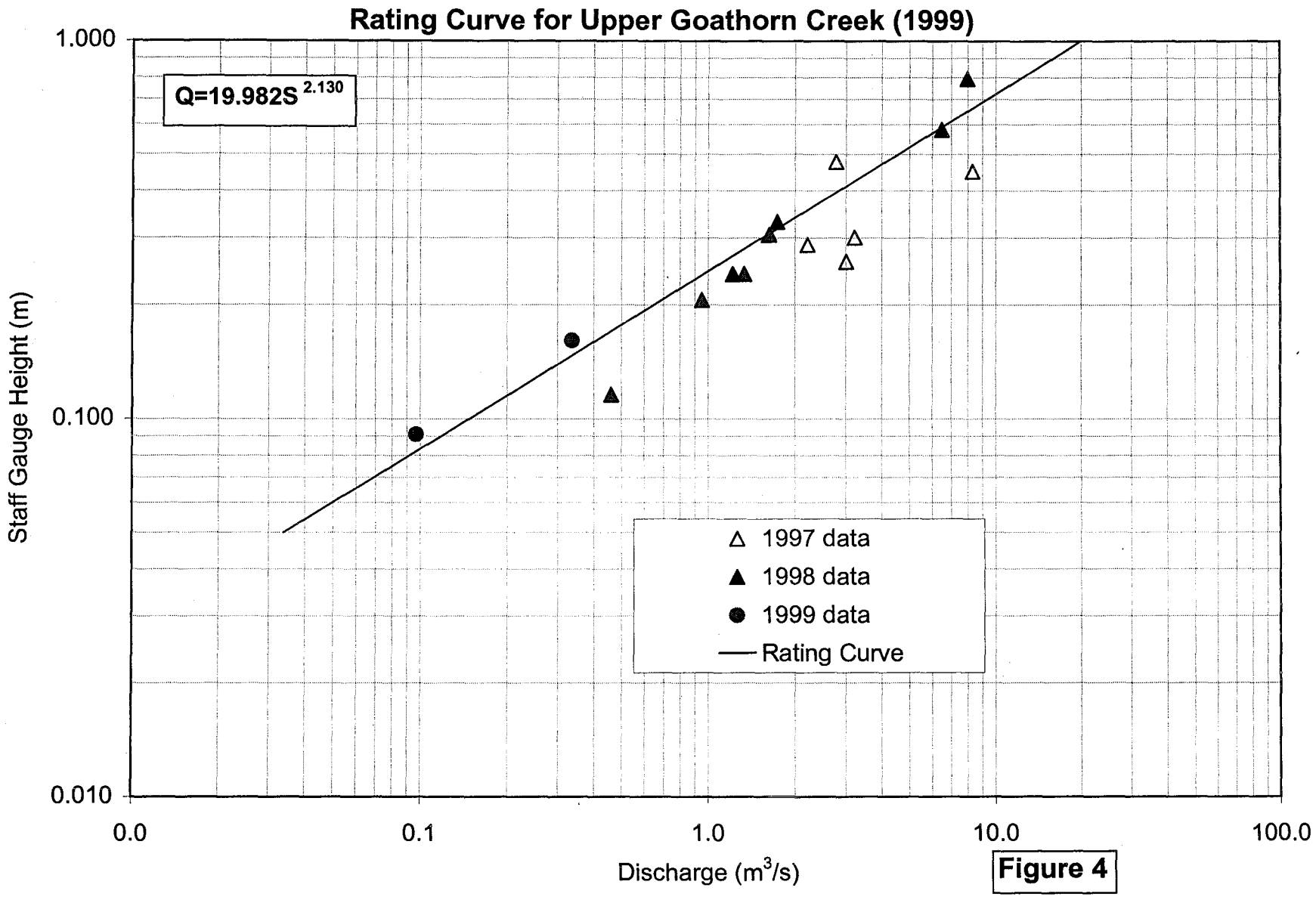


Figure 4

AGRA ENGINEERING GLOBAL SOLUTIONS

APPENDIX A

AGRA PROPOSAL FOR 1999
TELKWA COAL MONITORING PROGRAM

AGRA
ENGINEERING GLOBAL SOLUTIONS

March 2, 1999
CW1537.1

Luscar Ltd.
1600 Oxford Tower
10235 - 101 Street
Edmonton, Alberta T2P 3V4

Attention: Mr. Allan Flemming, P.Eng. Fax: (403) 420-5875

Dear Mr. Flemming:

RE: TELKWA COAL PROJECT 1999 BASELINE DATA REPORT

1.0 INTRODUCTION

AGRA Earth & Environmental Limited is pleased to present this proposal to conduct the 1999 Baseline Surface Water Flow and Water Quality Monitoring Report for the Telkwa Coal Project (TCP). The TCP is a proposed open pit coal mine located near Telkwa, B.C. and owned by Luscar Inc. (Luscar). This report contains the data collected during the 1999 baseline monitoring program and updates the rating curves for sites where discharge measurements were conducted.

2.0 SCHEDULE

SURFACE WATER MONITORING

AEE is pleased to present this revised budget for the 1999 baseline water flow and water quality program for the proposed Telkwa Coal Project. It is the understanding of AEE that during 1999 Luscar should be submitting the Final Project Report to the B.C. Environmental Assessment Office. Following certification of the project, it is the understanding of AEE that the entire surface water and water quality program may need to be revised to meet the construction plan for the mine.

2.0 WORK PROGRAM AND BUDGET

The work program proposed for 1999 is as follows:

Surface Water Flow

- Concentration of the base program on the winter and summer low flow periods.
- Monitoring of low flows on Four Creek, Hubert Creek, Tenas Creek, Upper Goathorn Creek and Lower Goathorn Creek. No monitoring will be conducted on Helps Creek, Telkwa River, and the Bulkley River. Low flow monitoring will result in two site visits. To reduce cost to Luscar, AEE has scheduled the summer low flow period measurement trip to

coincide with site visit #3 described below.

- Monitoring of peak flows at the streams using crest gauges already installed at all of the existing sites. To conduct this portion of the required work, AEE will conduct a total of four sites visits planned as follows:

1. Pre-freshet to set up crest and staff gauges and survey to local bench marks (April),
2. Post freshet to record peak flow during period and survey to local bench marks (June),
3. Pre fall high flow period to re-survey benchmarks and survey to local bench marks (late August to early September),
4. Post fall high flow to record peak flow and survey to local bench marks (November).

Water Quality

- Sampling of baseline parameters for the two low flow periods only.

Data Analysis

AEE proposes to conduct data analysis and reporting for the 1999 sampling program following each monitoring trip. A data analysis period has been allowed following each of the five surface flow site visits (one low flow and four peak flow visits) described above. The information reports from each trip will assist Luscar in public meetings by providing the most up to date information on the project.

Project Management

Project management involves dealing with items such as cost control, client liaison, and interfacing with other consultants working for Luscar on the proposed Telkwa Coal Mine. For the 1999 sampling program, AEE proposes to conduct project management on a cost plus basis. The totals for this item in the attached Table 1 represent estimates of the total budget required for project management. AEE will make every effort to ensure that it conducts stringent cost control on the project management for Luscar. Project management for the 1999 program will be conducted by Mr. Scott Davidson, M.Sc., P.Geo. of the Smithers office. Mr. Gary Beckstead, M.Sc., P.Eng. and Mr. Dennis Trotter will provide technical input and review to the project as required.

3.0 CLOSURE

We thank you for the opportunity to provide engineering and environmental services to this project and look forward to continuing to work with Luscar on the proposed Telkwa Coal Mine during 1999. If you have any questions or require further information concerning this project, please call Scott Davidson at (250) 847-8783 or Gary Beckstead at (403)235-8118.

Yours sincerely,

AGRA Earth & Environmental Limited

Reviewed by

Scott Davidson, M.Sc., P.Geo.
Project Manager

Gary R.E. Beckstead, M.Sc., P.Eng.
Senior Water Resource Engineer

C:\files\working\Luscar\1999\revised budget99.wpd
cc. Gary R.E. Beckstead, AEE - Calgary

APPENDIX B

SUMMARY OF 1999 FIELD DATA

Telkwa Coal Project Field Note Summary for 1999 Sampling Season

Hubert Creek

Date	Aug 3/99	12:47	Sept 21/99		Nov 18/99
SG	0.1		0.945		
Crest	>1.23				
		Diff to SG			
HI	1.65				
Top SG	2.463		Culvert Blocked by Beaver Debris		Culvert Blocked by Beaver Debris
Top Crest	2.464				
Telephone Pole	1.221	-1.242			
Top Box	0.5	-1.963			

Four Creek

			Site					
Date	Aug 3/99	13:25	Sep-20	11:40	Nov 18/99	12:15		
SG	0.18		0.182		0.185			
Crest	0.4		0.55		0.2			
		Diff to SG					Diff to SG	
HI	1.63				1.5621	1.5367		
Top SG	0.754				0.687	0.692		
Top Crest	0.506			Set up 1		0.444	Set up 2	
BM1	0.005	-0.749		-0.72	-0.033	0.038	-0.654	
BM2	0.215	-0.539		-0.54	0.147	0.151	-0.541	
			Culvert depth	0.08	Culvert depth	0.1		
			Sept 21/99	10:15	Nov 18/99	11:45		

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ENGINEERING GLOBAL SOLUTIONS

Lower Tenas Creek

	Aug 3/99	14:30	Sept 20/99	15:15		Nov 18/99	13:15	
SG	0.43		0.38			0.37		
Crest						0.25		
		Diff to SG		Diff to SG				Diff to SG
HI	1.6					1.6129		
Top SG	3.778		3.765			3.78	3.815	
Top Crest			3.275		Set up 1		3.325	Set up 2
BM1	1.18	-2.598	1.162	-2.603	-2.613	1.167	1.203	-2.612
BM2	1.227	-2.551	1.215	-2.55	-2.559	1.221	1.255	-2.56

Comments: Sand deposition near gauge

Upper Goathorn Cr.

	Sept 20/99	Sept 21/99	14:35		Nov 18/99	10:15	
SG	-0.03	0.12			0.075		
Crest					frozen shut		
			Diff to SG				Diff to SG
HI					1.6891	1.65735	
SG (to 1 m mark)		0.843			0.916	0.881	
Top Crest		1.546		Set up 1		1.585	Set up 2
BM1		0.185	-0.658	-0.659	0.257	0.221	-0.66
BM2		1.399	0.556	0.553	1.469	1.433	0.552

Comments: SG lowered 0.191 m
CG lowered 0.11 m

4" snow on ground
SG surveyed to 2 m mark

AGRA
ENGINEERING GLOBAL SOLUTIONS

Upper Tenas Cr.

		Sept 20/99				Nov 18/99		11:30	
SG		0.15				0.08			
Crest		0.18	0.7 read previous day			0.25			
			Diff to SG						Diff to SG
HI		1.71				1.651			
Top SG		1.035	1.035			0.972		1.022	
Top Crest	Set up 1	0.821		Set up 2	Set up 1			0.823	Set up 2
BM1	-0.969	0.066	0.066	-0.969	-0.967	0.005		0.071	-0.951
BM2	-0.97	0.065	0.065	-0.97	-0.967	0.005		0.07	-0.952
BM3	-0.755	0.28	0.28	-0.755	-0.737	0.235		0.285	-0.737

Site Maintenance Trip
Values for SG and Crest arer post-fix
BM3 added ~ 12m downstream of BM1 and BM2

AGRA
ENGINEERING GLOBAL SOLUTIONS

Discharge MeasurementDeterminations

Site: Lower Tenas 21-Sep-99 15:15
Staff Gauge: 0.38

LOC	REVS	SEC	VEL	DEPTH	Q
3.300	0	0		0.000	0.000
3.600	0	0		0.060	0.000
3.900	2	36.1		0.140	0.000
4.200	3	41.9	0.048	0.200	0.003
4.500	7	44.5	0.106	0.220	0.007
4.800	9	41.7	0.145	0.260	0.011
5.100	13	38.9	0.224	0.280	0.019
5.400	12	42	0.192	0.320	0.018
5.700	17	41.2	0.277	0.330	0.027
6.000	21	43.1	0.327	0.340	0.033
6.300	21	44.5	0.317	0.260	0.025
6.600	18	41.9	0.288	0.220	0.019
6.900	20	41.4	0.324	0.18	0.018
7.200	17	42.4	0.269	0.140	0.011
7.500	16	42.2	0.255	0.12	0.009
7.8	14	40.1	0.234	0.1	0.007
8.1	0	0		0.04	0
8.4	0	0		0.04	0
8.7	0	0		0.08	0
9	0	0		0.08	0
9.3	0	0		0.03	0
9.6	0	0		0	0
				Sum Q:	0.163

AGRA
ENGINEERING GLOBAL SOLUTIONS

Site: Upper Goathorn Cree 20-Sep-99 13:05
Staff Gaug -0.03

LOC	REVS	SEC	VEL	DEPTH	Q
8.700	0	0		0.000	0.000
9.000	0	0		0.030	0.000
9.300	0	0		0.070	0.000
9.600	0	0		0.100	0.000
9.900	12	40	0.201	0.190	0.011
10.200	27	42	0.432	0.220	0.028
10.500	23	45	0.343	0.280	0.029
10.800	35	45	0.522	0.380	0.060
11.100	32	40	0.537	0.320	0.052
11.400	19	42	0.304	0.420	0.038
11.700	29	40	0.487	0.370	0.054
12.000	33	40	0.554	0.390	0.065
12.300	21	41	0.344	0.39	0.040
12.600	38	40	0.638	0.330	0.063
12.900	35	40	0.588	0.35	0.062
13.2	52	41	0.852	0.31	0.079
13.5	48	40	0.806	0.29	0.070
13.8	40	40	0.672	0.24	0.048
14.1	26	42	0.416	0.26	0.032
14.4	23	40	0.386	0.3	0.035
14.7	49	40	0.823	0.24	0.059
15	12	40	0.201	0.26	0.016
15.3	0	0		0	0.000
15.6	0	0		0.07	0.000
15.9	11	40	0.185	0.09	0.005
16	0	0		0	0.000
				Sum Q:	0.337

AGRA
ENGINEERING GLOBAL SOLUTIONS

Site: Upper Tenas 20-Sep-99 11:30
Staff Gauge: 0.102

LOC	REVS	SEC	VEL	DEPTH	Q	
0.400	0	0		0.000	0.000	WW R/B
0.800	0	0		0.000	0.000	behind big rock
1.200	26	42	0.416	0.080	0.013	
1.600	21	42	0.336	0.100	0.013	
2.000	21	41	0.344	0.100	0.014	
2.400	22	42	0.352	0.120	0.017	
2.800	0	0		0.050	0.000	behind big rock
3.200	23	45	0.343	0.090	0.012	
3.600	0	0		0.140	0.000	back eddy behind roc
4.000	14	43	0.219	0.120	0.010	
4.400	41	40	0.688	0.120	0.033	
4.800	27	45	0.403	0.130	0.021	
5.200	28	44	0.427	0.15	0.026	
5.600	15	41	0.246	0.180	0.018	
6.000	16	40	0.269	0.18	0.019	
6.4	30	45	0.448	0.18	0.032	
6.8	22.5	43	0.351	0.14	0.020	
7.2	0	0		0.1	0.000	
7.6	0	0		0.02	0.000	
8	0	0		0		
8.1	0	0		0		L/B
				Sum Q:	0.134	

AGRA
ENGINEERING GLOBAL SOLUTIONS

Upper Tenas 21-Sep-99 11:30
0.15

LOC	REVS	SEC	VEL	DEPTH	Q	
3.500	0	0		0.000	0.000	WW L/B
3.900	0	0		0.070	0.000	Too Shallow to Measure
4.300	17	41		0.080	0.000	
4.700	24	43.9	0.367	0.130	0.019	
5.100	30	43	0.468	0.170	0.032	
5.500	24	40.2	0.401	0.190	0.030	
5.900	34	45.1	0.506	0.220	0.045	
6.300	30	43.4	0.464	0.170	0.032	
6.700	35	38.8	0.606	0.180	0.044	
7.100	35	36.6	0.642	0.180	0.046	
7.500	30	37.1	0.543	0.200	0.043	
7.900	12	41.5	0.194	0.140	0.011	
8.300	15	38.8	0.260	0.14	0.015	
8.700	0	0		0.070	0.000	Too Shallow to Measure
9.100	45	40.6	0.744	0.13	0.039	
9.5	31	41.7	0.499	0.14	0.028	
9.9	20	42.5		0.12	0.000	
10.3	0	0		0.08	0.000	
10.7	0	0		0	0.000	WW R/B
				Sum Q:	0.302	

AGRA
ENGINEERING GLOBAL SOLUTIONS

APPENDIX C

SEPTEMBER WATER QUALITY MONITORING TRIP RESULTS

Chemex Labs Ltd.

Analytical Chemists * Geochemists * Registered Assayers

212 Brooksbank Ave., North Vancouver
British Columbia, Canada V7J 2C1
PHONE: 604-984-0221 FAX: 604-984-0218

To: AGRA EARTH & ENVIRONMENTAL LIMITED ~*

BOX 3966, #3 - 3167 TATLOW ROAD
SMITHERS, BC
V0J 2N0

Project : KS00076
Comments: ATTN: SCOTT DAVIDSON

Certificate Date: 05-OCT-1999
Invoice No. : I9929585
P.O. Number :
Account : OXF

* PLEASE NOTE

CERTIFICATE OF ANALYSIS A9929585

PARAMETER DESCRIPTIONS	SAMPLE LOWER TENAS	SAMPLE TRIP BLANK	SAMPLE UPPER TENAS	SAMPLE FOUR CREEK	SAMPLE UPPER GOATHORN	SAMPLE LOWER GOATHORN	SAMPLE TELKWA RIVER	SAMPLE HUBERT CREEK	SAMPLE BULKLEY RIVER	
Sample preparation code	221	221	221	221	221	221	221	221	221	
Sample preparation code	---	---	---	---	---	---	---	---	---	
pH	8.0	7.9	7.7	8.0	7.9	7.8	7.8	7.3	7.7	
Conductivity (umhos/cm)	147	2	138	230	124	132	63	215	62	
Total Susp Solids (mg/L)	< 5	< 5	< 5	< 5	< 5	< 5	14	< 5	6	
SO4 mg/L - Ion Chrom.	2.9	< 0.1	2.5	1.5	27.4	26.6	4.8	0.5	4.6	
Alkalinity (mg/L CaCO3)	78	< 1	72	130	33	41	29	117	28	
Ammonia (mg/L N)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	
Nitrates (mg/L N)	< 0.05	< 0.05	< 0.05	< 0.05	0.06	< 0.05	< 0.05	< 0.05	< 0.05	
Nitrites (mg/L N)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
Tot Organic Carbon(mg/L)	2.0	< 1.0	2.0	7.0	< 1.0	1.0	< 1.0	15.0	1.0	
Tot Hardness(mg/L CaCO3)	74.3	0.4	67.7	121.0	57.8	62.8	31.6	119.0	30.4	
Tot phosphates (mg/L P)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05	0.04	0.03	
Chloride (mg/L)	0.2	< 0.1	0.1	0.4	0.1	0.2	0.1	0.7	0.2	

CERTIFICATION:

* pH ANALYSED SEPTEMBER 23, 1999, @ 14:15 HRS.

Chemex Labs Ltd.

Analytical Chemists * Geochemists * Registered Assayers

212 Brooksbank Ave., North Vancouver
British Columbia, Canada V7J 2C1
PHONE: 604-984-0221 FAX: 604-984-0218

To: AGRA EARTH & ENVIRONMENTAL LIMITED ~*

BOX 3966, #3 - 3167 TATLOW ROAD
SMITHERS, BC
V0J 2N0

Project : KS00076
Comments: ATTN: SCOTT DAVIDSON

Page Number : 1-A
Total Pages : 1
Certificate Date: 11-OCT-1999
Invoice No. : I9929588
P.O. Number :
Account : OXF

CERTIFICATE OF ANALYSIS A9929588

SAMPLE	PREP CODE	Ag ug/L	Al mg/L	As ug/L	Ba ug/L	Be ug/L	Bi ug/L	Ca mg/L	Cd ug/L	Co ug/L	Cr ug/L	Cu ug/L	Fe mg/L	Hg ug/L	K mg/L	Mg mg/L	Mn ug/L	Mo ug/L	Na mg/L	Ni ug/L
LOWER TENAS-TOT	221 2393	< 0.05	0.029	< 1	28.2	< 0.5	< 0.05	21.9	< 0.1	0.08	2.0	1.8	0.14	< 1	0.25	4.09	5.75	< 0.1	3.15	< 0.2
LOWER TENAS-DIS	221 --	< 0.05	0.006	< 1	27.2	< 0.5	< 0.05	21.7	< 0.1	0.08	3.0	2.0	0.10	< 1	0.25	4.04	3.65	< 0.1	3.10	< 0.2
TRIP BLANK-TOT	221 2393	< 0.05	0.027	< 1	< 0.05	< 0.5	< 0.05	0.05	< 0.1	< 0.02	2.0	0.6	0.04	< 1	< 0.05	< 0.001	0.15	< 0.1	< 0.05	< 0.2
TRIP BLANK-DIS	221 --	< 0.05	0.001	< 1	< 0.05	< 0.5	< 0.05	< 0.05	< 0.1	< 0.02	< 0.5	0.3	< 0.01	< 1	< 0.05	0.005	< 0.05	< 0.1	< 0.05	< 0.2
UPPER TENAS-TOT	221 2393	< 0.05	0.018	< 1	25.0	< 0.5	< 0.05	21.1	< 0.1	0.06	0.5	0.8	0.11	< 1	0.20	3.52	0.95	< 0.1	2.95	< 0.2
UPPER TENAS-DISS	221 --	< 0.05	0.009	< 1	23.4	< 0.5	< 0.05	19.45	< 0.1	0.06	0.5	2.0	0.11	< 1	0.20	3.25	0.80	0.1	2.95	< 0.2
FOUR CREEK-TOT	221 2393	< 0.05	0.061	< 1	79.5	< 0.5	< 0.05	25.6	< 0.1	0.10	2.0	1.2	0.16	< 1	0.50	11.85	0.95	0.1	5.95	0.4
FOUR CREEK-DISS	221 --	< 0.05	0.041	< 1	78.7	< 0.5	< 0.05	25.2	< 0.1	0.08	4.5	1.3	0.13	< 1	0.50	11.75	0.60	0.2	6.45	0.2
UPPER GOATHORN-T	221 2393	< 0.05	0.019	< 1	24.5	< 0.5	< 0.05	18.40	< 0.1	0.08	2.0	1.7	0.12	< 1	0.40	2.03	1.35	0.7	1.40	< 0.2
UPPER GOATHORN-D	221 --	< 0.05	0.010	< 1	23.5	< 0.5	< 0.05	17.80	< 0.1	0.06	0.5	1.8	0.10	< 1	0.35	2.01	1.10	0.7	1.40	0.2
LOWER GOATHORN-T	221 2393	< 0.05	0.018	< 1	50.3	< 0.5	< 0.05	17.75	< 0.1	0.18	2.0	1.1	0.13	< 1	0.40	2.83	2.85	0.5	1.65	< 0.2
LOWER GOATHORN-D	221 --	< 0.05	0.029	< 1	50.1	< 0.5	< 0.05	18.50	< 0.1	0.06	0.5	1.3	0.09	< 1	0.40	3.03	2.00	0.5	2.00	0.2
TELKWA RIVER-TOT	221 2393	< 0.05	0.583	< 1	41.2	< 0.5	< 0.05	9.50	< 0.1	0.40	2.5	2.4	0.80	< 1	0.40	1.490	35.7	0.5	1.00	0.6
TELKWA RIVER-DIS	221 --	< 0.05	0.048	< 1	26.9	< 0.5	< 0.05	9.35	< 0.1	0.04	< 0.5	0.9	0.08	< 1	0.30	1.215	11.60	0.5	0.95	< 0.2
HUBERT CREEK-TOT	221 2393	< 0.05	0.049	< 1	49.6	< 0.5	< 0.05	30.2	< 0.1	0.26	2.0	0.7	1.03	< 1	0.85	7.79	290	0.1	3.25	0.6
HUBERT CREEK-DIS	221 --	< 0.05	0.030	< 1	48.1	< 0.5	< 0.05	30.9	< 0.1	0.22	1.5	1.1	0.69	< 1	0.90	8.11	267	0.3	3.70	0.6
BULKLEY R.-TOT	221 2393	< 0.05	0.217	< 1	27.7	< 0.5	< 0.05	9.10	< 0.1	0.16	2.0	1.6	0.33	< 1	0.35	1.270	14.10	0.4	1.00	< 0.2
BULKLEY R.-DIS	221 --	< 0.05	0.048	< 1	22.7	< 0.5	< 0.05	9.50	< 0.1	0.02	< 0.5	1.6	0.08	< 1	0.35	1.300	5.55	0.6	1.70	< 0.2

CERTIFICATION:

Chemex Labs Ltd.

Analytical Chemists * Geochemists * Registered Assayers

212 Brooksbank Ave., North Vancouver
British Columbia, Canada V7J 2C1
PHONE: 604-984-0221 FAX: 604-984-0218

To: AGRA EARTH & ENVIRONMENTAL LIMITED ~*

BOX 3966, #3 - 3167 TATLOW ROAD
SMITHERS, BC
V0J 2N0

Project : KS00076
Comments: ATTN: SCOTT DAVIDSON

Certificate Date: 11-OCT-1999
Invoice No. :I9929588
P.O. Number :
Account :OXF

CERTIFICATE OF ANALYSIS A9929588

SAMPLE	PREP CODE	P mg/L	Pb ug/L	Sb ug/L	Se ug/L	Sn ug/L	Sr ug/L	Ti ug/L	Tl ug/L	U ug/L	V ug/L	Zn ug/L
LOWER TENAS-TOT	221 2393	0.4	< 2	0.20	< 1	< 0.5	89.4	< 1	< 0.05	0.05	< 1	< 0.5
LOWER TENAS-DIS	221 --	< 0.1	10	0.15	< 1	< 0.5	86.7	< 1	< 0.05	0.05	1	< 0.5
TRIP BLANK-TOT	221 2393	0.4	< 2	< 0.05	< 1	< 0.5	< 0.05	< 1	< 0.05	< 0.05	< 1	< 0.5
TRIP BLANK-DIS	221 --	< 0.1	< 2	< 0.05	< 1	< 0.5	< 0.05	< 1	< 0.05	< 0.05	< 1	< 0.5
UPPER TENAS-TOT	221 2393	0.3	< 2	0.15	< 1	< 0.5	85.6	< 1	< 0.05	0.05	1	< 0.5
UPPER TENAS-DISS	221 --	< 0.1	< 2	0.15	< 1	< 0.5	80.7	< 1	< 0.05	0.05	< 1	0.5
FOUR CREEK-TOT	221 2393	0.4	< 2	< 0.05	< 1	< 0.5	147.5	< 1	< 0.05	0.05	< 1	< 0.5
FOUR CREEK-DISS	221 --	< 0.1	< 2	< 0.05	< 1	< 0.5	141.5	< 1	< 0.05	0.05	1	1.5
UPPER GOATHORN-T	221 2393	0.5	< 2	0.05	< 1	< 0.5	52.8	1	< 0.05	< 0.05	< 1	0.5
UPPER GOATHORN-D	221 --	< 0.1	< 2	0.05	< 1	< 0.5	51.4	< 1	< 0.05	< 0.05	< 1	1.0
LOWER GOATHORN-T	221 2393	0.4	< 2	0.05	< 1	< 0.5	56.4	1	< 0.05	< 0.05	< 1	< 0.5
LOWER GOATHORN-D	221 --	< 0.1	< 2	0.05	< 1	< 0.5	57.0	< 1	< 0.05	< 0.05	< 1	0.5
TELKWA RIVER-TOT	221 2393	0.5	< 2	< 0.05	< 1	< 0.5	44.2	20	< 0.05	0.05	< 1	3.5
TELKWA RIVER-DIS	221 --	< 0.1	< 2	< 0.05	< 1	< 0.5	41.3	< 1	< 0.05	< 0.05	< 1	< 0.5
HUBERT CREEK-TOT	221 2393	0.4	< 2	< 0.05	< 1	< 0.5	108.0	2	< 0.05	0.05	< 1	< 0.5
HUBERT CREEK-DIS	221 --	< 0.1	< 2	< 0.05	< 1	< 0.5	106.5	< 1	< 0.05	0.05	< 1	1.0
BULKLEY R.-TOT	221 2393	0.5	< 2	< 0.05	< 1	< 0.5	37.9	8	< 0.05	< 0.05	< 1	< 0.5
BULKLEY R.-DIS	221 --	< 0.1	< 2	< 0.05	< 1	< 0.5	37.5	< 1	< 0.05	< 0.05	< 1	1.0

CERTIFICATION:

I called Scott and requested edits. He will forward final copies + email electronic. No work in 2000.
ALLAN, 7 PAGES Feb 29/00. .ab
DRAFT 1999 REPORT
SORRY FOR THE DELAYS.
APP. A + FIELD DATA SUMMARY APPENDIX TO BE ADDED

February 15, 2000
CW1537.1

Luscar Ltd.
1600 Oxford Tower
10235 - 101 Street
Edmonton, Alberta T2P 3V4

780
Attention: **Mr. Allan Flemming, P.Eng.** Fax: ~~403~~ 420-5875

Dear Mr. Flemming:

RE: TELKWA COAL PROJECT 1999 BASELINE DATA REPORT

1.0 INTRODUCTION

AGRA Earth & Environmental Limited is pleased to present the 1999 Baseline Surface Water Flow and Water Quality Monitoring Report for the Telkwa Coal Project (TCP). The TCP is a proposed open pit coal mine located near Telkwa, B.C. and owned by Luscar Inc. (Luscar). The location of the mine is illustrated on Figure 1. This report contains the data collected during the 1999 baseline monitoring program and updates the rating curves for sites where discharge measurements were conducted.

2.0 SCHEDULE OF 1999 SITE VISITS

The schedule of site visits for the 1999 field monitoring program is contained in the March 3, 1999 AGRA proposal to conduct the TCP baseline monitoring. A copy of the AGRA proposal is contained in Appendix A for reference. The dates of actual site visits and a listing of the work conducted during the site visits is contained in Table 1. The discharge measurement focus was on the low flow periods.

TABLE 1
1999 Monitoring Site Visits

Week of:	Feb 1	Aug 1	Sept 19	Nov 14
Telkwa River	WQ		WQ	
Upper Tenas Creek	No site access		SM, WQ, Q	S
Lower Tenas Creek	WQ, Q	S	SM, WQ, Q	S
Bulkley River	WQ		WQ	
Hubert Creek	WQ, S	S	WQ, S	S
Four Creek	WQ	S	WQ, Q	S
Upper Goathorn Creek	WQ, Q		SM, WQ, Q	S
Lower Goathorn Creek	WQ		WQ	

Q = Discharge and stage measurements conducted
S = Stage measurements conducted
WQ = Water quality sampling conducted
SM = Site Maintenance Visit

The purpose of the August field trips was to collect peak flow information from the crest gauges at each site and to survey the equipment and benchmarks at each site for the low flow period.

3.0 SURFACE WATER MONITORING RESULTS

This section contains a summary of the five sites where surface water monitoring was conducted during the 1999 field season. Summary field data for the site visits is contained in Appendix B.

3.1 LOWER TENAS CREEK SITE

The lower Tenas Creek site was visited four times as part of the 1999 monitoring program. The station was operated as a manual sampling with no installation of the automated equipment used in previous years.

The two low flow discharge measurements conducted during February and September yielded discharges of 0.041 m^3/s and 0.163 m^3/s respectively. These discharge measurements have been added to the rating curve and a revised rating curve for this site is shown in Figure 2.

An initial crest gauge installed in late 1998 at the site was replaced during the 1999 sampling season. Level surveys conducted at the site during the 1999 field season did not show significant shift of the benchmarks or the staff gauge. There was evidence of sand deposition noted near the gauge during the November 1999 field visit.

3.2 UPPER TENAS CREEK SITE

The upper Tenas Creek was visited twice during the 1999 monitoring program. There was no site access during the February 1999 field trip. As the crest gauge for this site was not checked and reset during February, this site was not visited during the August field trip.

The crest gauge was checked during September and the maximum stage was observed to be 0.70 m. This value would translate to a discharge of 8.43 m^3/s and is expected to be due to the spring freshet which consistently produces greater discharges than the fall peak flows. The low flow measurement from September 20th was 0.134 m^3/s. An updated rating curve for this site is shown in Figure 3. The two 1999 data points plot above the current stage-discharge relation. AGRA proposes that one high flow measurement be conducted at this site during the 2000 field season to determine whether the rating curve should be shifted upwards.

The September field visit to this site showed that the braces for the staff gauge had snapped but that the staff gauge did not appear to have shifted (based on a review of previous site photographs). Braces at the site were replaced and a third benchmark was added on the right bank side of the stream. Levelling checks showed that there was no significant shift of the benchmarks or the staff gauge during 1999. The breakage of the braces resulted in slight downstream leaning of the staff gauge mounting but this was corrected during the site

maintenance visit.

3.3 UPPER GOATHORN CREEK SITE

The upper Goathorn Creek site was visited four times during the 1999 monitoring program. The station was monitored as a manual station with a staff gauge and crest gauge.

The two low flow discharge measurements conducted during February and September yielded discharges of 0.097 m^3/s and 0.337 m^3/s respectively. These discharge measurements have been added to the rating curve and a revised rating curve for this site is shown in Figure 4.

Maintenance of the gauge equipment was conducted during the September visit . The bracing for the staff gauge was reinforced and the staff gauge was lowered by a distance of 0.19 m. A second staff gauge was added to the top of the first staff gauge to allow for visual measurement of peak flow levels during the freshet period. The level check of benchmarks showed that there were no changes in the elevations of the benchmarks. The staff gauge did not show any significant shift during the 1999 season.

problem with chart

3.4 FOUR CREEK SITES

Two sampling locations were operated on Four Creek during the 1999 field season. The low flow discharge measurements were made at the lowest road culvert crossing of Four Creek. Other stage measurements and water quality sampling were conducted at the original stream flow sampling site located approximately 1,800 m upstream of the culvert crossing on Four Creek.

Discharges for the low flow periods were determined by calculation of the discharge through the culvert based on the known inlet water levels and the culvert characteristics. The February low flow measurement revealed that there was only a small quantity of baseflow (< 1L/min) during the sampling trip. The culvert was almost completely iced up. The September low flow discharge for the culvert was calculated to be 0.077 m^3/s.

3.5 HUBERT CREEK SITE

The Hubert Creek site was visited four times during the 1999 monitoring program. Readings for the staff gauge are available from two of the site visits. Visits conducted during September and November did not yield useful data on flow levels due to numerous partial blockages of the culvert inlet by debris.

The crest gauge at the site indicated that there was a recorded stage greater than 1.23 m during the spring 1999 freshet period. This high stage is believed to be partially due to beaver debris blockage of the inlet of the Hubert Creek culvert.

4.0 WATER QUALITY MONITORING RESULTS

In 1999, baseline water chemistry was sampled during the two low flow periods at ten sites in the proposed Telkwa Coal Project area. The data for the February 1999 water quality monitoring was forwarded directly to Luscar as previously arranged. The laboratory results for the September water quality trip are included in Appendix C of this report. No analysis of the testing data, other than to identify specific stations where the BC Water Quality Criteria (Nagpal, 1995) were exceeded. A summary of metals and stations where exceedances occurred are summarized in Table 2. Due to operator error during the September 1999 water quality field trip, triplicate sampling was not conducted. A blank sample obtained from Chemex did not have any exceedances.

77
↖ QA/QC not done properly

TABLE 2: B.C. WATER QUALITY CRITERIA EXCEEDANCE INFORMATION FOR THE SEPTEMBER 20, 1999 SAMPLING TRIP

METAL	B.C. WATER QUALITY CRITERIA	STATIONS WITH TOTAL METALS CONCENTRATIONS GREATER THAN THE B.C. CRITERIA	STATIONS WITH TOTAL METALS CONCENTRATIONS EQUAL TO THE B.C. CRITERIA
Cr	2.0 ug/L	Telkwa River (2.5)	Upper Goathorn Creek, Lower Goathorn Creek, Bulkley River, Hubert Creek, Lower Tenas, Four Creek
Cu	2.0 ug/L	Telkwa River (2.4)	
Fe	0.3 mg/L	Telkwa River (0.8), Hubert Creek (1.03), Bulkley River (0.33)	
Zn	3.0 ug/L	Telkwa River (3.5)	

5.0 CLOSURE

AGRA Earth Environmental Limited is pleased to present this 1999 data summary to Luscar Ltd. AGRA looks forward to continuing to work with Luscar on the Telkwa Coal project over the 2000 season. Should you have any questions concerning this project please do not hesitate to contact the undersigned at (250) 847-8783.

Respectfully Submitted,

Reviewed by,

Scott Davidson, M.Sc., P.Geo.
Project Manager

Gary R.E. Beckstead, M.Sc., P.Eng.
Senior Water Resource Engineer

Dennis Trotter
Senior Toxicologist

02/16/00 WED 11:55 FAX 250 847 9049 AGRA SMITHERS 009/009

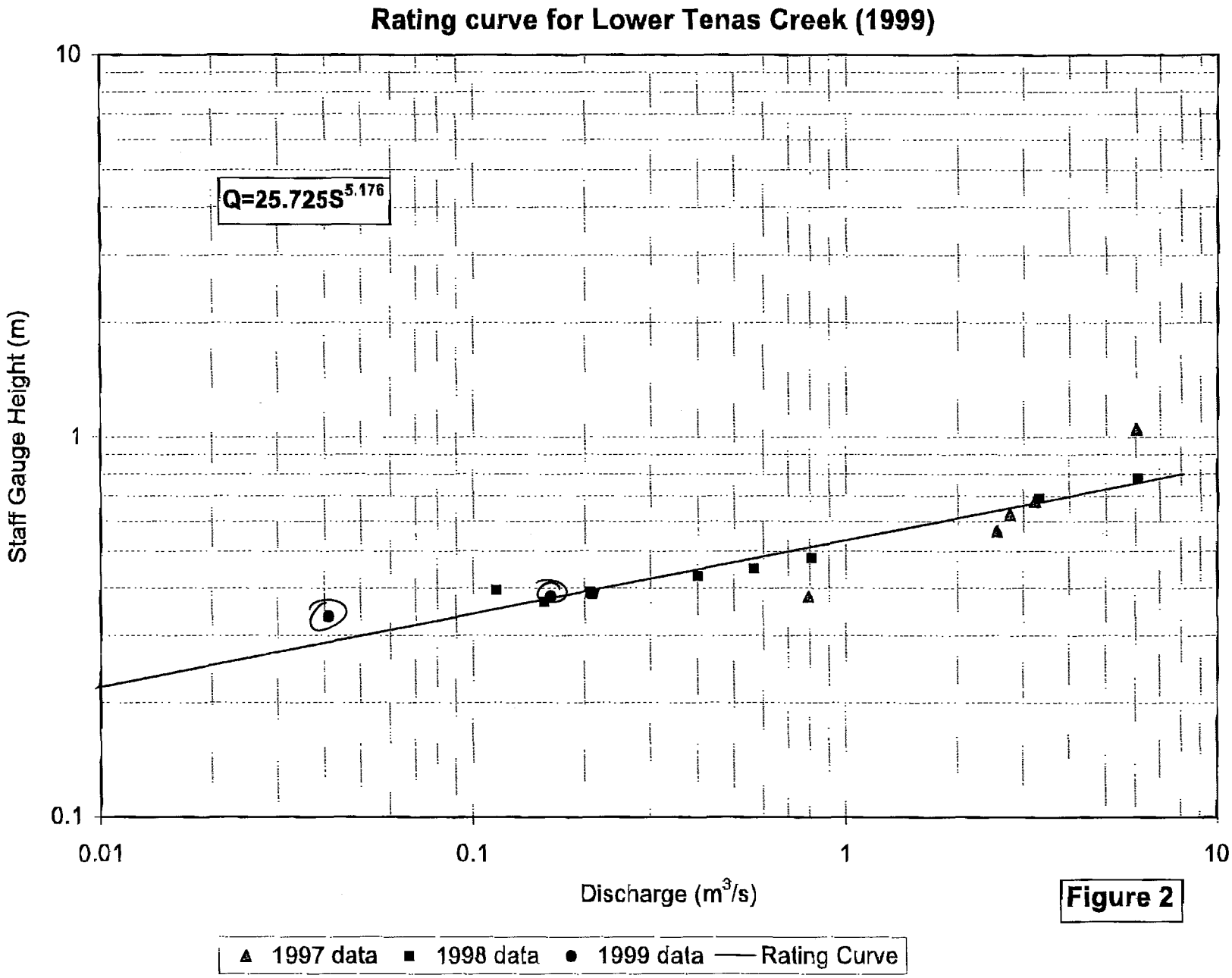


Figure 2

02/16/00 WED 11:55 FAX 250 847 9049 AGRA SMITHERS 005

Rating Curve for Upper Tenas Creek (1999)

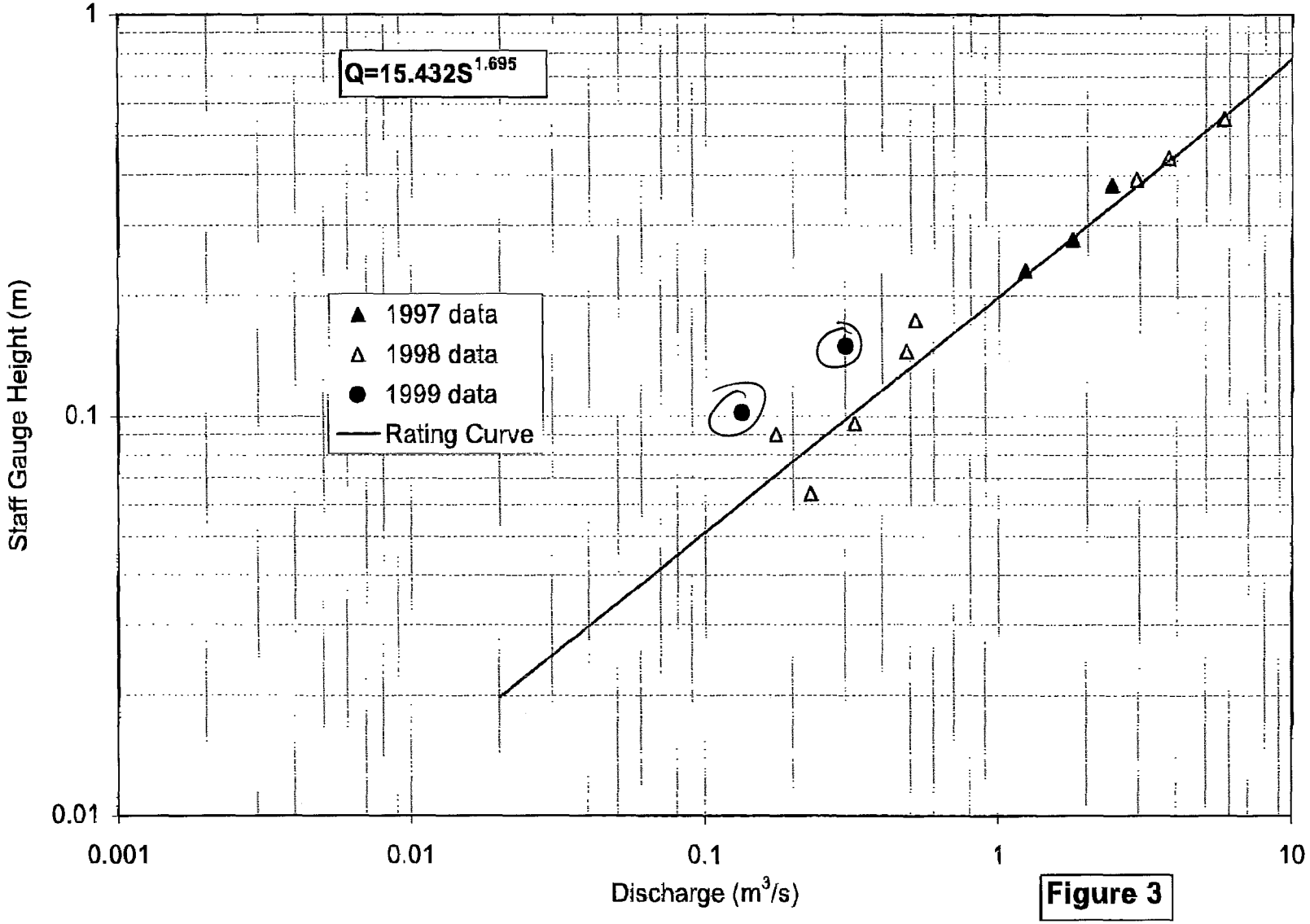


Figure 3

Graph. Did not change from 1998
(slope/intercept

rcurve-98.xls

15/02/2000

02/16/00 WED 11:56 FAX 250 847 9049 AGRA SMITHERS

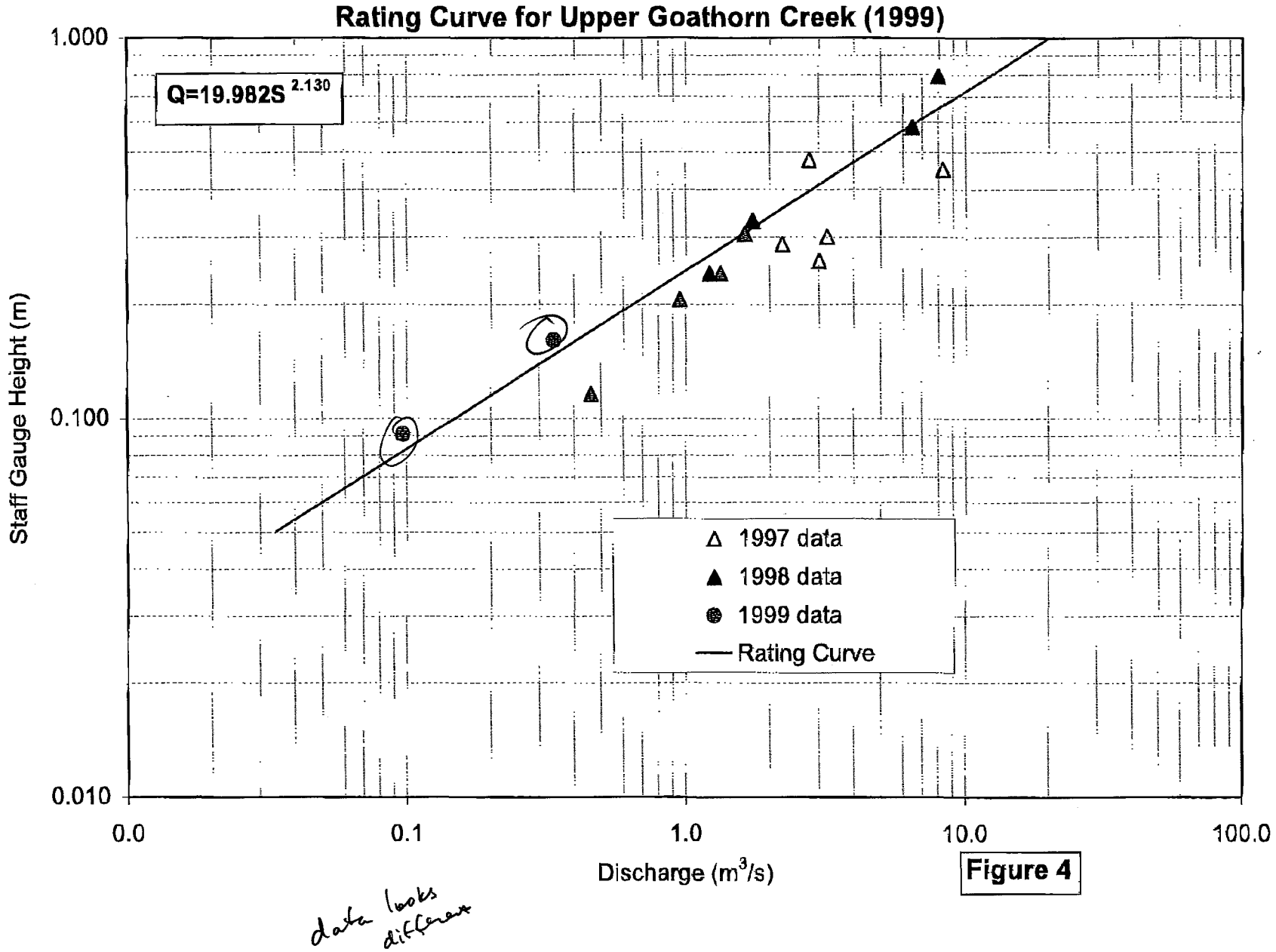


Figure 4

data looks different

AGRA
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental Limited
Box 3966
#3-3167 Tatlow Road
Smithers, B.C. V0J 2N0
Tel (250) 847-8783
Fax (250) 847-9049

June 8, 1999

KS00076

Luscar Ltd.
1600 Oxford Tower
10235 - 101 Street
Edmonton,AB. T5J 3G1

Attention: Allan Flemming, P.Eng.
Project Engineer

RE: 1999 DATA REPORT UPDATE

Dear Mr. Flemming,

AGRA Earth & Environmental Limited (AGRA) is pleased to present LuscarLtd. (Luscar) with this report containing data collected as part of the 1999 Telkwa Coal Surface Water and Water Quality Baseline Monitoring Program. The data presented in this report includes low flow data from February 1999 and the results of the site visits conducted during April and May to re-establish the crest gauges at selected sites.

LOW FLOW MONITORING TRIP

Low flow monitoring was conducted at sites on February 16th and 17th, 1999. During this trip water quality sampling was also completed; the data was directly forwarded from Chemex Labs to Luscar. The list of sites and the sampling completed is presented in Table 1.

Table 1. Low Flow Monitoring Trip Summary

SITE	FLOW CONDITIONS	WATER QUALITY SAMPLING
Telkwa River	Water level was 45 cm below the level of the main staff gauge located on the old bridge pilings.	Samples for total metals, dissolved metals and general nutrient analysis were collected.
Lower Goathorn Creek	There was some flow in the creek below approximately 30 cm of ice.	Samples for total metals, dissolved metals and general nutrient analysis were collected.
Four Creek	No evidence of flow at the lower culvert crossing.	No samples collected.
Upper Goathorn Creek	Water level was 0.1 m below the staff gauge. Discharge was measured to be 0.097 m^3/s.	Samples for total metals, dissolved metals and general nutrient analysis were collected.
Lower Tenas Creek	Staff gauge reading 0.337 m. Discharge was measured to be 0.041 m^3/s.	Samples for total metals, dissolved metals and general nutrient analysis were collected.
Hubert Creek	Staff gauge iced up; Unable to estimate water level. Discharge estimated from outlet velocity and depth to be 0.024 m^3/s.	Samples for total metals, dissolved metals and general nutrient analysis were collected.

RE-ESTABLISHMENT OF CREST GAUGES AND BENCHMARKS

The monitoring program was revised to meet Luscar's request to monitor peak flows at the study streams using only crest gauges. The crest gauges were visited at accessible sites to add cork and to check the relative elevations of staff gauges and crest gauges to site benchmarks. Table 2 contains a summary of the work completed in re-establishing the monitoring gauges.

As a result of weather conditions during April and May, the re-establishment of crest gauges required that multiple field trips be made. The two upper sites on Goathorn Creek and Tenas Creek were not accessable during May due to snow and road conditions. Therefore, AGRA did not re-establish these upper two sites, but chose instead to collect peak flow information from the lower sites on these streams. This was deemed to be the most effective use of available resources and budget given ground conditions. Peak flow levels will be determined during a field trip to be made to sites during July 1999. No crest stage readings for the Upper Goathorn and Upper Tenas sites until the july visit.

Table 2. Site Re-establishment for Peak Flow Determination

SITE	DATE VISITED	WORK COMPLETED
Telkwa River	April 14th, 1999	Water level was 45 cm below the level of the staff crest gauges at the site.
Hubert Creek	April 14th, 1999	Cork added to the crest gauge at the site. Staff gauges and benchmarks leveled for determining offsets.
Tailings Pond	April 16th, 1999	Cork added to the crest gauge at the site. Weir face, staff gauge and benchmarks leveled for determining offsets.
Four Creek	May 12th, 1999	Cork added to the crest gauge at the original site. Staff gauge and benchmarks leveled for determining offsets.
Lower Tenas Creek	May 12th, 1999	Cork added to the crest gauge at the site. Staff gauge and benchmarks leveled for determining offsets.
Lower Goathorn Creek	No work conducted at the site maintained by the WSC .	
Upper Tenas Creek	(May 12th, 1999)	No access to site because of snow and road conditions.
Upper Goathorn Creek	(May 12th, 1999)	No access to site because of snow and road conditions.

AGRA Earth & Environmental Limited is pleased to present this summary of data collection and work completed to date on the Telkwa Coal Project. Digital copies of the collected data will be forwarded to Luscar. Should you require any further information on this project please do not hesitate to contact the undersigned at (250) 847-8783.

Respectfully submitted,

AGRA Earth & Environmental Limited

Scott Davidson, M.Sc., P.Geo.
Project Manager

Reviewed by

Gary R.E. Beckstead, Msc., P.Eng.
Senior Project Manager

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

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March 2, 1999
CW1537.1

Luscar Ltd.
1600 Oxford Tower
10235 - 101 Street
Edmonton, Alberta T2P 3V4

Attention: Mr. Allan Flemming, P.Eng. Fax: (403) 420-5875

Dear Mr. Flemming:

Re: Telkwa Coal Mine
Revised 1999 Budget

1.0 SURFACE WATER MONITORING

AEE is pleased to present this revised budget for the 1999 baseline water flow and water quality program for the proposed Telkwa Coal Project. It is the understanding of AEE that during 1999 Luscar should be submitting the Final Project Report to the B.C. Environmental Assessment Office. Following certification of the project, it is the understanding of AEE that the entire surface water and water quality program may need to be revised to meet the construction plan for the mine.

2.0 WORK PROGRAM AND BUDGET

The work program proposed for 1999 is as follows:

<u>Surface Water Flow</u>

- Concentration of the base program on the winter and summer low flow periods.
- Monitoring of low flows on Four Creek, Hubert Creek, Tenas Creek, Upper Goathorn Creek and Lower Goathorn Creek. No monitoring will be conducted on Helps Creek, Telkwa River, and the Bulkley River. Low flow monitoring will result in two site visits. To reduce cost to Luscar, AEE has scheduled the summer low flow period measurement trip to coincide with site visit #3 described below.
- Monitoring of peak flows at the streams using crest gauges already installed at all of the existing sites. To conduct this portion of the required work, AEE will conduct a total of four sites visits planned as follows:

1. Pre-freshet to set up crest and staff gauges and survey to local bench marks (April),
2. Post freshet to record peak flow during period and survey to local bench marks (June),
3. Pre fall high flow period to re-survey benchmarks and survey to local bench marks (late August to early September),

4. Post fall high flow to record peak flow and survey to local bench marks (November).

Water Quality

- Sampling of baseline parameters for the two low flow periods only.

Data Analysis

AEE proposes to conduct data analysis and reporting for the 1999 sampling program following each monitoring trip. A data analysis period has been allowed following each of the five surface flow site visits (one low flow and four peak flow visits) described above. The information reports from each trip will assist Luscar in public meetings by providing the most up to date information on the project.

Project Management

Project management involves dealing with items such as cost control, client liaison, and interfacing with other consultants working for Luscar on the proposed Telkwa Coal Mine. For the 1999 sampling program, AEE proposes to conduct project management on a cost plus basis. The totals for this item in the attached Table 1 represent estimates of the total budget required for project management. AEE will make every effort to ensure that it conducts stringent cost control on the project management for Luscar. Project management for the 1999 program will be conducted by Mr. Scott Davidson, M.Sc., P.Geo. of the Smithers office. Mr. Gary Beckstead, M.Sc., P.Eng. and Mr. Dennis Trotter will provide technical input and review to the project as required.

3.0 CLOSURE

We thank you for the opportunity to provide engineering and environmental services to this project and look forward to continuing to work with Luscar on the proposed Telkwa Coal Mine during 1999. If you have any questions or require further information concerning this project, please call Scott Davidson at (250) 847-8783 or Gary Beckstead at (403)235-8118.

Yours sincerely,

AGRA Earth & Environmental Limited

Reviewed by

Scott Davidson, M.Sc., P.Geo.
Project Manager
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cc. Gary R.E. Beckstead, AEE - Calgary

Gary R.E. Beckstead, M.Sc., P.Eng.
Senior Water Resource Engineer

Table 1
Budget Estimate for 1999 Hydrometric Monitoring and Water Quality Sampling
Telkwa Coal Project

Task	Assumptions	Month												Total
		Jan	Feb	Mar.	Apr.	May	June	Jul.	Aug	Sept.	Oct	Nov.	Dec.	
Surface Flow Monitoring	1,3,4,6													
Labour		$ -	$ 3,240.00	$ -	$1,350.00	$ -	$ 1,284.00	$ -	$1,284.00	$ -	$ -	$1,080.00	$ -	$ 6,238.00
Disbursements		$ -	$ 378.00	$ -	$ 189.00	$ -	$ 189.00	$ -	$ 189.00	$ -	$ -	$ 189.00	$ -	$ 1,134.00
Water Quality	1,5,6,7													
Sampling		$1,115.00	$ 2,838.00	$ -	$ -	$ -	$ -	$ -	$ 428.00	$ -	$ -	$ -	$ -	$ 4,381.00
Disbursements		$ 310.20	$ 645.00	$ -	$ -	$ -	$ -	$ -	$ 100.00	$ -	$ -	$ -	$ -	$ 1,055.20
Data Analysis	1													
Labour		$ -	$ -	$ 970.00	$ 970.00	$ -	$ 970.00	$ -	$ -	$ 970.00	$ -	$ 970.00	$ -	$ 4,850.00
Disbursements		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Project Management	1,2													
Labour		$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 1,800.00
Disbursements		$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 25.00	$ 300.00
Total (Required Work)		$1,600.20	$ 7,276.00	$ 1,145.00	$2,684.00	$ 175.00	$ 2,616.00	$ 175.00	$2,176.00	$ 1,145.00	$ 175.00	$2,414.00	$ 175.00	$ 21,758.20

Assumptions:
1 The above budget is based on the Fw rate schedule
2 Project Management is quoted as an estimated maximum budget and will be billed on a cost plus basis.
3 The summer low flow period extends over August and September
4 The winter low flow period extends over February and March
5 The January water quality sampling costs represent the Selenium sampling
6 Disbursements listed under Water Flow and Water Quality are estimates for sampling equipment and vehicle expenses and do not include 10% handling charge
7 All Laboratory Analysis is to be directly billed to Luscar Ltd.

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

Faxed to JED at WDH.
For your comment
ad 2.

AGRA Earth & Environmental
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AGRA Earth & Environmental Limited
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Fax (250) 847-9049

January 29, 1999
CW1537.1

Luscar Ltd.
1600 Oxford Tower
10235 - 101 Street
Edmonton, Alberta T2P 3V4

Attention: Mr. Allan Flemming, P.Eng. Fax: (403) 420-5875

Dear Mr. Flemming:

Re: Telkwa Coal Mine
Revised 1999 Budget

1.0 SURFACE WATER MONITORING

As per the January 26th, 1999 discussion between Gary Beckstead of AGRA Earth & Environmental Limited (AEE) and Allan Flemming of Luscar Ltd. (Luscar), AEE is pleased to present this revised budget for the 1999 baseline water flow and water quality program for the proposed Telkwa Coal Project. It is the understanding of AEE that during 1999 Luscar should be submitting the Final Project Report to the B.C. Environmental Assessment Office. Following certification of the project, it is the understanding of AEE that the entire surface water and water quality program may need to be revised to meet the construction plan for the mine.

2.0 WORK PROGRAM AND BUDGET

The revised budget presented in Table 1 is based on the scope of services requested by Luscar at the January 26th, 1999 meeting. The work program proposed for 1999 is as follows:

Surface Water Flow

- Concentration of the base program on the winter and summer low flow periods.
- Monitoring of low flows on Four Creek, Hubert Creek, ~~Holpo Creek~~, Upper Goathorn Creek and Lower Goathorn Creek. No monitoring will be conducted on Tenas Creek, Telkwa River, and the Bulkley River.
- Monitoring of peak flows at the streams using crest gauges already installed at all of the existing sites. To conduct this portion of the required work, AEE must visit all sites during April to ensure that the sites are ready for the peak flow period (i.e. Checking of staff gauges and crest gauges). During November time has been allocated for conducting a final site visit to all sites to determine their condition prior to winter.
- A cost option has been prepared to operate the data loggers and pressure transducers at the continuous monitoring sites and to conduct a single high flow discharge measurement.

Water Quality

- Sampling of baseline parameters for the two low flow periods only.
- Sampling of metals for the two low flow periods.

Selenium sampling was requested to be deleted from the scope of work for 1999, however, the sampling for this was completed prior to receiving notification from Luscar. It is the expectation of AEE that the costs of this sampling will be paid by Luscar as the work was conducted at the request of Mr. Jerry Demchuck, the environmental coordinator for the Telkwa Coal Project. All future requests for increased sampling will not be initiated by AEE until a signed order to proceed with the work has been received from Luscar.

Not true.

Reporting

AEE proposes to conduct reporting for the 1999 sampling program following each monitoring trip. A data memo will be issued to Luscar presenting the results of the monitoring trip. This information will assist Luscar in public meetings by providing the most up to date information on the project. The costs of reporting for the optional water flow monitoring program are included in Table 1 as an additional cost of approximately $530.00 per monthly report.

Project Management

Project management involves dealing with items such as cost control, client liaison, responding to requests for extra work, and interfacing with other consultants working for Luscar on the proposed Telkwa Coal Mine. For the 1999 sampling program, AEE proposes to conduct each portion of the project as separate tasks. On receiving a request for extra work, AEE will issue to Luscar for approval, a change of work order along with an expected budget to complete the extra work. Project management for the 1999 program will be conducted by Mr. Scott Davidson, M.Sc., P.Geo. of the Smithers office. Mr. Gary Beckstead and Mr. Dennis Trotter will provide technical input and review to the project as required.

3.0 CLOSURE

We thank you for the opportunity to provide engineering and environmental services to this project and look forward to continuing to work with Luscar on the proposed Telkwa Coal Mine during 1999. If you have any questions or require further information concerning this project, please call Scott Davidson at (250) 847-8783 or Gary Beckstead at (403)235-8118.

Yours sincerely,

AGRA Earth & Environmental Limited

Scott Davidson, M.Sc., P.Geo.
Project Manager
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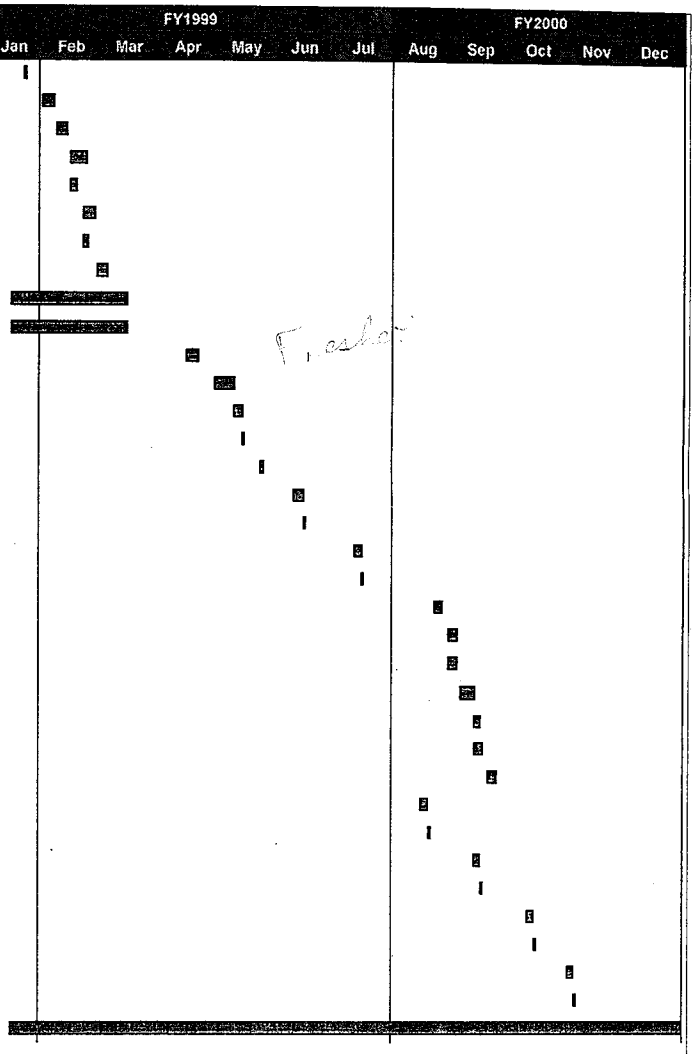
Reviewed by

Gary R.E. Beckstead, M.Sc., P.Eng.
Senior Water Resource Engineer

cc. Gary R.E. Beckstead, AEE - Calgary
Jerry Schmidt, AEE - Prince George

CW1537.00 Task 1999 Luscar Ltd.

Task Name	Start Date	Effort	End Date
Selenium Sampling Trip	1/21/99	2.00d	1/21/99
Winter Water Quality Trip	1/31/99	3.00d	2/5/99
Winter Revised Metals Sampling Trip	2/7/99	1.13d	2/12/99
Winter Revised Metals Sampling Trip	2/14/99	1.13d	2/22/99
Winter Low Flow Discharge Measurement	2/14/99	3.00d	2/17/99
Winter Revised Metals Sampling Trip	2/21/99	1.13d	2/26/99
Winter Low Flow Discharge Measurement	2/21/99	3.00d	2/23/99
Winter Revised Metals Sampling Trip	2/28/99	1.13d	3/5/99
Lab Calibration of Pressure Transducers	1/15/99	2.00d	3/15/99
Other Lab Prep Time Associated with Equipment Preparation	1/15/99	4.00d	3/15/99
All Sites Visit	4/15/99	4.00d	4/21/99
Installation of Automated Sites	4/30/99	2.00d	5/10/99
All Sites Visit, Data Download	5/10/99	3.00d	5/14/99
Data Analysis	5/14/99	1.00d	5/14/99
High Flow Discharge Measurement	5/24/99	4.00d	5/25/99
All Sites Visit and Data Download	6/10/99	3.00d	6/15/99
Data Analysis	6/15/99	1.00d	6/15/99
All Sites Visit and Data Download	7/12/99	3.00d	7/15/99
Data Analysis	7/16/99	1.00d	7/16/99
Summer Water Quality Trip	8/23/99	3.00d	8/26/99
Summer Revised Metals Sampling Trip	8/30/99	0.75d	9/3/99
Low Flow Discharge Measurement	8/30/99	3.00d	9/3/99
Summer Revised Metals Sampling Trip	9/6/99	0.75d	9/13/99
Summer Revised Metals Sampling Trip	9/13/99	0.75d	9/16/99
Low Flow Discharge Measurement	9/13/99	3.00d	9/17/99
Summer Revised Metals Sampling Trip	9/20/99	0.75d	9/24/99
All Sites Visit and Data Download	8/16/99	3.00d	8/19/99
Data Analysis	8/20/99	1.00d	8/20/99
All Sites Visit and Data Download	9/13/99	3.00d	9/16/99
Data Analysis	9/17/99	1.00d	9/17/99
All Sites Visit, Data Download	10/11/99	5.00d	10/14/99
Data Analysis	10/15/99	1.00d	10/15/99
Decommissioning of Sites/All Sites Visit	11/1/99	2.00d	11/4/99
Data Analysis	11/5/99	1.00d	11/5/99
Project Management	1/15/99	5.75d	12/31/99



Hobart
Four Creek (contd)
LT
UG
LG quality (WSC) did

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

Table 1
Budget Estimate for 1999 Hydrometric Monitoring and Water Quality Sampling
Telkwa Coal Project

Task	Assumptions	Month												Total
		Jan	Feb	Mar.	Apr.	May	June	Jul.	Aug	Sept.	Oct	Nov.	Dec.	
Required Flow Monitoring	1,2,3,4,8,9													
Labour		$ -	$ 3,240.00	$ -	$2,160.00	$ -	$ -	$ -	$1,284.00	$ 1,284.00	$ -	$ 856.00		$ 8,824.00
Disbursements		$ -	$ 378.00	$ -	$ 189.00	$ -	$ -	$ -	$ 189.00	$ 189.00	$ -	$ 69.30		$ 1,014.30
Optional Flow Monitoring	1,4,7,8,9													
Labour		$ -	$ -	$ -	$1,560.00	$ 3,974.00	$ 1,814.00	$ 1,814.00	$1,814.00	$ 1,814.00	$1,814.00	$1,376.00		$ 15,980.00
Disbursements		$ -	$ -	$ -	$ 300.00	$ 249.00	$ 249.00	$ 249.00	$ 249.00	$ 249.00	$ 249.00	$ 249.00		$ 2,043.00
Water Quality	1,2,3,5,8,9,10													
Sampling		$1,115.00	$ 2,838.00	$ 493.00	$ -	$ -	$ -	$ -	$1,674.00	$ 1,545.00	$ -	$ -	$ -	$ 7,665.00
Disbursements		$ 310.20	$ 645.00	$ 169.00	$ -	$ -	$ -	$ -	$ 407.00	$ 407.00	$ -	$ -	$ -	$ 1,938.20
Reporting	1,6,7													
Labour		$ -	$ 785.00	$ 635.00	$ 472.50	$ -	$ -	$ -	$ 597.50	$ 1,232.50	$ -	$ 472.50	$ -	$ 4,195.00
Disbursements		$ -	$ 100.00	$ 100.00	$ 100.00	$ -	$ -	$ -	$ 100.00	$ 100.00	$ -	$ 100.00	$ -	$ 600.00
Project Management	1,8													
Labour		$ 780.00	$ 405.00	$ 405.00	$ 405.00	$ 405.00	$ 405.00	$ 405.00	$ 405.00	$ 405.00	$ 405.00	$ 405.00	$ 405.00	$ 5,235.00
Disbursements		$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 1,200.00
Total (Required Work)		$2,305.20	$ 8,491.00	$ 1,902.00	$3,426.50	$ 505.00	$ 505.00	$ 505.00	$4,756.50	$ 5,262.50	$ 505.00	$2,002.80	$ 505.00	$ 30,671.50
Total (Optional Work)		$ -	$ -	$ -	$1,860.00	$ 4,223.00	$ 2,063.00	$ 2,063.00	$2,063.00	$ 2,063.00	$2,063.00	$1,625.00	$ -	$ 18,023.00

Assumptions:

1 The above budget are based on the Fw rate schedule
2 The summer low flow period extends over August and September
3 The winter low flow period extends over February and March
4 The Optional Water Flow Sampling would result in 1 monthly monitoring visit per month and 1 discharge measurement during May 1999
5 The January water quality sampling costs represent the Selenium sampling
6 Reporting costs are for the preparation of summary reports following completion of required project tasks
7 Reporting Costs from the Optional Water Flow program would be approximately $530.00 per monthly update report
8 Internal Disbursements are to be billed at Cost Plus 10% with information on these disbursements provided to Luscar Ltd..
9 Disbursements listed under Water Flow and Water Quality are estimates for sampling equipment and vehicle expenses and do not include 10% handling charge.
10 All Laboratory Analysis is to be directly billed to Luscar Ltd.

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

CC: JED for comment

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental Limited
221 - 18th Street S.E.
Calgary, Alberta
Canada T2E 6J5
Tel (403) 248-4331
Fax (403) 248-1590

January 21, 1999
CW1537.901.1

DRAFT

Way, way too much.

Luscar Ltd.
1600 Oxford Tower
10235 - 101 Street
Edmonton, Alberta T2P 3V4

Attention: Mr. Allan Flemming, P.Eng. Fax: (403) 420-4089

Dear Mr. Flemming:

Re: Telkwa Coal Mine
1999 Budget

1.0 SURFACE WATER MONITORING

As per the January 19th, 1999 discussion between Gary Beckstead of AGRA Earth & Environmental Limited (AEE) and Allan Flemming of Luscar Ltd. (Luscar), AEE is pleased to present this "**draft**" budget for the 1999 baseline water flow and water quality program for the proposed Telkwa Coal Project. This draft will be discussed with you at your office on January 26th, 1999. It is the understanding of AEE that during 1999 Luscar should be submitting the Final Project Report to the B.C. Environmental Assessment Office. Following certification of the project, it is the understanding of AEE that the entire surface water and water quality program will need to be revised.

2.0 WORK PROGRAM AND BUDGET

AEE's proposed 1999 work program is intended to allow for revision of the program during the year. Table 1 presents the monthly budget breakdown for 1999.

The work program proposed for 1999 is as follows:

Surface Water Flow

- Three winter low flow discharge measurements on the Telkwa River;
- Five free flow period discharge measurements at all sites[1];
- An initial site visit during spring followed by an installation trip to sites; and
- Seven trips to perform routine maintenance and downloading of continuous sites.

---

[1] The Telkwa River will only be measured during three of the five free flow discharge measurement trips

Water Quality

- Four trips are scheduled for seasonal baseline water quality sampling;
- One sediment collection trip is included with the seasonal baseline trips; and
- High frequency revised metals sampling program started in 1998 is currently scheduled for continuation in 1999[2].

Reporting

AEE proposes to conduct reporting for the 1999 sampling program at approximately four month intervals. By separating the reporting into smaller pieces, AEE expects to be able to realize cost savings over the previous annual report preparation costs. The issuing of three data reports during 1999 will also allow for easier revision of the sampling program following submittal of the Final Project Report and project certification.

Project Management

Project management involves dealing with items such as cost control, client liaison, responding to requests for extra work, and interfacing with other consultants working for Luscar on the proposed Telkwa Coal Mine. AEE has found that the project management required for the proposed Telkwa Coal Mine exceeded the original budget estimate. Based on an analysis of previous work, AEE has revised its method of project management for the 1999 sampling program. AEE feels that the revisions made to project management will simplify tracking of costs for each phase of the project.

Previous requests for extra work conducted by AEE on the Telkwa Coal project were often accompanied by a directive to bill the work to the existing sampling program budget. For the 1999 sampling program, AEE proposes to conduct each portion of the project as separate tasks. On receiving a request for extra work, AEE will issue to Luscar for approval, a change of work order along with an expected budget to complete the extra work.

3.0 CLOSURE

We thank you for the opportunity to provide engineering and environmental services to this project and look forward to continuing to work with Luscar on the proposed Telkwa Coal Mine during 1999. It is the understanding that AEE and Luscar will discuss this draft budget during

---

[2] The revised sampling program is intended to determine the optimum sampling frequency for project. Following the winter and spring sampling trips, AEE should have sufficient data to determine the optimum sampling frequency allowing for modification of the water quality program.

a meeting scheduled for Tuesday, January 26th, 1999. Other items which I would like to discuss with you on Tuesday include:

- miscellaneous disbursement charge (% of fees); and
- possible shift of Project Manager to Scott Davidson in Smithers.

If you have any questions or require further information prior to this meeting, please call Gary Beckstead at (403)235-8118.

Yours sincerely,

AGRA Earth & Environmental Limited

Scott Davidson, M.Sc., P.Geo.
Smithers Office Manager

Gary R.E. Beckstead, M.Sc., P.Eng.
Senior Project Manager

GREB/km

attach.

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(Low #2)
(1) Four
(2) Hubert/Helps
(3) Goodhamm (2)

Staff gauges for high flow
+option for datalogger

low flow (2 times)
high flow (2 times)

winter
Quality low flow

data reports after low flow
Not big reports

Purchase Order

Terrace
Telkwa
Bulkley

-no % of disbursements items

DRAFT

Table 1

Budget Estimate for 1999 Hydrometric Monitoring and Water Quality Sampling

Telkwa Coal Project

Task	Personnel	Month												Total
		Jan	Feb	Mar.	Apr.	May	June	Jul.	Aug	Sept.	Oct	Nov.	Dec.	
Flow Monitoring														
Labour		$ [illegible]	$ 4,425.00	$ 3,160.00	$ 2,160.00	$ 3,546.00	$ 4,036.00	$ 3,088.00	$ 3,088.00	$ 1,802.00	$ 2,660.00	$ 1,376.00		$ 29,341.00
Disbursements		$ [illegible]	$ 501.60	$ 165.00	$ 69.30	$ 396.00	$ 622.50	$ 737.00	$ 440.00	$ 69.30	$ 289.80	$ 69.30		$ 3,259.30
Water Quality														
Sampling		$ 1,115.00	$ 3,013.00	$ 743.00	$ -	$ 1,265.00	$ 2,160.00	$ 2,332.00	$ 835.00	$ 1,940.00	$ -	$ -	$ -	$ 13,403.00
Disbursements		$ 310.20	$ 4,442.90	$ 675.40	$ -	$ 5,183.20	$ 1,350.80	$ 4,901.60	$ 1,350.80	$ 5,989.50	$ -	$ -	$ -	$ 24,204.40
Reporting														
Labour		$ -	$ -	$ -	$ -	$ 1,350.00	$ -	$ -	$ -	$ 2,600.00	$ -	$ -	$ 3,620.00	$ 7,570.00
Disbursements		$ -	$ -	$ -	$ -	$ 120.00	$ -	$ -	$ -	$ 120.00	$ -	$ -	$ 120.00	$ 360.00
Project Management														
Labour		$ 780.00	$ 780.00	$ 780.00	$ 780.00	$ 780.00	$ 780.00	$ 780.00	$ 780.00	$ 780.00	$ 780.00	$ 780.00	$ 780.00	$ 9,360.00
Disbursements		$ -	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$ 660.00
Total		$ 2,205.20	$ 13,222.50	$ 5,583.40	$ 3,069.30	$ 12,700.20	$ 8,909.30	$ 11,898.60	$ 6,553.80	$ 13,360.60	$ 3,789.30	$ 2,285.30	$ 4,580.00	$ 88,157.70
Personnel		$ 1,895.00	$ 8,218.00	$ 4,683.00	$ 2,940.00	$ 6,941.00	$ 6,976.00	$ 6,200.00	$ 4,703.00	$ 7,122.00	$ 3,440.00	$ 2,156.00	$ 4,400.00	$ 59,674.00
Disbursements		$ 310.20	$ 5,004.50	$ 900.40	$ 129.30	$ 5,759.20	$ 1,933.30	$ 5,698.60	$ 1,850.80	$ 6,238.80	$ 349.30	$ 129.30	$ 180.00	$ 28,483.70

Assumptions:
The above budget is based on the Fw rate schedule
$60.00/month Unit 1292 laptop computer charge will be applied to this project from February to December
Project Management is based on an average of 3 hours per month for each of Scott Davidson, Jessy Harper, & Gary Beckstead
Water quality analysis costs following the Revised Metals Sampling Analysis are expected to drop in total costs to ~15K/year

Allan: For Your Info.:

Incidental Disbursements													
If 5% of fees	94.75	410.9	234.15	147	347.05	348.8	310	235.15	356.1	172	107.8	220	$ 2,983.70
If 3% of fees	56.85	246.54	140.49	88.2	208.23	209.28	186	141.09	213.66	103.2	64.68	132	$ 1,790.22

NOTE:
No. : OPERATION NUMBER 48 : 4800BPS SELECTED EC : ERROR CORRECT G2 : G2 COMMUNICATION
PD : POLLED BY REMOTE SF : STORE & FORWARD RI : RELAY INITIATE RS : RELAY STATION
MB : SEND TO MAILBOX PG : POLLING A REMOTE MP : MULTI-POLLING RM : RECEIVE TO MEMORY

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No.	REMOTE STATION	START TIME	DURATION	#PAGES	MODE	RESULTS
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TRANSMISSION REPORT

cc: Jerry

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental Limited
221 - 18th Street S.E.
Calgary, Alberta
Canada T2E 6J5
Tel (403) 248-4331
Fax (403) 248-1590

January 21, 1999
CW1537.901.1

DRAFT

Way, way too much.

To: Jerry Demchuk

For Comment

Allan Z

Luscar Ltd.
1600 Oxford Tower
10235 - 101 Street
Edmonton, Alberta T2P 3V4

Attention: Mr. Allan Flemming, P.Eng.

Dear Mr. Flemming:

Re: Telkwa Coal Mine
1999 Budget

1.0 SURFACE WATER MONITORING

As per the January 19th, 1999 discussion between Gary Beckstead of AGRA Earth & Environmental Limited (AEE) and Allan Flemming of Luscar Ltd. (Luscar), AEE is pleased to present this "draft" budget for the 1999 baseline water flow and water quality program for the proposed Telkwa Coal Project. This draft will be discussed with you at your office on January 26th, 1999. It is the understanding of AEE that during 1999 Luscar should be submitting the Final Project Report to the B.C. Environmental Assessment Office. Following certification of the project, it is the understanding of AEE that the entire surface water and water quality program will need to be revised.

2.0 WORK PROGRAM AND BUDGET

AEE's proposed 1999 work program is intended to allow for revision of the program during the year. Table 1 presents the monthly budget breakdown for 1999.

The work program proposed for 1999 is as follows:

Surface Water Flow

- Three winter low flow discharge measurements on the Telkwa River;
- Five free flow period discharge measurements at all sites[1];
- An initial site visit during spring followed by an installation trip to sites; and
- Seven trips to perform routine maintenance and downloading of continuous sites.

---

[1] The Telkwa River will only be measured during three of the five free flow discharge measurement trips

cc: JED at Norecol, (403) 777-4150 FYI

6 pages

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental Limited
221 - 18th Street S.E.
Calgary, Alberta
Canada T2E 6J5
Tel (403) 248-4331
Fax (403) 248-1590

January 29, 1999
CW1537.101

FAXED 1/29/99

Luscar Ltd.
1600 Oxford Tower
Edmonton, AB T5J 3G1

Attention: **Mr. Allan Flemming, P.Eng.**
Manager, Special Projects

Dear Mr. Flemming:

Re: **Lakewood and Geneq Dataloggers in Relation to the Y2K Problem** (Telkwa)

We have recently been in contact with Lakewood Systems Ltd. and Geneq Inc. with regard to the problems which may occur as a result of the operation of their dataloggers into the year 2000. The status of each datalogger make is discussed below.

Lakewood has indicated that there will be no hardware modifications required. However, new software will be required to run the Lakewood dataloggers. The current LS-4 software will not allow the datalogger to be programmed correctly, nor will it allow the datalogger's time clock to be set correctly. All users must update their software to LS-4 Version 4.5 prior to the year 2000. This software will be posted on the Lakewood website (http://www.lakewood.com) in the near future and can be downloaded free of charge.

The Unidata Starloggers supplied by Geneq will not have a date problem with the year 2000 as the Starloggers calculate dates based on the number of scans from 1980. Therefore, the year will be calculated correctly. More specific information is available from the Unidata web site (http://www.unidata.com.au). Version 2 and 3 of the Starlog software are Y2K compliant. These programs are updated on a continual basis and are available on the website.

AEE will continue to monitor the progress made with the Y2K software at Lakewood. We will also ensure that the most current software is downloaded from each of these websites and used in future flow monitoring at Telkwa.

Should additional information be required with regard to this problem, you can contact Doug Calvert at Lakewood ((403)462-9110) or via e-mail at mail@lakewood.com or Steve Biduk at Geneq ((604)739-0889).

Sincerely,

AGRA Earth & Environmental Limited

Kristi McKay, M.Sc., P.Eng.
Water Resources Engineer

Reviewed by:

Gary R.E. Beckstead, M.Sc., P.Eng.
Reviewer

cc. Scott Davidson, AEE - Smithers

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AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental Limited
221 - 18th Street S.E.
Calgary, Alberta
Canada T2E 6J5
Tel (403) 248-4331
Fax (403) 248-1590

January 19, 1999
CW1537.901

Luscar Ltd.
1600, Oxford Tower
10235 - 101 Street
Edmonton, Alberta T2P 3V4

Attention: Mr. Allan Flemming, P.Eng.

Dear Mr. Flemming:

Re: Telkwa Coal Mine
Hydrological Analyses

Further to our letter of October 6, 1998, and our discussions, some additional costs have appeared which were not included in that letter. These costs are as follows:

1. Chemex Labs water quality analyses ($4,788.30, as per the subsequent October 30, 1998 invoice).

2. Fees for Westmacott, McKay, Dick, Beckstead ($823.75) for completion of the 200 year flood assessment that Jerry Demchuk had commissioned. This report was finalized on September 28, 1998, immediately prior to the October 6 letter.

3. A significant portion of the 36 hours of Dennis Trotter's time in the October 30, 1998 invoice concerned ongoing discussions and data analysis in response to requests from Steve Day.

These subsequent costs of $9,212.05 plus GST had not been included in the forecast total. We should not require the entire amount to complete the outstanding deliverable, namely the 1998 monitoring report. For preliminary budgeting purposes, let us say that the total budget be increased to $210,000 from $203,853.64.

The 1998 monitoring report is nearing completion. It will be ready for internal technical review by January 20. It should be ready for final issue by January 29, 1999.

Scott Davidson and I are preparing an outline of tasks and associated costs for the 1999 program, as discussed with you earlier. We hope to have a draft ready by January 22, 1999. We can discuss the draft when we meet in your office on January 26, 1999.

We thank you for the opportunity to provide engineering and environmental services to this project. If you have any questions or require further information, please call the undersigned at 235-8118.

Yours sincerely,

AGRA Earth & Environmental Limited

Gary R.E. Beckstead, M.Sc., P.Eng.
Senior Project Manager

GREB/km

cc: Scott Davidson, AEE - Smithers

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AGRA Earth & Environmental

FACSIMILE TRANSMITTAL

#221 - 18 Street S.E.
CALGARY, ALBERTA, CANADA T2E 6J5
Phone NO. (403) 248-4331
FAX NO. (403) 248-1590
DIRECT 235-8118

TO: AL FLEMING
COMPANY: LUSCAR LTD.
FAX NO.: 1-403-420-5875
SENDER: GARY BECKSTEAD FILE NO.: 1537.101-3
FAX OPERATOR: GREB DATE: 98 1125
NO. OF PAGES: 5 (including this page)

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AL:

(1) DRAFT RESPONSE LETTER TO OBEDKOFF re: 1997 MONITORING PROGRAM IS ATTACHED, FOR YOUR REVIEW & COMMENT.

(2) STATUS REPORT FROM OUR SMITHERS OFFICE ATTACHED, FYI.

(3) THAT INVOICE WAS PAID NOV. 23/98 THANKS!

REGARDS,

Gary

November 9, 1998
CW1537.101

DRAFT

Luscar Ltd./Manalta Coal Ltd.
7th Floor, 700 - 9th Avenue SW
Calgary, Alberta T2P 3V4

Attention: Mr. Al Fleming, P.Eng.

Dear Mr. Fleming:

Re: Response to BC Ministry of Environment Lands and Parks letter
July 23, 1998
Telkwa Coal Mine Surface Water Monitoring Program 1997

Further to our discussions with Jerry Demchuk, Environmental Advisor to Luscar/Manalta on November 5, 1998, AGRA Earth & Environmental Limited (AEE) is pleased to respond to the comments presented in the above-noted letter. We appreciate Mr. Obedkoff's comments and suggestions in the spirit of improving the quality of the surface water monitoring program where it is required. Many of his concerns relate to the volume of data available following the first year of the program. Where possible these comments will be considered in the analysis and assessment of the year 2 monitoring report, which will be prepared soon.

AEE has tried to purchase the Manual of Standard Operating Procedures for Hydrometric Surveys in British Columbia through our contacts in Prince George and Smiths over the past year; however the document has not been available until recently. We have now ordered copies and will use this publication for reference. Thanks to Mr. Obedkoff for the "heads up" that the publication is now available.

The responses to each of the individual comments for specific sections of the 1997 Surface Water Monitoring Report are presented below.

1.2 *Federal Water Survey of Canada (WSC) and Resources Inventory Branch (RIB) personnel should also be consulted for advice on hydrometric data collection procedures.*

AEE has established communications Ed Link of the WSC office in Terrace. We have discussed procedures with him and will continue to use him as a resource, when and if required.

It is our understanding that the RIB is located only in Victoria. Subject to your consent AEE will make contact with Mr. Obedkoff of the RIB.

2.1 *Include the WSC hydrometric station on Simpson Creek (08EE012). Is site C below the Tenas North Pit? If not, it should be below its outflow.*

DRAFT

AEE used data for Simpson Creek in the derivation of a regional flood frequency relationship. Otherwise, to date the data for this stream has not been used extensively as the Simpson Creek drainage basin lies outside the basin draining the Telkwa Project area. However, we will consider the use of the data further should the need arise.

Site C is located on Four Creek east of north tip of North Tenas pit. The location of the outflow point from the pit is unknown at this time. (get pit design from Al/Jerry and find out where outflow is.) Gaugung site locations will be reviewed critically to ensure location provides useful/reliable information once the project reaches the Certificate level.

3.1.3 *Stage-discharge curves must be based on measured points only.*

Only 7 months duration of data were available at the time the year one data report was prepared. IN the preparation of the 2nd year monitoring report, additional measurements from the 1998 field season will be available and used to confirm the results from the previous year. AS such it may prove necessary to evaluate and revise some of the data from the previous year based on the results from 1998. We appreciate the comment on this particular data plot, and will check the data again.

3.1.4 *The datalogger record is not coincident with staff gauge readings, except for three points; the calculated discharges are thus questionable. The datalogger must be calibrated at the site with hydrometric levelling of staff gauges and benchmarks. The datalogger and staff gauge level readings must be coincident, if not, an error must be applied to form corrected gauge heights before discharges are calculated.*

The data logger was tied in to local benchmarks. These surveys were conducted in 1997 and 1998. At this site there is a possibility that some stage readings may be relative to one staff gauge and some to another staff gauge. (Two staff gauges were established att he site to cover low and high stages. The data will be reviewed to ensure that the proper staff gauge was referenced and so that the transducer and staff gauge records correlate properly.

3.1.5 *Consult WSC or RIB personnel for a cost estimate of a cableway.*

WSC staff in Terrace have been consulted regarding the construction of a cableway across the Telkwa River. Cost estimates have been prepared, and were provided to MCL/LL on date. Long term site location needs to be determined relative to planned discharge (outfalll) points at which time a cableway will be considered. In the meantime the discharge data from the Telkwa River gauge can be added to the WSC Gaothorn Creek gauge data to give estimates of river discharges in the lower reach of the river.

3.3.4 *As per comments for 3.1.4*

DRAFT

AEE will take a second look at the data for Four Creek.

3.9.1 *What is the hydrologic purpose of an ephemeral stream hydrometric station for this project? If the gauge is for mines operations or water management, then it has a purpose.*

The Tailings Pond gauge was established on the ephemeral stream (called Tailings Pond Creek) below the proposed pond outlet and approximately 500 m downstream of present tailings disposal area. The intent of the data gathering for this station was to provide discharge data to facilitate the derivation of a water balance. for the proposed tailings pond. It should be noted that as the design of the facility has progressed, the size of the proposed tailings pond has shrunk from 100 ha to 30 ha

5.0 *Delete the last sentence of the third paragraph. The stage data collected may not lead to good quality discharge data.*

AEE will take under advisement the comments provided relative to sections 3.1.4 and 3.3.4. These items will be reviewed as discussed above. Also, as more discharge data is obtained, the rating curves will be improved. This will provide an opportunity to review previous estimates of discharge from the historical stream gauge height records.

We thank you for the opportunity to provide engineering and environmental services to this project. If you have any questions or require further information, please call the undersigned at 235-8118.

Yours sincerely,

AGRA Earth & Environmental Limited

Gary R.E. Beckstead, M.Sc., P.Eng.
Senior Project Manager

Scott Davidson, M.Sc., P.Geo.
Geomorphologist

DRAFT

SCD/GREB/km

Attach.

cc: Jerry Demchuk, Norecol Dames & Moore

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Manalta Coal / Luscar mine site Fall 1998

Upper Goathorn - XS Nov 10. Staff gauge @ site

Upper Tenas - XS Nov 10 Staff gauge @ site

Four Creek - automated depth logger removed Nov 9
Staff gauge at site
no XS, waters level too low.

Lower Tenas - XS Nov 10. Staff gauge @ site
- automated depth logger removed Nov 10

Helps Cr - automated depth logger removed Nov 24
- Staff gauge @ site

Telkwa R - automated depth logger removed Nov 24
- staff gauge at site

North Site - logger downloaded Nov 9. Plans to remove Nov 25.

Tailings Pond - logger not re-installed after June 10 (dry).
Little/No fall flows at site

Water Chemistry at all sites Nov 9/10

Metals sampling at Lower Goathorn Lower Tenas + Telkwa R on Nov 9, Nov 16, Nov 24 with two weeks of metals sampling remaining.

Please call Jessy Harper 847-8783 (area code 250) if you have any questions.

AGRA
Earth & Environmental Limited
Box 3966
#3, 3167 Tatlow Road
Smithers, B.C. V0J 2N0

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental Limited
221 - 18th Street S.E.
Calgary, Alberta
Canada T2E 6J5
Tel (403) 248-4331
Fax (403) 248-1590

October 6, 1998
CW1537.901

Manalta Coal Ltd./Luscar Ltd.
7th Floor, 700 - 9th Avenue SW
Calgary, Alberta T2P 3V4

Attention: Mr. Al Fleming, P.Eng. Fax: 269-8075

Dear Mr. Fleming:

Re: Budget Update
Telkwa Coal Mine
Hydrological Analyses

Further to our telephone conference call on October 2, 1998 with you and Jerry Demchuk, AGRA Earth & Environmental Limited (AEE) is pleased to provide you with a summary of the hydrological work you requested for the remainder of the calendar year. It is understood that Manalta Coal Ltd. (MCL, and/or its present owner, Luscar Ltd.) wish to have a single amendment to the existing contract for the remainder of this year's work related to the Telkwa Coal Mine Project.

A total of $25,182 is required to complete activities presently authorized by MCL for 1998. Table 1, attached, summarizes the individual tasks.

This estimate reflects the present monitoring program and does not include provision for changes to stations or station locations that may be required following granting of the Project Certificate.

The present contract value is $170,697.05, as amended by Change Order #5 (Oct. 2, 1997). Billings under this contract have totalled $178,671.64. As discussed October 2, 1998, the project is therefore over-billed $7,974.59. The outstanding work presented in Table 1 totals $25,182.00. The required adjustment to the contract is therefore $33,156.59. The resultant contract value following the revision is therefore $203,853.64.

If the program is continued to February 1999, the following additional components would be required: metals sampling ($8,720), regular monitoring and water quality sampling and analysis ($4,622 or less, depending on access and whether streams are flowing or frozen solid) , low-flow discharge measurements on the Telkwa River (potentially 2 measurements at $1,200 per

measurement) and additional data analysis and reporting ($4,000). The total for extending the program to February, 1999 is estimated at $19,742 (on top of the 1998 budget discussed above).

2.0 SCHEDULE

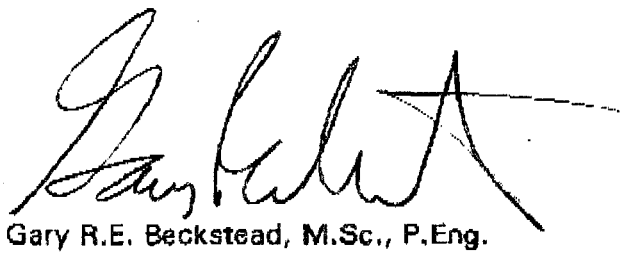
AEE will complete the work (i.e., reporting) by January 31, 1999. The actual field work will be completed by the end of November or the first week of December, 1998.

3.0 CLOSURE

We thank you for the opportunity to provide engineering and environmental services to this project. If you have any questions or require further information, please call the undersigned at 235-8118.

Yours sincerely,

AGRA Earth & Environmental Limited



Gary R.E. Beckstead, M.Sc., P.Eng.
Senior Project Manager

GREB/km

Attach.

cc: Scott Davidson, AEE - Smithers

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TABLE 1
Remaining Tasks and Costs for 1998
Surface Water Monitoring Program

Task	Description	Cost
1	Metals Sampling. Additional metals sampling program, scheduled for late October and early November, 1998[1], as per the June 16, 1998 letter.	$8720
2	Regular flow Monitoring. Flow measurement, water quality sampling and analysis and data download from dataloggers[1] at the end of October as per October 24, 1997 fax to J. Demchuk.	$4622
3	Regular flow Monitoring. Flow measurement data download from dataloggers and removal of water level transducers and dataloggers for the winter season at the end of November or the first week of December as per October 24, 1997 fax to J. Demchuk.	$1190
4	Reporting. Preparation of annual data report to the end of December, 1998 and incorporate the 1997 and 1998 data into a single summary report, as directed.	$10,000
5	Project Management. QA/QC and financial management of the work, as per October 24, 1997 fax to J. Demchuk..	$2190
Total		**$25,182**

[1] The work for Tasks 1 and 2 will be scheduled at the same time to reduce travel and time expenditures. Special laboratory analyses of water quality samples are included in Tasks 1 and 2.

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

NOTICE OF TRANSMITTAL

221 - 18 Street SE
Calgary, Alberta T2E 6J5
Phone: (403) 235-8118
Fax: (403) 248-1590
E-mail: gbeckstead@agraee.com

TO: Luscar Ltd.
1600 Oxford Tower,
10235 - 101 St.
Edmonton , AB
T2P 3V4

DATE: February 11, 1999
OFFICE: Calgary
PROJECT NO.: CW1537
PROJECT NAME: Telkwa Coal Mine

ATTENTION: Mr. Al Fleming **PHONE:** (780) 420-4080

THE ENCLOSED DOCUMENTS AND/OR DRAWINGS ARE SUBMITTED:

☐ FOR YOUR APPROVAL ☑ AS REQUESTED ☐ FOR YOUR REVIEW AND COMMENT
☐ FOR YOUR INFORMATION ☐ FOR YOUR SIGNATURE ☐

DELIVERED BY: ☐ MAIL ☑ COURIER ☐ HAND

COPIES	DRAWING NO.	DESCRIPTION
2	Bound Copies	Reports entitled "Telkwa Coal Mine Surface Water Monitoring Program 1998"
1	Unbound Copy	Report entitled "Telkwa Coal Mine Surface Water Monitoring Program 1998"

REMARKS: Please find the above mentioned reports enclosed. A CD with the report and figures will be sent in tomorrow's courier. One copy of the report has been forwarded to Mr. Jerry Demchuk at his request.

SUBMITTED BY: for: Gary Beckstead, M.Sc., P.Eng.

P:\PROJECT\Cw\1537\tn021199.wpd

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

NOTICE OF TRANSMITTAL

221 - 18 Street SE
Calgary, Alberta T2E 6J5
Phone: (403) 235-8118
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❑ FOR YOUR INFORMATION ❑ FOR YOUR SIGNATURE ❑

DELIVERED BY: ❑ MAIL ☑ COURIER ❑ HAND

COPIES	DRAWING NO.	DESCRIPTION
1	CD	Report and Figures for Telkwa Surface Water Monitoring 1998

SUBMITTED BY: _____
for Gary Beckstead, M.Sc., P.Eng.

cc: Mr. Jerry Demchuk
1610, 734 - 7 Avenue SW
Calgary, AB T2P 3P8

P:\PROJECT\Cw\1537\tn021299.wpd

PITEAU ENGINEERING LTD.

HYDROGEOLOGICAL AND GEOTECHNICAL CONSULTANTS
Suite 100, 4500 - 16th Avenue NW
Calgary, Alberta, Canada T3B 0M6

Telephone: *(403) 286-2522*
Facsimile: *(403) 247-4811 / (403) 247-0779*
E-mail: *komex@komex.com*

TO FAX #: 269-8075
COMPANY: Manalta Coal Ltd.
ATTENTION: Al Vanderputten

Fleming

DATE: June 27, 1997
PROJ. #: 3773-13
FROM: Bob Clarkson
NO. OF PAGES: 10
(INCLUDING COVER PAGE)

Al,

Please find attached a draft copy of our proposed workplan/cost estimate for the 1997 geotechnical/hydrogeological program at Telkwa. Figure 1 has not been included, but the piezometer locations are the same as identified during the meeting.

Once you have had a chance to review, please give either Fred or myself a call to discuss.

Regards,

Bob Clarkson

J:\3773\3773-13\CORR\FAX1.DOC

PITEAU ENGINEERING LTD.
HYDROGEOLOGICAL AND GEOTECHNICAL CONSULTANTS

SUITE 100, 4500 - 16TH AVENUE N.W.
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TELEPHONE (403) 286-2522
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e-mail: komex@komex.com

June 24 1997

OUR FILE: KI97-3773-13

Manalta Coal Ltd.
7th Floor, 700 - 9th Ave. SW
Calgary, Alberta
T2P 3V4

Attention: Mr. Allan Vanderputten, P.Eng.

Dear Sir:

Re: ***Work Plan for Geotechnical and Hydrogeological Services 1997 Program, Tenas Creek Area, British Columbia***

1.0 INTRODUCTION

Piteau Engineering Ltd. (Piteau) is pleased to present our draft proposal and workplan for the above project. This proposal addresses the 1997 geotechnical, hydrogeologic and hydrologic workplans for the Tenas Pit and Pit 3 areas, and was developed in consultation with Manalta Coal Ltd. (Manalta) based on our meeting of June 13, 1997. These workplans fulfill the groundwater and water quality information requirements outlined on the draft project specifications for the Telkwa Coal project provided to us by Manalta.

The purpose of the 1997 geotechnical work program is to assess geotechnical conditions in the area of the Pit 3 waste dumps, the coal processing plant, and at the proposed location of the bridge crossing of the Telkwa River. The overall objective of the 1997 hydrogeological work program is to improve the level of understanding of baseline groundwater conditions in the areas of Tenas Pit and particularly Pit 3. The hydrological work will focus on development of a water balance for the post mining condition at Tenas Pit and Pit 3.

Information and data from previous investigations (Klohn Leonoff, 1985, Piteau 1994a and 1994b, Piteau 1995, Piteau 1996a and 1996b, and Piteau 1997a, 1997b, and 1997c) shall be referenced as much as possible to assist in attaining these objectives.

2.0 PROPOSED FIELD INVESTIGATIONS

The field investigations proposed within each facility area are briefly discussed below. As in previous geotechnical/hydrogeological investigations completed for the Telkwa coal project, the rotary drill to be used by Manalta for their coal exploration program will be adapted for the deep borehole drilling and proposed monitoring well installations. Moreover, piezometers will be installed within coal exploration boreholes. A backhoe will be utilized for the geotechnical investigations at the Pit 3 waste dumps, plant site and bridge crossing, coupled with interpretation of general overburden type and depth to bedrock from exploration holes.

Proposed hydrogeological borehole/monitoring well locations are shown in Figure 1.

2.1 PIT 3

2.1.1 GEOTECHNICAL INVESTIGATION OF WASTE DUMPS

The objective of the geotechnical investigation is to determine the lithology and basic soil parameters of the dump foundation. The investigation shall consist of the following:

- reconnaissance of the dump sites to verify terrain conditions, map surface water and springs, and to examine soil and rock exposures;
- excavation of approximately 5 test pits, up to 5 m deep, along the existing road in the central area of the dump to log soil units and collect soil samples; and,
- laboratory testing of soil samples, including moisture content, Atterberg limits, grain size and penetrometer strengths.

Depth to bedrock will be determined from exploration drill holes.

A brief report will be prepared documenting the investigations, geotechnical conditions, overall suitability of the site, and any limitations on dump development.

2.1.2 HYDROGEOLOGICAL INVESTIGATION

In view of the fairly complex hydrogeological setting at Pit 3, and in particular the potential importance of faults and fractures on groundwater flow, it is proposed that the groundwater monitoring network be expanded with the installation of six double piezometer nests (site # 3, 10, 15, 24, 28, and 52, see Figure 1). If possible, at one or two piezometer nest locations, efforts will be made to install a piezometer(s) directly within or adjacent to an identified fault zone.

The deeper piezometer will be completed in coal seam 2 while the shallow piezometer will be installed in coal seam 4. However at sites # 28 and #52, it is anticipated the deeper piezometer will be installed in seam 1. Following piezometer development, hydraulic conductivity testing will be performed. The piezometers will be sampled to determine groundwater quality, as well as to assess horizontal groundwater flow patterns, and vertical hydraulic gradients between the two coal seams.

Groundwater quality monitoring will be also be completed at the other existing piezometers (5 in total) completed within the Pit 3 area (i.e., T96R series piezometers). Groundwater samples will be analyzed for the same suite of chemical parameters previously analyzed for, and as specified by the B.C. Ministry of Environment.

Results from the 1997 hydrogeological program, together with hydrogeological information gathered from the aquifer test (discussed below) will be used to develop a better conceptual understanding of groundwater flow and groundwater quality within Pit 3.

2.1.3 AQUIFER TESTING PROGRAM

One of the key hydrogeological issues pertaining to the Telkwa Coal project is the potential influence of regional faults and fractures on groundwater flow. Moreover, related to this is the potential for impact of mining activities on local water wells. To address these issues, it is recommended that an aquifer test be conducted at a test well located within a suitable area of Pit 3 (location to be finalized).

Although the final design of the test well will be determined in the field, based on hydrogeological conditions, it is recommended that the pilot hole be drilled to a diameter of 200 mm (8"). This borehole diameter will permit installation of 150 mm (6") diameter water well casing and use of a submersible pump (5 or 7 hp) sufficient to adequately stress the aquifer. The decision as to whether to install well screen (compared with open hole) will be assessed during the borehole drilling. It is our understanding the test well will be drilled using a local water well contractor and that Manalta will be responsible for overseeing drilling activities. Consequently, we have not included costs for supervision of the drilling of the test hole.

It is recommended that the aquifer test consist of a 48 hour constant rate drawdown component followed by a 48 hour recovery component. In the event aquifer boundary conditions are identified, the drawdown component of the test would be extended to at least 72 hours. The constant rate test should be preceded by a 4 hour step drawdown test to evaluate well efficiency and to determine a suitable rate for the constant yield test. During the aquifer test, groundwater levels will be monitored in selected observation wells in Pit 3 and if possible, in domestic wells located within 2 km of the test well. Groundwater levels will be monitored manually using electric water level tapes as well as using pressure transducers and data loggers. A turbine and digital flow meter would be used to monitor groundwater pumping rates.

policy! require

Results from the aquifer test will permit determination of the hydraulic properties (i.e., transmissivity and storativity) of coal seam 2. This information will be used to refine estimates of the groundwater flow velocity in the coal seams and may provide insight into the role and importance of fractures and faults within the Pit 3 area. Potential effects of mining activities on nearby domestic wells will also be assessed.

2.1.4 GEOTECHNICAL LOGGING OF ROCK CORE

There is an opportunity for collection of geotechnical information of rock core during exploration drilling operations. It is thus proposed that a geotechnical engineer from Piteau (Vancouver)

spend one day on-site with Manalta geologists to provide training for the collection of geotechnical data (as required) during their drilling and logging operations.

Tamas ✓ missing?

2.1.5 HYDROLOGICAL ASSESSMENT

Sect 2.4

A preliminary water balance will be developed for Pit 3. The pit water balance methodology will be based on the procedures previously developed for Pits 7 and 8 (Piteau, 1994a). Estimates of groundwater inflows will be combined with estimates of surface water runoff to establish filling rates. As was the case for Pits 7 and 8, a sensitivity analysis will be conducted to establish the range of possible filling rates, taking into account uncertainties in groundwater inflow rates and wet/dry year scenarios.

2.2 COAL PROCESSING PLANT - GEOTECHNICAL INVESTIGATION

The objective of the geotechnical investigation is to provide data for confirming the feasibility of two potential sites and to develop preliminary designs. The investigation will consist of the following:

- excavation of approximately 6 test pits, 5 m deep, to be located along the perimeter of the 43 m x 16 m plant site configuration - log soil units and collect soil samples; and,
- laboratory testing of soil samples, comprising moisture content, Atterberg limits, grain size and penetrometer strengths, and if softer clay soils are found unconsolidated undrained triaxial and consolidation tests.

Depth to bedrock will be determined from exploration drill holes.

A brief report will be prepared documenting geotechnical conditions, and discussing options and providing relevant design parameters for the plant foundation.

2.3 BRIDGE ON TELKWA RIVER - GEOTECHNICAL INVESTIGATION

The objective of the geotechnical investigation is to confirm the geotechnical feasibility of crossing the river and to provide data for preliminary foundation design. The investigation will consist of the following:

- excavation of approximately 6 tests pits, 5 m deep, at 2 or 3 locations on each side of the river crossing to log soil units and collect soil samples;
- drilling 2 boreholes with the exploration rig: one on each bank (to bedrock or to 30 m deep in gravel, or 50 m deep in clay), logging of drill cuttings to determine soil type (gravels vs. sand vs. silt/clay); and,
- laboratory testing of soil samples, comprising moisture content, Atterberg limits, grain size and penetrometer strengths, and if softer clay soils are found, perform unconsolidated undrained triaxial and consolidation tests.

A brief report will be prepared on the investigation and geotechnical conditions encountered, and providing relevant foundation design parameters.

2.4 TENAS PIT

2.4.1 HYDROGEOLOGICAL INVESTIGATION

It is proposed that the groundwater monitoring network be expanded with the installation of two double piezometer nests near the north end of Tenas Pit (Figure 1). The deeper piezometer will be completed in coal seam 1 while the shallow piezometer will be installed in coal seam "c". Following piezometer development, hydraulic conductivity testing will be performed. The piezometers will be sampled to determine groundwater quality, and to estimate horizontal groundwater flow patterns, and vertical hydraulic gradients between the two coal seams.

Groundwater quality monitoring shall also be completed at all other existing piezometers (19 in total) completed within the Tenas Pit area (i.e., T95R, T96R, and TOB96 series piezometers).

Information garnered from the 1997 hydrogeological program will augment the existing hydrogeological database that exists for the Tenas Pit.

2.4.2 HYDROLOGICAL ASSESSMENT

A preliminary water balance will be developed for the Tenas Pit. The approach for the water balance will be the same as described for Pit 3 in Section 2.1.5.

3.0 COST ESTIMATE

The estimated cost of the investigation program is $118,405, exclusive of the GST. A detailed cost breakdown is provided on Table 1.

In developing these costs the following assumptions were made:

- all survey work (i.e., ground surface and top of piezometer casing elevation) will be arranged by Manalta;
- costs for borehole drilling, piezometer construction materials and excavation of test pits are not included;
- contractor costs for the drilling/installation of the test well and aquifer testing are not included; and,
- Piteau only charges for costs actually incurred. Any cost savings generated through more rapid program completion would be passed onto Manalta; conversely any additional costs due to unexpected or difficult subsurface conditions or down time from poor weather, would be charged at extra cost at the units rate listed in Table 1.

Additional assumptions in the cost estimate are presented in Table 1.

4.0 SCHEDULE AND REPORTING

The schedule of the work will coincide with Manalta's exploration program, which is presently understood to consist of a 3 week on/3 week off rotation, beginning July 15, 1997. Therefore, it

is anticipated scheduling for the geotechnical/hydrogeological field work and reporting will be as follows:

- July 21 to August 2, - Borehole drilling and piezometer installations (Pit 3 area); geotechnical investigations;
- Late-August to mid-September, - borehole drilling and piezometer installations (Tenas Pit area); aquifer testing program; groundwater sampling; and,
- October 30, - submission of draft reports summarizing results from the hydrogeological and geotechnical programs completed in 1997.

It is our understanding that results from the hydrogeological/hydrological investigations will form the basis for a stand alone report summarizing baseline hydrogeological conditions at the Tenas Pit and Pit 3. The reports will essentially augment the previous detailed baseline report prepared by Piteau (1997a). Information from the geotechnical investigations will be presented under separate cover.

5.0 CLOSURE

We trust this cost proposal is suitable for your present needs. If you have any questions, please do not hesitate to contact either of the undersigned or Dr. Tad Dabrowski.

Respectfully,

PITEAU ENGINEERING LTD.

Frederic B. Claridge, M.S., P.Eng.

Robert S. Clarkson, M.Sc., P.Geol.

REFERENCES

Klohn Leonoff Consulting Engineers, 1985. *Crows Nest Resources Ltd., Telkwa Coal Project, Stage II Geotechnical, Hydrogeological & Hydrological Design Report.*

Piteau Engineering Ltd., 1997a. *Baseline Hydrogeological Investigations in the Tenas Pit, Waste Dumps, and Mine Pit 3, Telkwa Coal Project.* Unpublished report prepared for Manalta Coal Ltd. KI97-3773-12. January 1997.

Piteau Engineering Ltd., 1997b. *Geotechnical and Hydrogeological Assessment Proposed Tailings Pond Area, Telkwa Coal Project.* Unpublished report prepared for Manalta Coal Ltd. KI97-3773-12. January 1997.

Piteau Engineering Ltd., 1997c. *Engineering Geology and Geotechnical Assessment Tenas Pit and Waste Dumps, Telkwa Coal Project.* Unpublished report prepared for Manalta Coal Ltd. KI97-3773-12. January 1997.

Piteau Engineering Ltd., 1996a. *Preliminary Assessment of Potential Groundwater Inflows and Dewatering Requirements in the Tenas Creek Region, Telkwa Coal Project, British Columbia.* Unpublished report prepared for Manalta Coal Limited. KI93-3773-10. January, 1996.

Piteau Engineering Ltd., 1996b. *Surficial Geology Map of the Telkwa Property.* Unpublished Preliminary Map prepared for Manalta Coal Limited. KI93-3773-11. April, 1996.

Piteau Engineering Ltd., 1995. *Results of Groundwater Sampling Project Telkwa Coal Project, British Columbia.* Unpublished report prepared for Manalta Coal Limited. KI93-3773-8. November, 1995.

Piteau, 1994a. *Telkwa Coal Project: Water Management of Tailings Pond and Pits 7 and 8.* Prepared for Manalta Coal Ltd. Project # KI93-3773-3.

Piteau Engineering Ltd., 1994b. *Baseline Data Surface Water and Groundwater Telkwa Coal Project.* Unpublished report prepared for Manalta Coal Limited. KI93-3773-1. June, 1994.

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DRAFT

TABLE 1
COST ESTIMATE

FACILITY/WORK TASK	PRINCIPAL ENGINEERS		HYDROGEOLOGIST/ENGINEER			TECHNOLOGIST	DRAFTING/ CLERICAL	DISBURSEMENTS	TOTAL ($)
	F. Claridge $100.00/hr	T. Dabrowski $110.00/hr	B. Clarkson $80.00/hr	M. Fitch $77.50/hr	R. Armstrong $65.00/hr	$55.00/hr	$50.00/hr		
1. Pit #1 Waste Dumps									
Reconnaissance and Test Pits					12			350	1,130
Geotech Lab Tests								600	600
Stability Analysis					8				520
Reporting	4				15		5	400	2,025
Vehicle Rental (assume 1 day)								150	150
Living Expenses (assume 1 day)								110	110
Travel Expense								1,200	1,200
Sub-total	4				35		5	2,810	5,735
2. Plant Site									
Test Pits					12			200	980
Lab Tests								600	600
Reporting	4				25		5	200	2,475
Vehicle Rental (assume 2 days)								300	300
Living Expenses (assume 2 days)								220	220
Sub-total	4				37		5	1,520	4,575
3. Bridge Crossing of Telkwa River									
Test Pits and Drilling					20				1,300
Lab Tests								600	600
Reporting	4				30		10	400	3,250
Vehicle Rental (assume 2 days)								300	300
Living Expenses (assume 2 days)								220	220
Sub-total	4				50		10	1,520	5,670
4. Geotechical Logging of Rock Core									
Training/on-site supervision						14			770
Vehicle Rental (1 day)								150	150
Living Expenses (1 day)								110	110
Travel Expense								1,000	1,000
Sub-total						14		1,260	2,030
5.1 Pit 3 - Hydrogeological/Hydrological Investigations									
Piezometer Installations (6 double piezometer nests; 12 piezometers in total)									
Supervision			72						5,760
K Tests (12 piezometers)			24			24		250	3,480
Groundwater Sampling/Analysis (1996 and 1997 piezometers; 23 in total)			20			20		10,925	13,625
Water Balance			10	30		6	4	100	1,540
Reporting		6	50			26	30	500	6,035
Vehicle Rental (14 days)								2,100	2,100
Living Expenses (16 man days)								1,780	1,780
Travel Expense (assume 1 person mob/demob in July; assume 2 persons mobile/demob in August)								3,600	3,600
Sub-total		6	176	30		77	34	19,235	39,910
5.2 Pit 3 - Aquifer Test									
Step/drawdown Test			8						480
Aquifer Test (assume 48 hour drawdown and 48 hour recovery)			40			40		2,000	7,400
Groundwater Sampling/Analysis (2 samples from test well)								900	900
Equipment Rentals(Pressure transducers, data loggers, field parameter kit, water level, etc.)									0
Reporting			40			10	6	200	4,250
Vehicle Rental (5 days)								750	750
Living Expenses (10 man days)								1,100	1,100
Travel Expense (NC, assume mob during August program)								2,400	2,400
Sub-total			88			50	6	7,350	17,280

JUN-27-1997 08:42 KOMEX INTERNATIONAL LTD. 403 247 4811 P.09/10

DRAFT

TABLE 1
COST ESTIMATE

FACILITY/WORK TASK	PRINCIPAL ENGINEERS		HYDROGEOLOGIST/ENGINEER			TECHNOLOGIST	DRAFTING/ CLERICAL	DISBURSEMENTS	TOTAL ($)
	F. Claridge $100.00/hr	T. Dabrowski $110.00/hr	B. Clarkson $80.00/hr	M. Fitch $77.50/hr	R. Armstrong $65.00/hr	$55.00/hr	$50.00/hr		
5.3 Tenas Pit - Hydrogeological/Hydrological Investigations									
Piezometer Installations (2 double piezometer nests; 4 piezometers in total)			22						1,760
Supervision			8			8			1,080
K Tests (4 piezometers)			25			25		11,000	14,375
Groundwater Sampling/Analysis (1995, 1996 and 1997 piezometers; 19 in total)			8	30		8	4	100	1,380
Water Balance		2	30			16	12		3,770
Reporting								750	750
Vehicle Rental (5 days)								1,100	1,100
Living Expenses (10 man days)									
Travel Expense (NC, assume mob during August program)									
Sub-total		2	93	30		51	16	12,950	24,215
5. REPORTING AND MANAGEMENT									
Reporting (Final/Review)	16	16	35		10	8	20	500	8,750
Management/Coordination	16	4	16					200	3,520
Field Program Preparation			16						1,280
Meetings	8	6	16				4	300	3,240
Computer Usage								2,200	2,200
Sub-total	40	28	83		10	8	24	3,200	18,990
TOTAL	*52*	*34*	*435*	*60*	*132*	*200*	*100*	*49,845*	*$118,405*
									+GST

Notes:

1. Vehicle Expense = $150/day
2. Living Expense (accommodation and meals) = $110/day
3. Groundwater chemical analysis (as per B.C. Environment requirements) = $475/sample.
4. Geotechnical laboratory analysis (moisture content = $4/sample; Atterberg limits = $65/sample; grain size and hydrometer = $160/sample; standard proctor density = $145/sample.
5. It is assumed the drilling rig for the coal exploration program will be available for deep borehole drilling, geotechnical sampling, and monitoring well installations in the Tenas Creek Pit area; theodore drilling costs have not been included.
6. Costs for the backhoe and drill rig required for Tasks 1, 2, and 3 are not included.
7. Piezometer installation assumes the boreholes have been drilled and a drill rig is available to install construction materials. Any delays in the piezometer installation outside of Komex's control will be charged at the unit rates listed.
8. It is assumed that all survey work (i.e., ground surface elevation, top of piezometer casing elevation, and piezometer stick-up will be the responsibility of Manalta.

JUN-27-1997 08:42 KOMEX INTERNATIONAL LTD. 403 247 4811 P.10/10

TOTAL P.10

(403)-420-4089 ATTN: ALLAN FLEMMING

PITEAU ENGINEERING LTD.

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TO: Jerry Demchuk
COMPANY: Norecol
FAX #: 777-4150

FROM: Rob Armstrong
DATE: January 12, 1999
PROJ. #: 3773-17
NO. OF PAGES: 3
(Including Cover Page)

rarmstrong@calgary.komex.com

Re: Telkwa Coal Project: Remaining Issues

This fax is to describe the scope of work developed in our January 8, 1999, meeting. The scope of work for the three issues we discussed is as follows:

Hydrology of Four Creek
There is concern over diversions on the ecosystem (most importantly fish) on Four Creek. The hydrology component will examine the pre- and post-development flows in the creek. Discussions with Dave Bustard will be required to determine the sensitivity of the aquatic community to these flow changes.

The hydrology for the Telkwa project collected to date has largely ignored the hydrology data collected on-site, since this data was previously too sporadic and of insufficient duration to answer questions concerning long-term hydrology (such as 1:200 year low flow events). However, given that a question specific to Four Creek has been posed, it will be necessary to integrate the regional flow information and the Four Creek monitoring data provided by Agra. Using this information, estimated monthly average and low flows (pre- and post-development) will be calculated. ← Luscar to do stats.

If the proposed diversions are likely to cause problems for the fishery, it may be necessary to examine alternate filling scenarios for the Tenas pits. For example, a structure could be constructed which would divert water to the pit only when a minimum flow level was achieved. This will require recalculation of the filling times for the Tenas pits.

Residual Moisture Content of Haul Road Surface No. Cirmac consulted
An estimate of the residual moisture content of the Haul road surface (soil surface) is required for the dust fall modelling. At present the model has been performed for a moisture content range of 4 to 11%, and the predicted dust fall has proven to be sensitive within that range. A literature review is required, along with some preliminary analysis specific to the weather conditions at the Telkwa area, to refine the data input.

Weathering Characteristics of Waste Rock
There is empirical evidence that the waste rock that will be generated at Telkwa is susceptible to breakdown due to weathering. It has therefore been suggested that the waste rock dumps will be self sealing as the waste rock weathers, resulting in surface water running off the dumps, rather than infiltrating them. A review of all current data available on the waste rock is required, with the purpose

of predicting the breakdown of the waste rock dump faces, the resulting permeability of the dump surface, and the resistance of the dump face to erosion.

Closure

Since these issues are all significantly different, we suggest that three separate letter reports would be suitable. We propose to issue a draft of the reports by February 5, 1999. Final copies to be issued 1 week after comments are received back from yourself. The cost estimate to perform this work is attached. Since this scope of work is a bit loose we emphasize that it is only an estimate, and believe that the cost will range between $5,000 and $10,000.

PITEAU ENGINEERING LTD.	ESTIMATE OF ENGINEERING COSTS	FILE: Telkwa
	Residual Moisture Content of Road Material and Weathering of Waste Rock Dump Desk Top Investigation	DATE: 12-Jan-99
CLIENT: Luscar		BY: RCA
PROJECT NO.: 3773-17		REV: A
LOCATION: Telkwa		

ITEM	DESCRIPTION	ENGINEERING QTY	UNITS	RATE	EXTENSION		
1	**RESIDUAL MOISUTRE CONTENT IN ROAD MATERIAL**						
	Literature Review	15	Hours	$60	$900		
	Report	8	Hours	$75	$600		
	Sr. Review	4	Hours	$110	$440		
	Client Support	8	Hours	$75	$600		
		35			SUB TOTAL	$2,540	2540
2	**WASTE ROCK WEATHERING**						
	Review Existing Data	10	Hours	$60	$600		
	Review Other Mine Experience	10	Hours	$60	$600		
	Report	8	Hours	$75	$600		
	Sr. Review	4	Hours	$110	$440		
		32			SUB TOTAL	$2,240	2240
3	**HYDROLOGY OF FOUR CREEK (Junior Hydrologist: $60, Senior Hydrologist: $85, Principal Water Resources Engineer: $110)**						
	Review Existing Data	4	Hours	$85	$340		
		2	Hours	$60	$120		
	Integration of regional data and Agra data	8	Hours	$85	$680		
		4	Hours	$60	$240		
	Examine diversion alternatives (if fisheries problem)	8	Hours	$85	$680		
		8	Hours	$60	$480		
	Report	8	Hours	$60	$480		
		4	Hours	$85	$340		
	Sr. Review	4	Hours	$110	$440		
		38			SUB TOTAL	$3,800	3800
	COMPUTER OVERHEAD	70	Hours	$2.50	$293		293
	SECRETARY (5%)				$429		429
	Subtotals	117	Hours		$9,302		5551
	Contingency (10%)				$930		555
	GRAND TOTAL				$10,232		6106

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1/12/99 - 11:58 PM
JAN-12-1999 15:38 KOMEX INTERNATIONAL LTD. 403 247 4811 P.03/03
TOTAL P.03

PITEAU ENGINEERING LTD.

HYDROGEOLOGICAL AND GEOTECHNICAL CONSULTANTS
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Calgary, Alberta, Canada T3B 0M6

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Facsimile: *(403) 247-4811 / (403) 247-0779*
E-mail: *komex@komex.com*
Website: *www.komex.com*

TO FAX #: 780. (403) 420-5878
COMPANY: Luscar
ATTENTION: Allan Flemming

DATE: Jan 26, 1999
PROJ. #: 3773-17
FROM: Murray Fitch
NO. OF PAGES: 18.
(INCLUDING COVER PAGE)

JED
(403) 777-4150

Re: ***Final Draft Letter - Four Creek Hydrology***

Allan,

Please find attached a final draft of the letter. It is basically complete – lacking only the unfaxable (because of size) Figure 1. If this meets your requirements, I can courier it out whenever you say the word. If not, please call me at (403)286-2522.

Murray

\\CENTRAL\DATA3\X\PROJECTS\3773\3773-17\CORR\fltr156.doc

⇒ Jerry).

PITEAU ENGINEERING LTD.
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February 26, 1999

OUR FILE: 3773-17

Luscar Coal Ltd.
10235 - 101 St.
Edmonton, AB
T5J 3G1

(fax) 780.420.5878
(tel) 780.420.4080

Attention: Allan Flemming, P.Eng.

Dear Mr. Flemming:

Re: Hydrology of Four Creek

INTRODUCTION

A previous report, *Water Management for the Telkwa Coal Project* (Piteau 1998, henceforward referred to as WMTCP), addressed the issue of hydrology in and around the proposed Telkwa Coal Project. In order to ensure the rapid filling of abandoned pits, the diversion of a number of creeks is anticipated. One of these, Four Creek, was identified by the British Columbia Ministry of Environment, Lands and Parks (MELP) as being of concern from a fisheries perspective. This letter addresses the issue of the hydrologic implications of the diversion of a portion of the upper drainage of Four Creek.

HYDROLOGY OF FOUR CREEK

Figure 1 shows the drainage sub-basins of Four Creek[1]. For analysis purposes, flows have been considered at the following locations:

---

[1] A discrepancy exists between the drainage area used in this report and that used in the WMTCP report. Previously, a drainage area of 13 km^2 was calculated using 1:50,000 topographical maps - 1:20,000 scale maps used in this report suggest a 10 km^2 drainage area.

1: the proposed diversion location into the Tenas Main Pit
2: two thirds of the drainage area
3: the mouth of Four Creek (confluence with Goathorn Creek)

Four Creek flow data was collected in 1997 (October-November) and 1998 (June-November). Of greatest hydrologic (and fisheries) concern are the relatively rare low flow events. The data record for Four Creek is not sufficiently long to permit the calculation of low-flow statistics, and thus the record must be supplemented by longer-term precipitation data and/or regional hydrologic data. These are discussed below.

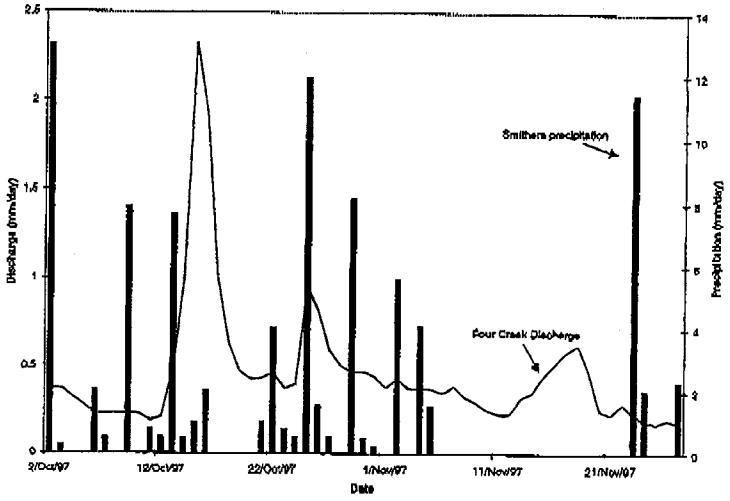


Figure 2: Four Creek discharge and Smithers Precipitation for 1997

CORRELATION OF TELKWA AREA RUNOFF AND SMITHERS PRECIPITATION

In general, the correlation between precipitation recorded at Smithers Airport and discharges in Simpson, Goathorn and Four Creeks is only fair. The discrepancy is more pronounced in the 1997 record than in 1998. Figure 2 and Figure 3 show the relationship between Four Creek discharges and Smithers precipitation for 1997 and 1998. Large precipitation events are not reflected in the discharge record, particularly after October 22. In addition, discharge in Four Creek increased in mid-November when no precipitation was recorded at Smithers.

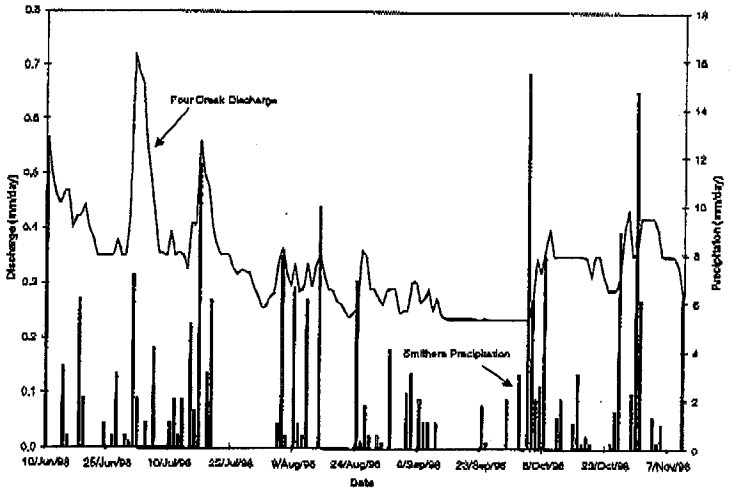


Figure 3: Four Creek Discharge and Smithers Precipitation for 1998

The timing of runoff and precipitation events for 1998 have a closer relationship than in 1997. Storm events in Smithers are generally reflected in the Four Creek discharge record. However, the magnitude of runoff response to precipitation is not well represented. Several large late-season precipitation events only result in minor increases in Four Creek discharge, as compared to early July where runoff is at its peak with only moderate precipitation recorded at Smithers. The record suggests that, at least on a daily time scale, precipitation recorded at Smithers is not representative of the precipitation received at Telkwa.

Over the longer-term (monthly or annually), however, the precipitation, however, the Smithers and Telkwa precipitation data appeared to correlate reasonably well. In the WMTCP report, precipitation recorded at Smithers (elevation 523 masl; 55 years of data) was compared to precipitation recorded at Telkwa (elevation 683 masl; 26 years of data) and Telkwa Coal Mine Road (elevation 670 masl; 3 years of data). Both Telkwa stations were discontinued over 10 years ago, however, the data suggests that the Telkwa area receives roughly 11% less precipitation than Smithers. Thus, the Smithers precipitation data was reduced by 11%, which was used to estimate precipitation, surface runoff and infiltration into the coal pits.

COMPARISON OF HYDROLOGY OF FOUR AND GOATHORN CREEKS

The WMTCP report identified four key gauged drainages in the Telkwa area:

- Canyon Creek Near Smithers (Environment Canada station #08EE014)
- Kathlyn Creek above Simpson Creek (08EE010)
- Simpson Creek at the Mouth (08EE012)
- Goathorn Creek near Telkwa (08EE008)

Two of Environment Canada's gauging stations, Canyon Creek and Kathlyn Creek, have been discontinued. Flow data for Goathorn, Simpson, and Four Creek are presented in Figure 4 and Figure 5. The data are presented as unit runoff (in mm). Thus, flows in the creeks have been corrected for drainage basin size.

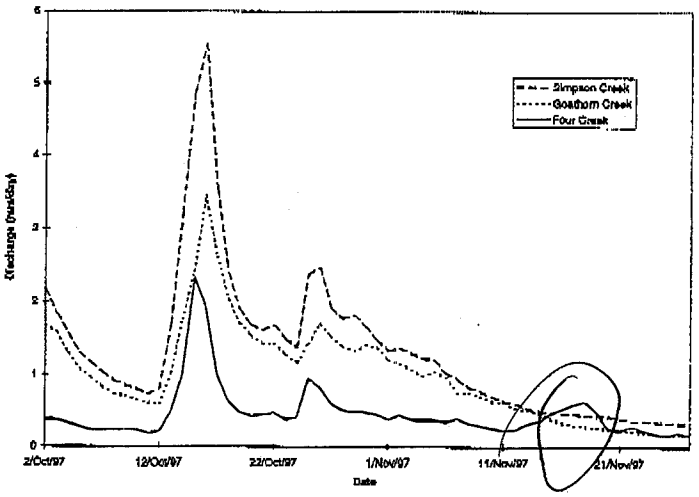


Figure 4: Comparison of Four, Simpson and Goathorn Creek average daily discharge for 1997

Data from Simpson Creek suggest that this basin is very "peaky" - a trait which was less marked in the Goathorn and Four Creek data. Thus, it appears that Goathorn Creek is a more appropriate comparison for Four Creek, and will be used in subsequent analyses.

Thus, to transform long-term Goathorn Creek data for use at the Four Creek site, a comparison of the 1997 data at the two sites was made[2]. The cumulative runoff at the Four Creek station was 23 mm, and at Goathorn Creek, 54 mm. This gives a ratio of 22.9/54.2 = 0.42. For 1998, the cumulative runoff for Four and Goathorn Creeks were 52 and 156 mm respectively, yielding a ratio of 0.33. The ratios for the 1997 and 1998 discharge records were averaged to produce a value of 0.38, which was applied to the Goathorn Creek data as a transformation.

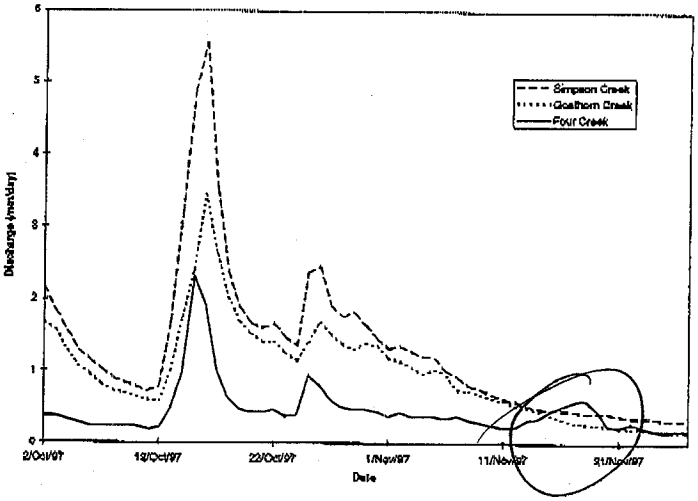


Figure 5: Comparison of Four, Simpson and Goathorn Creek average daily discharge for 1997

Table 1 shows the runoff coefficients for Goathorn and Four Creeks. These coefficients were calculated using Smithers precipitation data (decreased by 11% to account for differences between Smithers and Telkwa, as described previously). Runoff coefficients for Four Creek do not change from 1997 to 1998, remaining at 28%. In the WMTCP report, a runoff coefficient of 30% was adopted. This latter figure was challenged by the BC MELP, as 30% is a lower coefficient than has been determined in nearby gauged basins. However, the limited Four Creek flow data

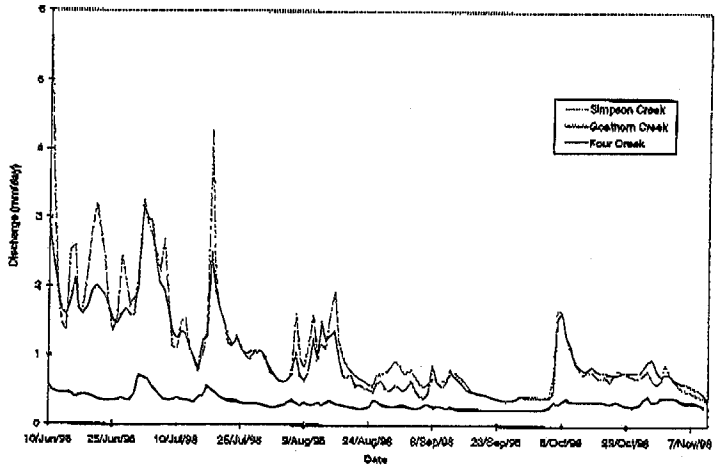


Figure 6: Comparison of Four, Goathorn and Simpson Creek Average Daily Discharge for 1998

Table 1 – Runoff coefficients for Four Creek and Goathorn Creek.

	1997			*1998*		
Basin	****Smithers Precipitation***	***Runoff***	***Runoff Coefficient***	****Smithers Precipitation***	***Runoff***	***Runoff Coefficient***
Four Creek	82 mm	23 mm	0.28	187 mm	52 mm	0.28
Goathorn Creek	82 mm	54 mm	0.65	187 mm	156 mm	0.83

Notes: Period of record for 1997 is October 2 to November 27.
Period of record for 1998 is June 10 to November 10.
* Decreased by 11% to transform to Telkwa area.

available suggest that a 30% runoff coefficient is indeed reasonable. The runoff coefficients for Goathorn Creek (relative to Smithers rainfall data) vary from 65% in 1997 to 83% in 1998. Our experience and knowledge of the area suggests that these figures are too high, since they imply that the Goathorn basin produces almost three times as much runoff (per square kilometre) as Four Creek. There are a number of potential sources for this discrepancy.

First, both basin aspect and elevation are expected to have a significant effect on discharge. The Goathorn Creek Basin has an altitude range of 1745 m (from 550 to 2295 masl) whereas the Four Creek basin has a range of only 670 m (from 700 to 1370 masl). If an orographic precipitation enhancement factor of roughly 40% per 1000 m is assumed (an average value for the Canadian Rocky Mountains, Quick and Pipes, 1996), then the Goathorn Creek watershed should receive significantly more precipitation. In addition, the Four Creek basin generally faces the northeast, where as the Goathorn Creek Basin faces both the northeast and the northwest. This variance in aspect will cause differences in snowpack accumulation and ablation.

Secondly, the influence of groundwater may be more pronounced in Goathorn Creek as it extends lower in the basin. Springs surfacing from fractures may augment flows in Goathorn Creek at elevations below the Goathorn/Four Creek confluence (700 masl).

Another factor is that Goathorn Creek is augmented by glacial runoff where as Four Creek is non-glaciated. Although the ice melt contribution during October and November is not expected to be great, there should be some water coming from glaciers due to pressure melting and perhaps internal storage.

TIMING OF RUNOFF

In general, the timing of the discharge record for Goathorn and Four Creeks compare favourably, as is illustrated in Figures 5 through 7. This suggests that the basins respond to meteorological events in a similar fashion, and thereby justifies the use of transformed Goathorn Creek discharge data as a surrogate for Four Creek data. Applying a time lag (at the daily scale) to the discharge does not improve this relationship.

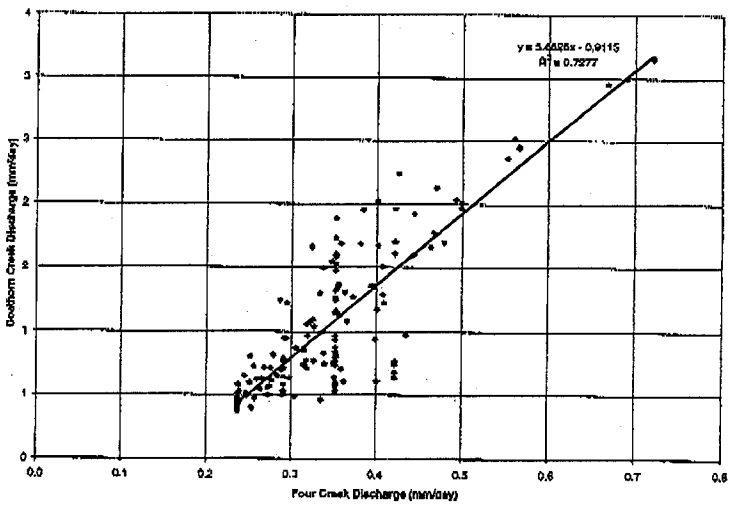


Figure 7: Relationship between Goathorn Creek and Four Creek average daily discharge

LOW FLOW ANALYSIS

Figure 8 shows the probabilities of mean annual low flows in Goathorn Creek. The data plotted are the lowest mean daily flows in Goathorn Creek (one mean daily flow for each year of record). For subsequent analysis purposes, the 1 in 10 year (10% probability) mean daily runoff of 0.045 mm/day was used as the reference. The runoff ratio of 0.38 was applied to estimate the 1 in 10 year low flow for Four Creek, giving a value of 0.017 mm/day. The average daily discharge for Goathorn Creek is 1.15 mm/day. Applying the ratio gives an estimated average daily runoff of 0.43 mm/day for Four Creek.

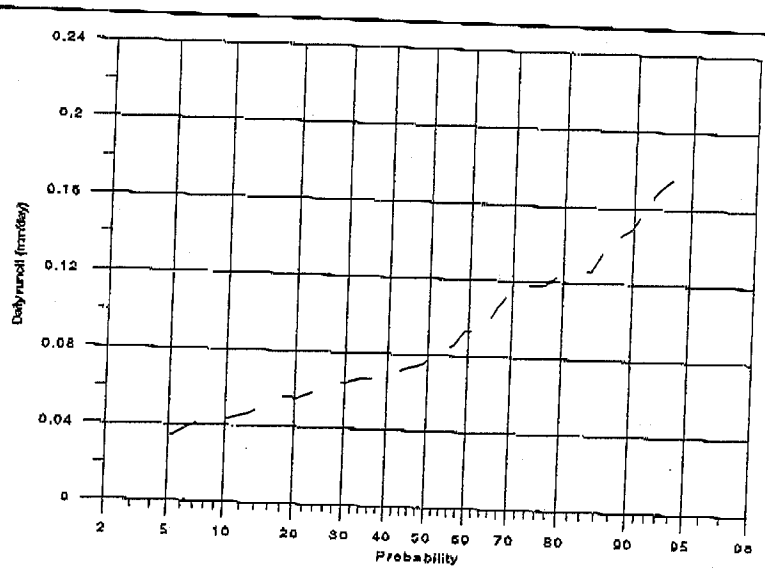


Figure 8: Mean daily low flow distribution in Goathorn Creek

The proposed diversion of the Four Creek tributary results in a reduction of roughly 18% of the total discharge area of Four Creek. Assuming that all areas of the basin behave in the same manner hydrologically, it can be assumed that the total discharge of Four Creek would also be reduced by 18%. Table 1 shows the estimated average daily and 1 in 10 year low flow for Four Creek at three stream locations assuming pre- and post-diversion scenarios. The influence of the proposed diversion on the flow of Four Creek is displayed graphically in the Appendix.

Table 2 - Estimated discharges for various locations along Four Creek.

Location	*% of original drainage area*	*Estimated Minimum 1 in 10 year Discharge (L/s)*		*Estimated Average Daily Discharge (L/s)*	
		with diversion	*without diversion*	*with diversion*	*without diversion*
At diversion	58	0.7	0.6	8.4	15
2/3 of basin length	74	0.9	1.3	22	30
At mouth	82	1.6	1.9	40	49

CONCLUSION

The use of Goathorn Creek data as a surrogate for Four Creek is reasonable provided that a transformation is applied (a value of 0.38 was used in this analysis). The two basins respond in a similar fashion in terms of timing, however, the Goathorn basin produces greater unit runoff. This may be a result of elevation, aspect, groundwater and/or icemelt.

The impact of the diversion on flows in Four Creek varies between the upper reaches and the mouth. At the mouth, only 18% of the original drainage is removed by diversion. At the point of diversion, however, 42% of the drainage (and hence flow) is removed. It is important to note that there is significant natural variability in the creek, ranging from a 1 in 10-year minimum of 1.9 L/s (assuming no diversion) to an average of 49 L/s.

It is possible to construct a diversion structure, which would guarantee a minimum flow in the creek. Only flows exceeding this minimum would be diverted into the pits. Withdrawals to the pits could therefore be restricted to higher flow periods, making the impact of the diversion relatively minor compared to natural creek variability.

Respectfully,

PITEAU ENGINEERING LTD.

Murray Fitch, M.A.Sc., P.Eng.
Senior Hydrologist

REFERENCES

Piteau, 1998. *Water Management for the Telkwa Coal Project.* Unpublished report prepared for Manalta Coal Ltd. Project #3773-16.

Quick, M.C, and Pipes, A.P., 1996. *U.B.C. Watershed Model Manual, Version 4.0,* Department of Civil Engineering, University of British Columbia.

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E-mail: *komex@komex.com*
Website: *www.komex.com*

TO FAX #: 780.420.5878
COMPANY: Luscar
ATTENTION: Allan Flemming

DATE: Feb. 16, 1999
PROJ. #: 3773-17
FROM: Murray Fitch
NO. OF PAGES: 5
(INCLUDING COVER PAGE)

Allan,

Please find attached our first cut at a report on the effects of diversions of Four Creek. I recommend that the report be passed on to David Bustard for comments on potential fisheries impacts.

As I mentioned in our telephone conversation, there remains the issue of 1998 Four Creek monitoring data, which would give us a way to assess the relationship between low flows in Goathorn and Four Creeks. I believe that it is prudent that we wait for Agra to review this data prior to finalizing the report.

We have not included a map of the site, which is in production but was delayed due to problems in assessing drainage areas. Agra originally established the Four Creek gauge basin area using 1:50,000 topographic maps - the more recent maps provided by Manalta/Luscar have allowed us to more precisely define the drainage area. The upshot is some of the notes on the map are incorrect. I should also add that some of the numbers in the report will also change slightly, but I thought it more important to get you the report now despite the minor errors.

The major conclusion of the report should not change. In brief, the impact of the diversion will be relatively small in the lower watershed, and could be further minimized through the construction of a structure which would allow diversions only during higher flows. In the upper watershed, the effects of the diversion on flows are more substantial - it remains for the aquatics people to determine if these are changes would be significant for fish. Certainly, the natural variability of flows in the creek would appear to be a significant stressor for fish, particularly in the upper reaches.

If you have questions, please do not hesitate to call me or Alexi Zawadzki at (403)247-0200.

Murray Fitch

new release to come out by Feb 24/99

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February 16, 1999

OUR FILE: 3773-17

Luscar Coal Ltd.
10235 - 101 St.
Edmonton, AB
T5J 3G1
(fax) 780.420.5878 (tel) 780.420.4080

Attention: Allan Flemming, P.Eng.

Dear Mr. Flemming:

Re: ***Hydrology of Four Creek***

Introduction

We have reviewed the hydrology of Four Creek, and have reached the following preliminary findings. The following is intended for your review. We would be happy to incorporate the findings into a letter which would be suitable for dissemination to other parties such as BC MELP.

Figure 1 shows the drainage sub-basins of Four Creek. For analysis purposes, we have considered flows at the following locations:

1: the proposed diversion location into the Tenas Main Pit
2: two thirds of the drainage area
3: the mouth of Four Creek (confluence with Goathorn Creek)

Hydrology of Four Creek

The Telkwa Report (official name) presented a detailed analysis of the hydrology of the Telkwa region. Four key watercourses were identified in this work:

- Canyon Creek Near Smithers - 08EE014
- Kathlyn Creek above Simpson Creek - 08EE010

- Simpson Creek at the Mouth - 08EE012
- Goathorn Creek near Telkwa - 08EE008

Piteau has subsequently received flow measurement data from Agra for 1997 (Oct. 2-Nov. 27) and 1998 (Jun. 9-Oct. 19). Ideally this short-term data could be used in conjunction with regional flow data to accurately characterize the hydrology of Four Creek. However, our analysis of the Four Creek data shows that the 1997 data appears generally plausible, but the 1998 discharges are too low to be credible[1].

thurs/Fri of last week revised rating curve. re-issue 4-Creek

Comparison of hydrology of Four and Goathorn Creeks (1997)

Two of the Environment Canada gauging stations, Canyon Creek and Kathlyn Creek, have been discontinued. Flow data for Goathorn, Simpson, and Four Creek are presented in Figure 1. The data are presented as unit runoff (in mm). Thus, flows in the creeks have been corrected for drainage basin size. Basins with identical runoff coefficients (the percentage of precipitation which runs off into a creek) would plot as identical lines, regardless of basin size.

Data from Simpson Creek suggest that this basin is very "peaky" - a trait which was less marked in the Goathorn and Four Creek data. Thus, it appears that Goathorn Creek is a more appropriate comparison for Four Creek, and will be used in subsequent analyses.

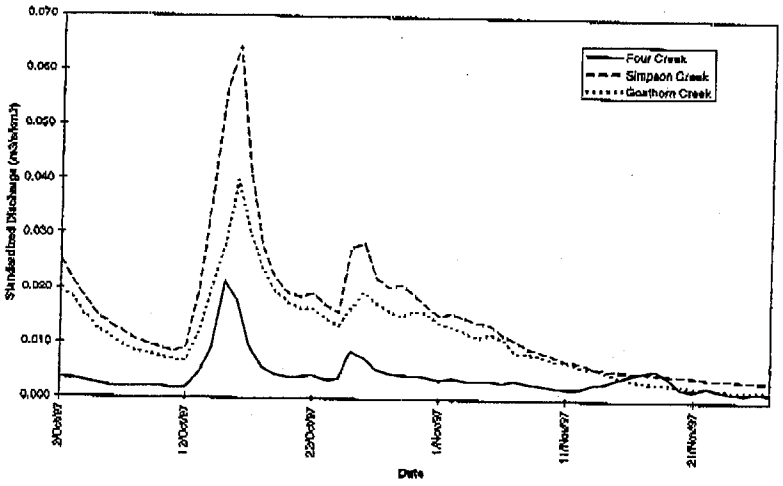


Figure 1: Comparison of Four Creek, Goathorn Creek and Simpson Creek Average Daily Discharge

Flow data for Goathorn Creek in 1997 was reported to be unreliable after November 15 due to ice conditions. Thus, to transform long-term Goathorn Creek data for use at the Four Creek site, a comparison of the 1997 data at the two sites was made. The cumulative runoff at the Four Creek station was 22.9 mm, and at Goathorn Creek, 54.2 mm. Thus, a ratio of 22.9/54.2 = 0.42 was applied to Goathorn data as a transformation. This implies that the Goathorn basin produces more than three times as much runoff (per square kilometre). There are a number of ~~potential sources of error~~ reasons for this discrepancy in this estimate.

First, Goathorn Creek is augmented by glacial runoff where as Four Creek is ice-free (termed *nival*). Although the ice melt contribution during October and November is not expected to be great, there will be some water coming from glaciers due to pressure melting and perhaps internal storage. A second source of error may be from the estimation of drainage area. Agra had

[1] Agra has indicated to us that the 1998 data had not been quality controlled (Kristi McKay, pers. comm.). This quality control is in process.

which is correct

estimated the drainage area of Four Creek as being 13 km^2 using 1:50,000 topographical maps. Komex had estimated the drainage area as being 10 km^2 using 1:20,000 maps provided by Manalta Coal Ltd/Luscar. The ramifications of an overestimation of drainage area are that discharge per unit area is underestimated. This may be the case as it is estimated that Four Creek produces three times less runoff than neighbouring Goat Creek. Goathorn.

Figure 2 shows the probabilities of mean annual low flows in Goathorn Creek. The data plotted are the lowest mean daily flows in Goathorn Creek (one mean daily flow for each year of record). For subsequent analysis purposes, the 1 in 10 year (10% probability) mean daily runoff of 0.045 mm/day was used as the reference. The runoff ratio of 0.32 was applied to estimate the 1 in 10 year low flow for Four Creek, giving a value of 0.012 mm/day. The average daily discharge for Goathorn Creek is 1.15 mm/day. Applying the ratio gives an estimated average daily discharge of 0.373 mm/day for Four Creek.

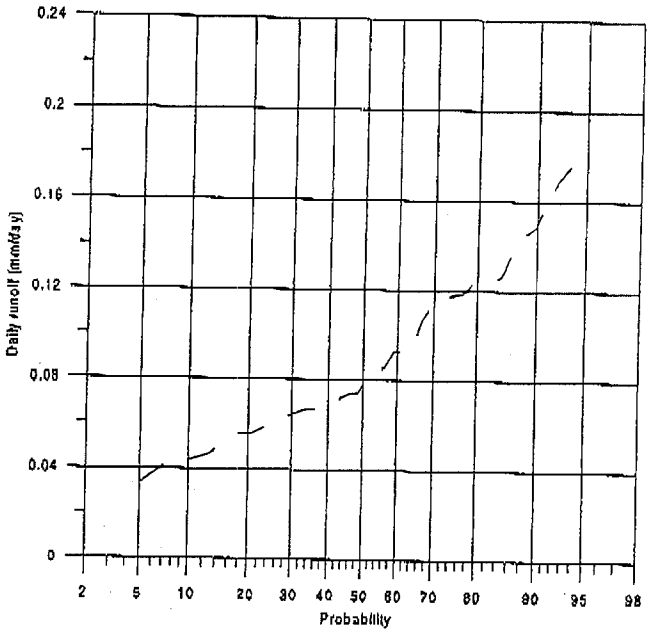


Figure 2: Mean Daily Low Flow Distribution in Goathorn Creek

The proposed diversion of the Four Creek tributary results in a reduction of roughly 18% of the total discharge area of Four Creek. Assuming that all areas of the basin behave in the same manner hydrologically, it can be assumed that the total discharge of Four Creek would also be reduced by 17%. Table 1 shows the estimated average daily and 1 in 10 year low flow for Four Creek at three stream locations assuming pre- and post-diversion scenarios.

or 18%

Table 1 - Estimated discharges for various locations along Four Creek.

Location	*% of original drainage area*	*Estimated Minimum 1 in 10 year Discharge (L/s)*		*Estimated Average Daily Discharge (L/s)*	
		with diversion	*without diversion*	*with diversion*	*without diversion*
At diversion	58	0.35	0.60	8.00	13.80
2/3 of basin length	74	0.89	1.20	21.20	28.65
At mouth	82	1.48	1.80	37.76	46.05

Conclusion

The impact of the diversion on flows in Four Creek varies between the upper reaches and the mouth. At the mouth, only 18% of the original drainage is removed by diversion. At the point of diversion, however, 42% of the drainage (and hence flow) is removed. It is important to note that there is significant natural variability in the creek, ranging from a 1 in 10 year minimum of 1.8 L/s (assuming no diversion) to an average of 46 L/s.

It is possible to construct a diversion structure which would guarantee a minimum flow in the creek. Only flows exceeding this minimum would be diverted into the pits. Withdrawals to the pits could therefore be restricted to higher flow periods, making the impact of the diversion relatively minor compared to natural creek variability.

Respectfully,

PITEAU ENGINEERING LTD.

Murray Fitch

Murray Fitch, M.A.Sc., P.Eng.
Senior Hydrologist

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Attachment B Baseflow Separation Results

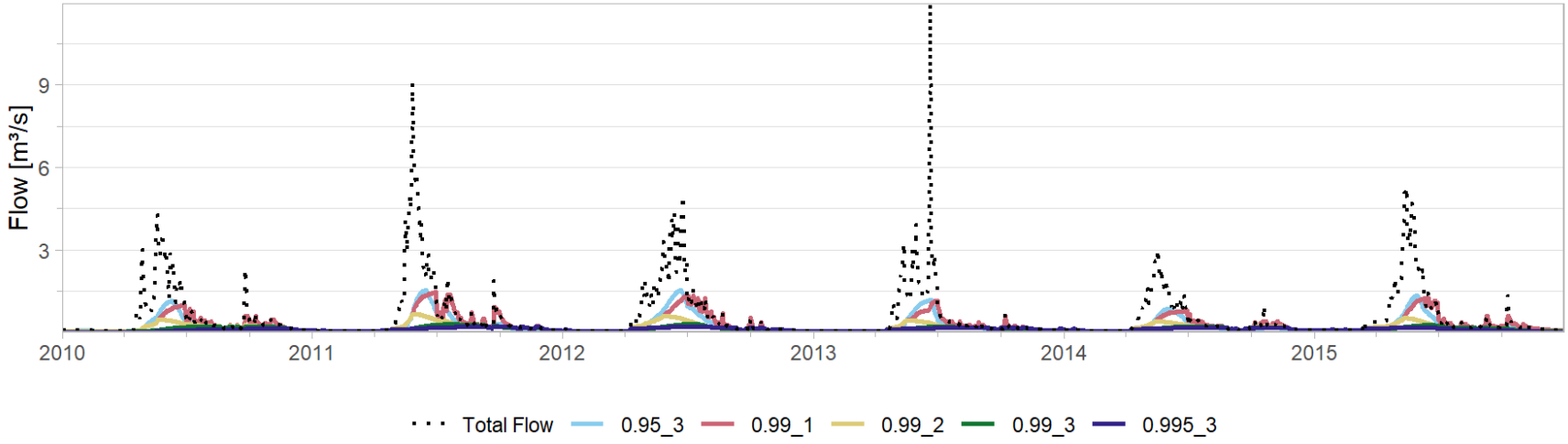


Figure A- 1: Tenas Creek Baseflow Separation results with varied Filter Parameter and Number of Passes

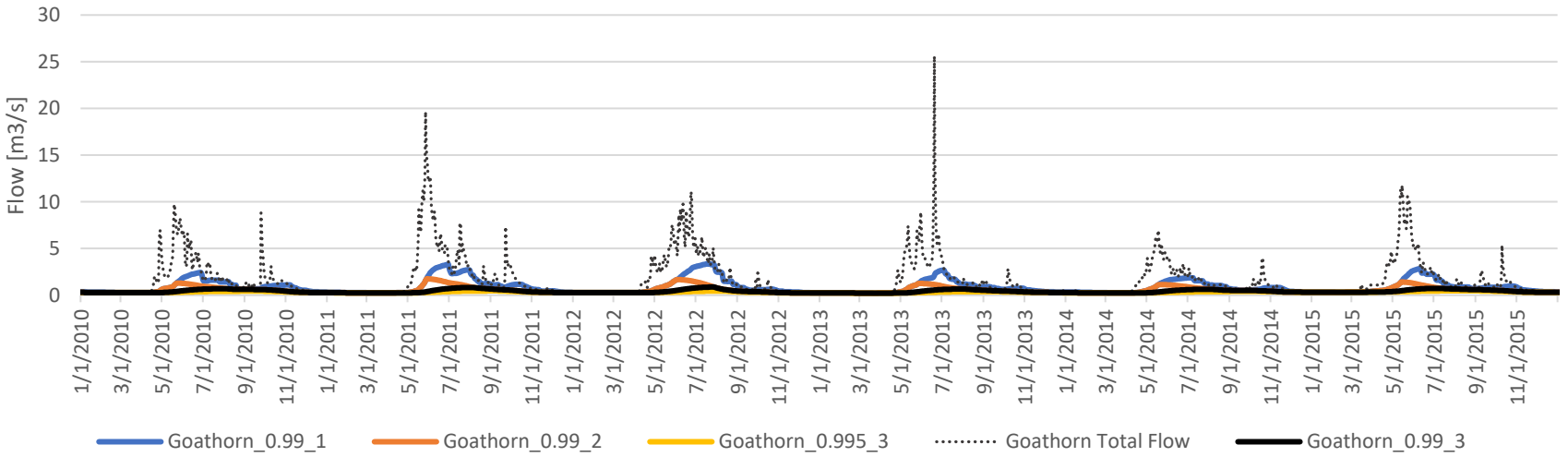


Figure A- 2: Goathorn Creek Baseflow Separation results with varied Filter Parameter and Number of Passes

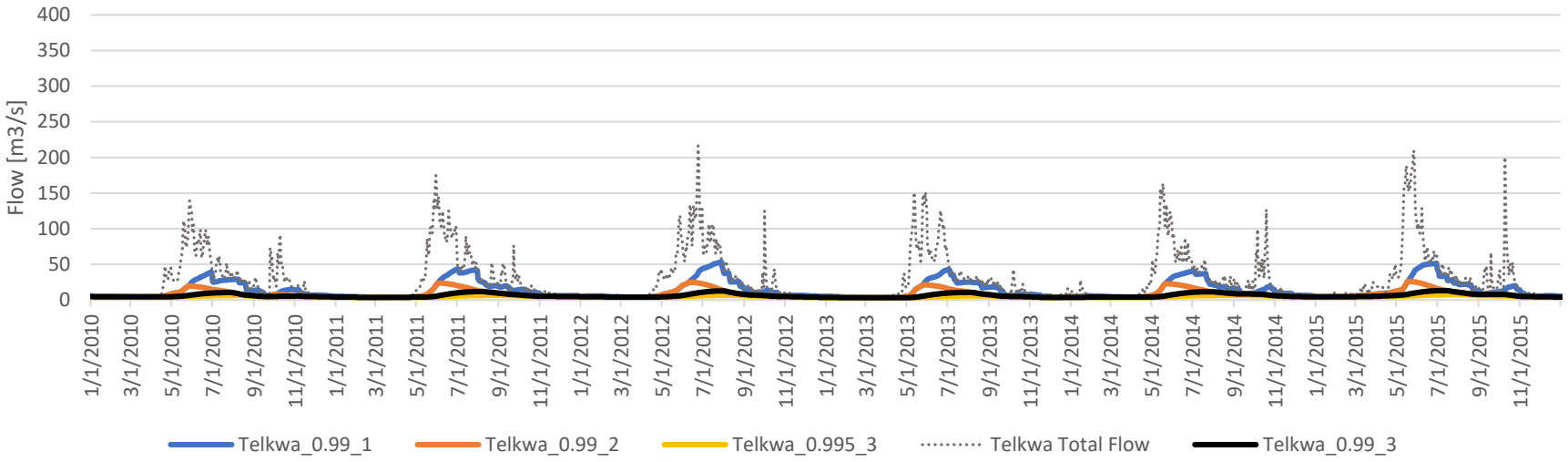


Figure A- 3: Telkwa River Baseflow Separation results with varied Filter Parameter and Number of Passes

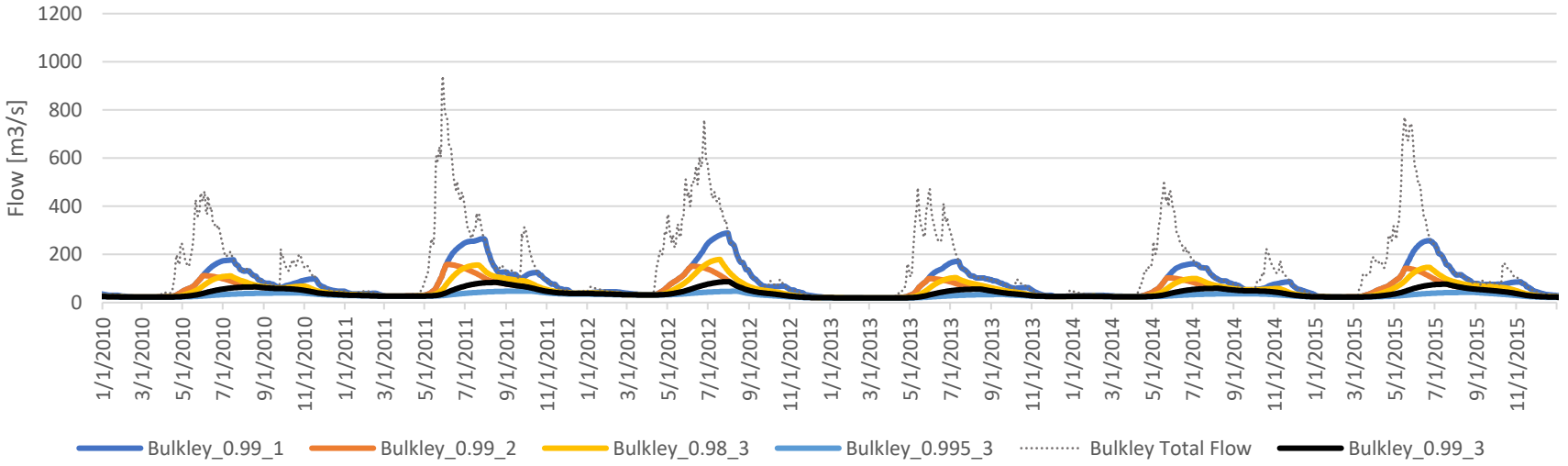


Figure A- 4: Bulkley River Baseflow Separation results with varied Filter Parameter and Number of Passes

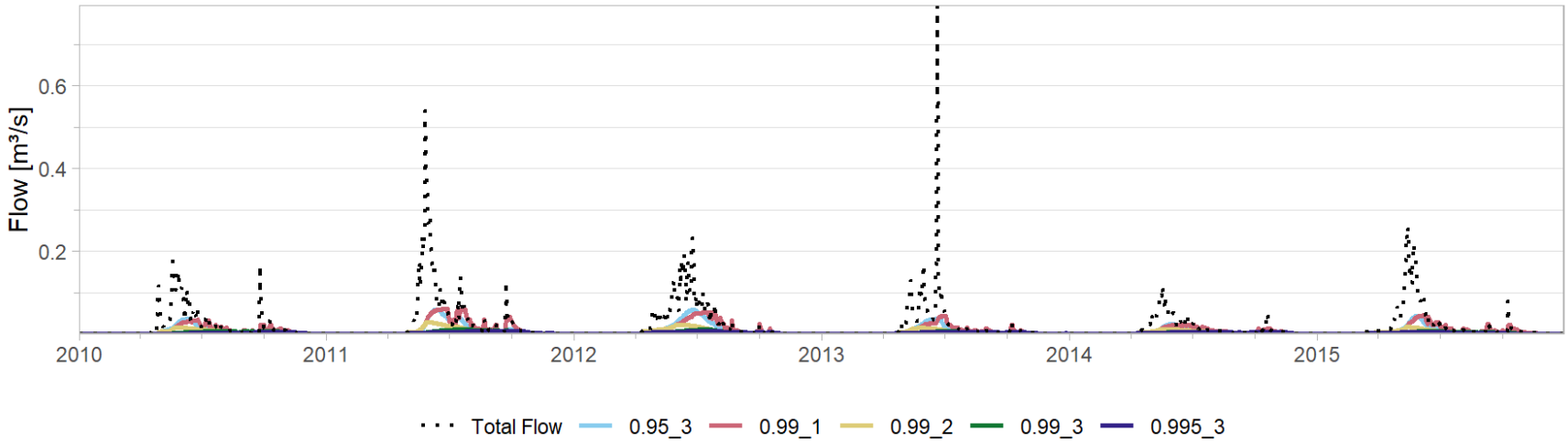


Figure A- 5: Four River Baseflow Separation results with varied Filter Parameter and Number of Passes

Attachment C AGRA 1999 Data Summaries

Table C-1. Tenas Creek Summary Sheet

Description: Lower Tenas Creek downstream of the Tenas Pit

Site ID:	Lower Tenas Ck	Start Date:	08-May-97
Operator:	TELKWA COAL	End Date:	10-Nov-98
Frequency:	DISCONTINUOUS	Discharge:	In Stream
Monitored:	YES	Water Level:	Level Survey

Comments:

The continuous discharge times series was calculated from 1-hour interval water level recordings.

1997 and 1998 Spot Measurement Summary

Date & Time	Discharge (m^3/s)	Staff Gauge (m)	Flow Measurement Method
08-May-1997	2.55	0.566	Current meter
16-May-1997	6.04	1.05	Current meter
22-May-1997	2.76	0.624	Current meter
13-Jun-1997	3.22	0.676	Current meter
24-Apr-1998	0.810	0.480	Current meter
14-May-1998	3.31	0.690	Current meter
27-May-1998	6.10	0.780	Current meter
23-Jun-1998	0.566	0.450	Current meter
21-Jul-1998	0.399	0.430	Current meter
19-Aug-1998	0.208	0.390	Current meter
09-Sep-1998	0.210	0.385	Current meter
25-Sep-1998	0.156	0.368	Current meter
10-Nov-1998	0.116	0.395	Current meter

ND: No Data

Figure: 1997 - 1998 Spot Discharge and Daily Discharge in Lower Tenas Creek

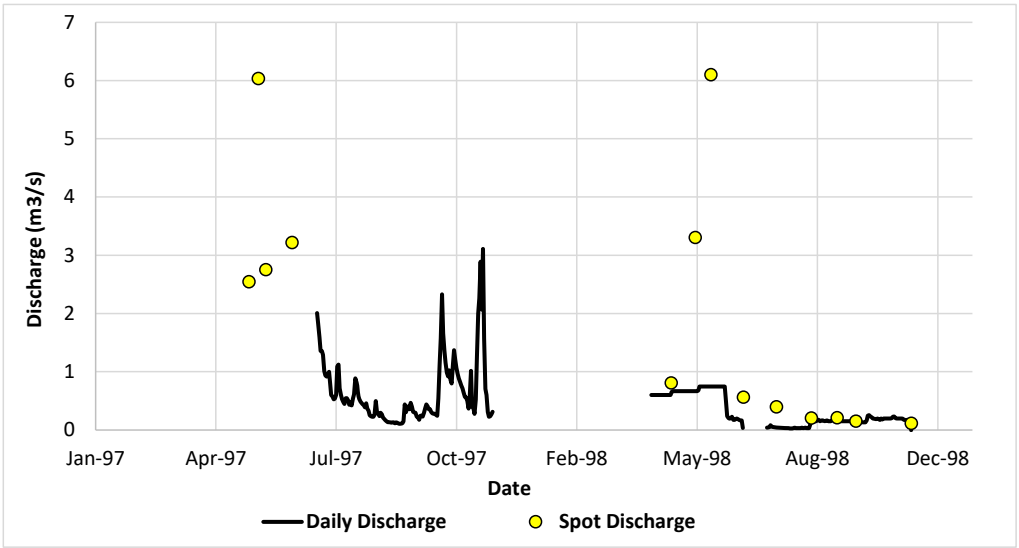


Table C-2. Four Creek Summary Sheet

Description: Four Creek above the confluence with Goathorn Creek

Site ID:	Lower Four Ck	Start Date:	09-May-97
Operator:	TELKWA COAL	End Date:	10-Nov-98
Frequency:	DISCONTINUOUS	Discharge:	In Stream
Monitored:	YES	Water Level:	Level Survey

Comments:

The continuous discharge times series was calculated from 1-hour interval datalogger recordings.

1997 and 1998 Spot Measurement Summary

Date & Time	Discharge (m^3/s)	Staff Gauge (m)	Flow Measurement Method
09-May-1997	0.384	0.336	Current meter
15-May-1997	0.786	0.421	Current meter
21-May-1997	0.269	0.268	Current meter
11-Jun-1997	0.0810	0.193	Current meter
28-Apr-1998	0.569	0.375	Current meter
30-Apr-1998	0.545	0.372	Current meter
13-May-1998	0.271	0.326	Current meter
26-May-1998	0.313	0.335	Current meter
10-Jun-1998	0.0117	0.180	Current meter
23-Jun-1998	0.00495	0.153	Current meter
24-Jun-1998	0.00739	0.165	Current meter
10-Jul-1998	0.00865	0.170	Current meter
22-Jul-1998	0.00813	0.168	Current meter
29-Jul-1998	0.00628	0.160	Current meter
18-Aug-1998	0.00628	0.160	Current meter
09-Sep-1998	0.00670	0.162	Current meter
10-Nov-1998	0.01474	0.188	Current meter

ND: No Data

Figure: 1997 - 1998 Spot Discharge and Daily Discharge in Lower Four Creek

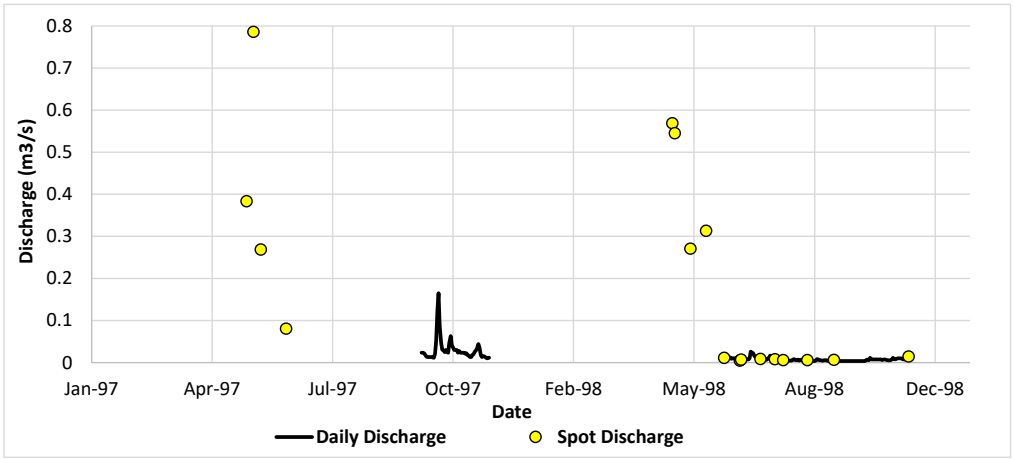


Table C-3. Goathorn Creek Summary Sheet

Description: Goathorn Creek near Telkwa

Site ID:	WSC 08EE008	Start Date:	01-Jan-97
Operator:	WATER SURVEY OF CANADA	End Date:	31-Dec-98
Frequency:	CONTINUOUS	Discharge:	In Stream
Monitored:	YES	Water Level:	Level Survey

Comments:

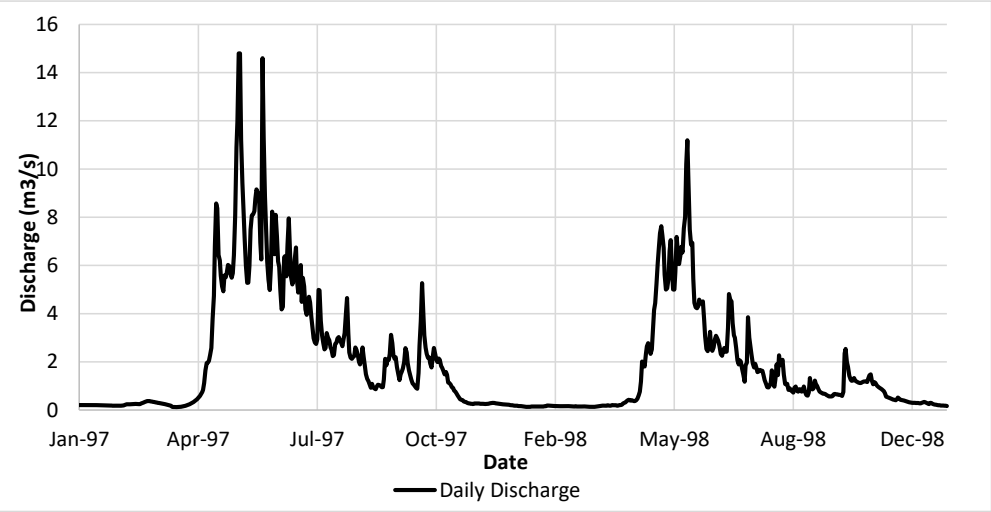
Continuous daily discharge time series generated by WSC.

1997 and 1998 Spot Measurement Summary

Date & Time	Discharge (m^3/s)	Staff Gauge (m)	Flow Measurement Method
ND	ND	ND	ND

ND: No Data (Data provided by Water Survey of Canada)

Figure: 1997 - 1998 Daily Discharge in Goathorn Creek (WSC 08EE008)



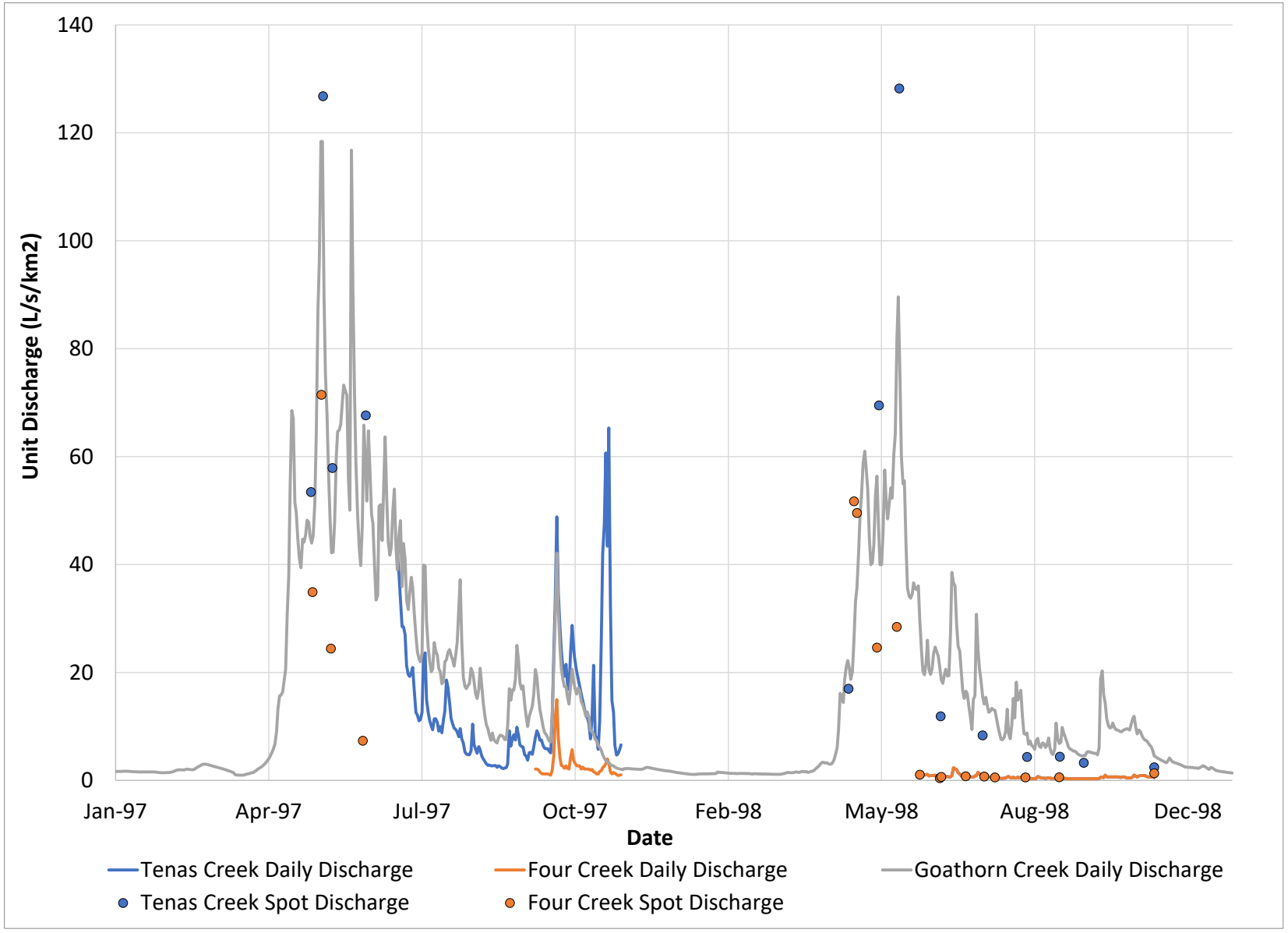


Figure C-1. Daily and Spot Unit Discharge at Each Station

Table C-4. Time Series of Daily Discharge at Each Station

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
01-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.69
02-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.69
03-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.70
04-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.70
05-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.70
06-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.70
07-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.71
08-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.22	1.72
09-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.22	1.73
10-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.69
11-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.67
12-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.66
13-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.64
14-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.62
15-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.62
16-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.61
17-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.61
18-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.60
19-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.60
20-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.60
21-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.61
22-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.61
23-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.60
24-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.59
25-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.58
26-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.58
27-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.58
28-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.19	1.54
29-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.19	1.50
30-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.18	1.46
31-Jan-97	ND	ND	ND	ND	ND	ND	0.00	0.18	1.45
01-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.18	1.44
02-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.18	1.45
03-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.18	1.46
04-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.18	1.47
05-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.19	1.50
06-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.19	1.52
07-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.58

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
08-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.70
09-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.23	1.84
10-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.24	1.92
11-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.25	2.00
12-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.25	1.99
13-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.25	1.98
14-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.25	1.98
15-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.25	1.97
16-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.08
17-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.08
18-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.07
19-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.04
20-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.25	2.00
21-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.04
22-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.28	2.24
23-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.30	2.40
24-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.32	2.56
25-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.34	2.72
26-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.36	2.88
27-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.38	3.04
28-Feb-97	ND	ND	ND	ND	ND	ND	0.00	0.38	3.04
01-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.38	3.04
02-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.37	2.94
03-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.36	2.88
04-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.35	2.80
05-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.34	2.72
06-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.33	2.64
07-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.32	2.56
08-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.31	2.48
09-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.30	2.40
10-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.29	2.32
11-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.28	2.24
12-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.27	2.16
13-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.08
14-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.25	1.98
15-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.24	1.90
16-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.22	1.76
17-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.68
18-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.60
19-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.18	1.46

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
20-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.14	1.10
21-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.13	1.04
22-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.13	1.02
23-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.12	0.99
24-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.13	1.00
25-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.13	1.00
26-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.13	1.04
27-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.15	1.16
28-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.15	1.22
29-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.16	1.26
30-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.17	1.36
31-Mar-97	ND	ND	ND	ND	ND	ND	0.00	0.18	1.44
01-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.19	1.48
02-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.22	1.72
03-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.24	1.88
04-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.27	2.16
05-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.29	2.32
06-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.31	2.48
07-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.34	2.72
08-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.37	2.96
09-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.41	3.28
10-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.45	3.60
11-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.51	4.08
12-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.56	4.48
13-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.65	5.20
14-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.74	5.92
15-Apr-97	ND	ND	ND	ND	ND	ND	0.00	0.84	6.74
16-Apr-97	ND	ND	ND	ND	ND	ND	0.00	1.13	9.04
17-Apr-97	ND	ND	ND	ND	ND	ND	0.00	1.65	13.20
18-Apr-97	ND	ND	ND	ND	ND	ND	0.00	1.96	15.68
19-Apr-97	ND	ND	ND	ND	ND	ND	0.00	1.98	15.84
20-Apr-97	ND	ND	ND	ND	ND	ND	0.00	2.05	16.40
21-Apr-97	ND	ND	ND	ND	ND	ND	0.00	2.29	18.32
22-Apr-97	ND	ND	ND	ND	ND	ND	0.00	2.58	20.64
23-Apr-97	ND	ND	ND	ND	ND	ND	0.00	3.80	30.40
24-Apr-97	ND	ND	ND	ND	ND	ND	0.00	4.75	38.00
25-Apr-97	ND	ND	ND	ND	ND	ND	0.00	6.81	54.48
26-Apr-97	ND	ND	ND	ND	ND	ND	0.00	8.57	68.56
27-Apr-97	ND	ND	ND	ND	ND	ND	0.00	8.38	67.04
28-Apr-97	ND	ND	ND	ND	ND	ND	0.00	6.44	51.52

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
29-Apr-97	ND	ND	ND	ND	ND	ND	0.00	6.21	49.68
30-Apr-97	ND	ND	ND	ND	ND	ND	0.00	5.58	44.64
01-May-97	ND	ND	ND	ND	ND	ND	0.00	5.14	41.12
02-May-97	ND	ND	ND	ND	ND	ND	0.00	4.93	39.44
03-May-97	ND	ND	ND	ND	ND	ND	0.00	5.59	44.72
04-May-97	ND	ND	ND	ND	ND	ND	0.00	5.52	44.16
05-May-97	ND	ND	ND	ND	ND	ND	0.00	5.68	45.44
06-May-97	ND	ND	ND	ND	ND	ND	0.00	6.03	48.24
07-May-97	ND	ND	ND	ND	ND	ND	0.00	5.98	47.84
08-May-97	ND	ND	ND	ND	ND	ND	0.00	5.66	45.28
09-May-97	ND	ND	ND	ND	ND	ND	0.00	5.50	44.00
10-May-97	ND	ND	ND	ND	ND	ND	0.00	5.68	45.44
11-May-97	ND	ND	ND	ND	ND	ND	0.00	6.43	51.44
12-May-97	ND	ND	ND	ND	ND	ND	0.00	8.09	64.72
13-May-97	ND	ND	ND	ND	ND	ND	0.00	10.90	87.20
14-May-97	ND	ND	ND	ND	ND	ND	0.00	12.00	96.00
15-May-97	ND	ND	ND	ND	ND	ND	0.00	14.80	118.40
16-May-97	ND	ND	ND	ND	ND	ND	0.00	14.80	118.40
17-May-97	ND	ND	ND	ND	ND	ND	0.00	11.20	89.60
18-May-97	ND	ND	ND	ND	ND	ND	0.00	9.42	75.36
19-May-97	ND	ND	ND	ND	ND	ND	0.00	8.46	67.68
20-May-97	ND	ND	ND	ND	ND	ND	0.00	7.13	57.04
21-May-97	ND	ND	ND	ND	ND	ND	0.00	5.99	47.92
22-May-97	ND	ND	ND	ND	ND	ND	0.00	5.28	42.24
23-May-97	ND	ND	ND	ND	ND	ND	0.00	5.29	42.32
24-May-97	ND	ND	ND	ND	ND	ND	0.00	5.99	47.92
25-May-97	ND	ND	ND	ND	ND	ND	0.00	7.49	59.92
26-May-97	ND	ND	ND	ND	ND	ND	0.00	8.08	64.64
27-May-97	ND	ND	ND	ND	ND	ND	0.00	8.12	64.96
28-May-97	ND	ND	ND	ND	ND	ND	0.00	8.25	66.00
29-May-97	ND	ND	ND	ND	ND	ND	0.00	8.77	70.16
30-May-97	ND	ND	ND	ND	ND	ND	0.00	9.16	73.28
31-May-97	ND	ND	ND	ND	ND	ND	0.00	9.03	72.24
01-Jun-97	ND	ND	ND	ND	ND	ND	0.00	8.92	71.36
02-Jun-97	ND	ND	ND	ND	ND	ND	0.00	6.95	55.60
03-Jun-97	ND	ND	ND	ND	ND	ND	0.00	6.26	50.08
04-Jun-97	ND	ND	ND	ND	ND	ND	0.00	14.60	116.80
05-Jun-97	ND	ND	ND	ND	ND	ND	0.00	11.30	90.40
06-Jun-97	ND	ND	ND	ND	ND	ND	0.00	8.87	70.96
07-Jun-97	ND	ND	ND	ND	ND	ND	0.00	7.33	58.64

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
08-Jun-97	ND	ND	ND	ND	ND	ND	0.00	6.17	49.36
09-Jun-97	ND	ND	ND	ND	ND	ND	0.00	5.41	43.28
10-Jun-97	ND	ND	ND	ND	ND	ND	0.00	4.98	39.84
11-Jun-97	ND	ND	ND	ND	ND	ND	0.00	5.92	47.36
12-Jun-97	ND	ND	ND	ND	ND	ND	0.00	8.23	65.84
13-Jun-97	ND	ND	ND	ND	ND	ND	0.00	7.43	59.44
14-Jun-97	ND	ND	ND	ND	ND	ND	0.00	6.47	51.76
15-Jun-97	ND	ND	ND	ND	ND	ND	0.00	8.10	64.80
16-Jun-97	ND	ND	ND	ND	ND	ND	0.00	7.20	57.60
17-Jun-97	ND	ND	ND	ND	ND	ND	0.00	6.17	49.36
18-Jun-97	ND	ND	ND	ND	ND	ND	0.00	5.95	47.60
19-Jun-97	ND	ND	ND	ND	ND	ND	0.00	4.99	39.92
20-Jun-97	ND	ND	ND	ND	ND	ND	0.00	4.18	33.44
21-Jun-97	ND	ND	ND	ND	ND	ND	0.00	4.29	34.32
22-Jun-97	ND	ND	ND	ND	ND	ND	0.00	6.35	50.80
23-Jun-97	ND	ND	ND	ND	ND	ND	0.00	6.39	51.12
24-Jun-97	ND	ND	ND	ND	ND	ND	0.00	5.56	44.48
25-Jun-97	ND	ND	ND	ND	ND	ND	0.00	6.86	54.88
26-Jun-97	ND	ND	ND	ND	ND	ND	0.00	7.96	63.68
27-Jun-97	ND	ND	ND	ND	ND	ND	0.00	6.51	52.08
28-Jun-97	ND	ND	ND	ND	ND	ND	0.00	5.53	44.24
29-Jun-97	ND	ND	ND	ND	ND	ND	0.00	5.22	41.76
30-Jun-97	ND	ND	ND	ND	ND	ND	0.00	5.40	43.20
01-Jul-97	ND	ND	ND	ND	ND	ND	0.00	6.26	50.08
02-Jul-97	ND	ND	ND	ND	ND	ND	0.00	6.75	54.00
03-Jul-97	ND	ND	ND	ND	ND	ND	0.00	5.39	43.12
04-Jul-97	0.58	2.01	42.22	ND	ND	ND	0.00	4.88	39.04
05-Jul-97	0.57	1.82	38.2	ND	ND	ND	0.00	5.67	45.36
06-Jul-97	0.56	1.59	33.47	ND	ND	ND	0.00	6.02	48.16
07-Jul-97	0.54	1.36	28.5	ND	ND	ND	0.00	4.49	35.92
08-Jul-97	0.54	1.36	28.49	ND	ND	ND	0.00	5.49	43.92
09-Jul-97	0.53	1.29	27.06	ND	ND	ND	0.00	5.14	41.12
10-Jul-97	0.51	1.01	21.29	ND	ND	ND	0.00	4.17	33.36
11-Jul-97	0.5	0.94	19.65	ND	ND	ND	0.00	3.96	31.68
12-Jul-97	0.5	0.92	19.25	ND	ND	ND	0.00	4.36	34.88
13-Jul-97	0.5	0.95	20	ND	ND	ND	0.00	4.71	37.68
14-Jul-97	0.51	1	20.98	ND	ND	ND	0.00	4.47	35.76
15-Jul-97	0.49	0.79	16.53	ND	ND	ND	0.00	3.86	30.88
16-Jul-97	0.46	0.6	12.63	ND	ND	ND	0.00	3.36	26.88
17-Jul-97	0.46	0.58	12.11	ND	ND	ND	0.00	2.98	23.84

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
18-Jul-97	0.45	0.53	11.08	ND	ND	ND	0.00	2.81	22.48
19-Jul-97	0.45	0.54	11.29	ND	ND	ND	0.00	2.75	22.00
20-Jul-97	0.46	0.6	12.65	ND	ND	ND	0.00	2.94	23.52
21-Jul-97	0.51	1.09	22.9	ND	ND	ND	0.00	4.99	39.92
22-Jul-97	0.52	1.13	23.65	ND	ND	ND	0.00	4.97	39.76
23-Jul-97	0.48	0.72	15.04	ND	ND	ND	0.00	3.70	29.60
24-Jul-97	0.46	0.6	12.69	ND	ND	ND	0.00	3.10	24.80
25-Jul-97	0.45	0.53	11.13	ND	ND	ND	0.00	2.77	22.16
26-Jul-97	0.44	0.48	10.1	ND	ND	ND	0.00	2.52	20.16
27-Jul-97	0.43	0.45	9.41	ND	ND	ND	0.00	2.58	20.64
28-Jul-97	0.45	0.55	11.46	ND	ND	ND	0.00	3.20	25.60
29-Jul-97	0.45	0.55	11.46	ND	ND	ND	0.00	3.00	24.00
30-Jul-97	0.45	0.51	10.74	ND	ND	ND	0.00	2.90	23.20
31-Jul-97	0.43	0.44	9.16	ND	ND	ND	0.00	2.60	20.80
01-Aug-97	0.44	0.48	10.02	ND	ND	ND	0.00	2.51	20.08
02-Aug-97	0.43	0.42	8.85	ND	ND	ND	0.00	2.24	17.92
03-Aug-97	0.45	0.54	11.3	ND	ND	ND	0.00	2.29	18.32
04-Aug-97	0.46	0.61	12.88	ND	ND	ND	0.00	2.75	22.00
05-Aug-97	0.5	0.89	18.64	ND	ND	ND	0.00	2.80	22.40
06-Aug-97	0.49	0.82	17.19	ND	ND	ND	0.00	2.97	23.76
07-Aug-97	0.47	0.69	14.4	ND	ND	ND	0.00	3.03	24.24
08-Aug-97	0.45	0.55	11.51	ND	ND	ND	0.00	2.90	23.20
09-Aug-97	0.44	0.5	10.54	ND	ND	ND	0.00	2.80	22.40
10-Aug-97	0.44	0.46	9.72	ND	ND	ND	0.00	2.65	21.20
11-Aug-97	0.43	0.45	9.49	ND	ND	ND	0.00	2.90	23.20
12-Aug-97	0.43	0.43	8.97	ND	ND	ND	0.00	3.20	25.60
13-Aug-97	0.42	0.39	8.13	ND	ND	ND	0.00	4.00	32.00
14-Aug-97	0.44	0.46	9.63	ND	ND	ND	0.00	4.65	37.20
15-Aug-97	0.42	0.37	7.7	ND	ND	ND	0.00	3.20	25.60
16-Aug-97	0.41	0.33	6.96	ND	ND	ND	0.00	2.40	19.20
17-Aug-97	0.39	0.25	5.32	ND	ND	ND	0.00	2.18	17.44
18-Aug-97	0.38	0.23	4.92	ND	ND	ND	0.00	2.13	17.04
19-Aug-97	0.38	0.23	4.8	ND	ND	ND	0.00	2.20	17.60
20-Aug-97	0.38	0.23	4.78	ND	ND	ND	0.00	2.24	17.92
21-Aug-97	0.39	0.26	5.48	ND	ND	ND	0.00	2.60	20.80
22-Aug-97	0.44	0.5	10.43	ND	ND	ND	0.00	2.50	20.00
23-Aug-97	0.41	0.32	6.69	ND	ND	ND	0.00	2.30	18.40
24-Aug-97	0.39	0.28	5.8	ND	ND	ND	0.00	2.00	16.00
25-Aug-97	0.38	0.24	5.06	ND	ND	ND	0.00	1.90	15.20
26-Aug-97	0.4	0.3	6.28	ND	ND	ND	0.00	2.10	16.80

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
27-Aug-97	0.39	0.27	5.68	ND	ND	ND	0.00	2.60	20.80
28-Aug-97	0.38	0.22	4.53	ND	ND	ND	0.00	2.20	17.60
29-Aug-97	0.37	0.19	4.02	ND	ND	ND	0.00	1.80	14.40
30-Aug-97	0.36	0.17	3.52	ND	ND	ND	0.00	1.50	12.00
31-Aug-97	0.35	0.15	3.12	ND	ND	ND	0.00	1.30	10.40
01-Sep-97	0.34	0.13	2.81	ND	ND	ND	0.00	1.20	9.60
02-Sep-97	0.34	0.14	2.88	ND	ND	ND	0.00	1.05	8.40
03-Sep-97	0.34	0.13	2.74	ND	ND	ND	0.00	0.93	7.44
04-Sep-97	0.34	0.13	2.72	ND	ND	ND	0.00	1.10	8.80
05-Sep-97	0.34	0.13	2.76	ND	ND	ND	0.00	0.95	7.60
06-Sep-97	0.34	0.13	2.78	ND	ND	ND	0.00	0.90	7.20
07-Sep-97	0.33	0.12	2.45	ND	ND	ND	0.00	0.87	6.96
08-Sep-97	0.34	0.13	2.73	ND	ND	ND	0.00	0.99	7.94
09-Sep-97	0.34	0.12	2.55	ND	ND	ND	0.00	1.05	8.40
10-Sep-97	0.33	0.11	2.36	ND	ND	ND	0.00	1.04	8.32
11-Sep-97	0.33	0.11	2.21	ND	ND	ND	0.00	1.02	8.16
12-Sep-97	0.33	0.11	2.34	ND	ND	ND	0.00	0.95	7.60
13-Sep-97	0.33	0.11	2.38	ND	ND	ND	0.00	0.95	7.62
14-Sep-97	0.35	0.15	3.14	ND	ND	ND	0.00	1.27	10.16
15-Sep-97	0.43	0.44	9.23	ND	ND	ND	0.00	2.13	17.04
16-Sep-97	0.4	0.3	6.38	ND	ND	ND	0.00	1.86	14.88
17-Sep-97	0.42	0.37	7.76	ND	ND	ND	0.00	2.10	16.80
18-Sep-97	0.43	0.4	8.48	ND	ND	ND	0.00	2.09	16.72
19-Sep-97	0.42	0.36	7.51	ND	ND	ND	0.00	2.34	18.72
20-Sep-97	0.44	0.47	9.87	ND	ND	ND	0.00	3.13	25.04
21-Sep-97	0.42	0.4	8.38	ND	ND	ND	0.00	2.78	22.24
22-Sep-97	0.4	0.31	6.6	ND	ND	ND	0.00	2.27	18.16
23-Sep-97	0.4	0.3	6.33	ND	ND	ND	0.00	2.12	16.96
24-Sep-97	0.4	0.3	6.23	ND	ND	ND	0.00	2.19	17.52
25-Sep-97	0.38	0.23	4.75	ND	ND	ND	0.00	1.78	14.24
26-Sep-97	0.38	0.22	4.6	ND	ND	ND	0.00	1.51	12.08
27-Sep-97	0.36	0.18	3.76	ND	ND	ND	0.00	1.25	10.00
28-Sep-97	0.38	0.24	5.14	ND	ND	ND	0.00	1.49	11.92
29-Sep-97	0.39	0.25	5.22	ND	ND	ND	0.00	1.60	12.80
30-Sep-97	0.38	0.23	4.86	ND	ND	ND	0.00	1.73	13.84
01-Oct-97	0.4	0.3	6.21	ND	ND	ND	0.00	2.00	16.00
02-Oct-97	0.42	0.38	7.94	0.21	0.02	2.12	0.00	2.57	20.56
03-Oct-97	0.43	0.44	9.21	0.21	0.02	2.12	0.00	2.40	19.20
04-Oct-97	0.43	0.41	8.56	0.2	0.02	1.99	0.00	1.96	15.68
05-Oct-97	0.41	0.36	7.48	0.2	0.02	1.63	0.00	1.65	13.20

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Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
06-Oct-97	0.42	0.36	7.51	0.19	0.01	1.28	0.00	1.46	11.68
07-Oct-97	0.4	0.31	6.55	0.19	0.01	1.23	0.00	1.26	10.08
08-Oct-97	0.4	0.29	5.99	0.19	0.01	1.23	0.00	1.11	8.88
09-Oct-97	0.4	0.28	5.9	0.19	0.01	1.23	0.00	1.07	8.56
10-Oct-97	0.4	0.28	5.92	0.19	0.01	1.23	0.00	0.99	7.92
11-Oct-97	0.39	0.26	5.49	0.18	0.01	1.11	0.00	0.92	7.34
12-Oct-97	0.38	0.24	5.12	0.18	0.01	1.01	0.00	0.89	7.15
13-Oct-97	0.44	0.54	11.38	0.2	0.02	1.89	0.00	1.55	12.40
14-Oct-97	0.52	1.13	23.72	0.24	0.05	4.67	0.00	2.68	21.44
15-Oct-97	0.55	1.57	33.06	0.28	0.13	11.39	0.00	3.69	29.52
16-Oct-97	0.6	2.33	48.89	0.3	0.16	14.99	0.00	5.27	42.16
17-Oct-97	0.56	1.66	34.87	0.26	0.09	7.99	0.00	4.00	32.00
18-Oct-97	0.54	1.36	28.52	0.23	0.05	4.31	0.00	3.10	24.80
19-Oct-97	0.52	1.15	24.21	0.22	0.03	2.82	0.00	2.59	20.72
20-Oct-97	0.51	0.99	20.74	0.21	0.03	2.65	0.00	2.34	18.72
21-Oct-97	0.5	0.92	19.31	0.21	0.02	2.27	0.00	2.17	17.36
22-Oct-97	0.51	1.03	21.54	0.22	0.03	2.72	0.00	2.18	17.44
23-Oct-97	0.49	0.86	18.05	0.21	0.02	2.27	0.00	1.94	15.52
24-Oct-97	0.49	0.8	16.85	0.21	0.02	2.12	0.00	1.77	14.16
25-Oct-97	0.52	1.12	23.57	0.23	0.05	4.26	0.00	2.17	17.36
26-Oct-97	0.54	1.37	28.73	0.25	0.06	5.73	0.00	2.58	20.64
27-Oct-97	0.53	1.19	25.1	0.23	0.04	3.76	0.00	2.33	18.64
28-Oct-97	0.52	1.06	22.33	0.22	0.04	3.19	0.00	2.12	16.96
29-Oct-97	0.5	0.96	20.14	0.22	0.03	2.72	0.00	2.00	16.00
30-Oct-97	0.5	0.88	18.52	0.22	0.03	2.72	0.00	2.14	17.12
31-Oct-97	0.49	0.83	17.35	0.22	0.03	2.72	0.00	2.08	16.64
01-Nov-97	0.48	0.77	16.14	0.21	0.02	2.14	0.00	1.83	14.64
02-Nov-97	0.48	0.71	14.98	0.21	0.03	2.5	0.00	1.76	14.08
03-Nov-97	0.47	0.64	13.46	0.21	0.02	2.12	0.00	1.63	13.04
04-Nov-97	0.46	0.57	11.95	0.21	0.02	2.12	0.00	1.49	11.92
05-Nov-97	0.45	0.56	11.73	0.21	0.02	2.12	0.00	1.59	12.72
06-Nov-97	0.44	0.5	10.49	0.21	0.02	2.12	0.00	1.47	11.76
07-Nov-97	0.42	0.37	7.72	0.2	0.02	1.93	0.00	1.15	9.20
08-Nov-97	0.45	0.57	11.93	0.2	0.02	2.06	0.00	1.13	9.04
09-Nov-97	0.51	1.02	21.37	0.2	0.02	1.63	0.00	1.07	8.56
10-Nov-97	0.42	0.4	8.35	0.19	0.02	1.51	0.00	0.95	7.62
11-Nov-97	0.42	0.37	7.87	0.19	0.01	1.23	0.00	0.92	7.39
12-Nov-97	0.39	0.28	5.79	0.19	0.01	1.23	0.00	0.82	6.56
13-Nov-97	0.44	0.52	11.01	0.2	0.02	1.66	0.00	0.77	6.16
14-Nov-97	0.53	1.25	26.19	0.2	0.02	1.81	0.00	0.70	5.60

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
15-Nov-97	0.58	2	42.02	0.21	0.03	2.38	0.00	0.60	4.80
16-Nov-97	0.6	2.26	47.52	0.21	0.03	2.67	0.00	0.52	4.16
17-Nov-97	0.63	2.89	60.68	0.22	0.03	3.13	0.00	0.46	3.68
18-Nov-97	0.59	2.07	43.43	0.23	0.04	4	0.00	0.43	3.44
19-Nov-97	0.64	3.11	65.32	0.22	0.04	3.26	0.00	0.42	3.32
20-Nov-97	0.55	1.57	32.98	0.19	0.02	1.6	0.00	0.37	2.96
21-Nov-97	0.47	0.71	14.83	0.19	0.01	1.23	0.00	0.35	2.80
22-Nov-97	0.46	0.6	12.66	0.19	0.02	1.48	0.00	0.34	2.72
23-Nov-97	0.4	0.31	6.49	0.19	0.01	1.31	0.00	0.31	2.48
24-Nov-97	0.38	0.23	4.73	0.18	0.01	1.13	0.00	0.29	2.32
25-Nov-97	0.38	0.24	4.95	0.18	0.01	0.92	0.00	0.28	2.24
26-Nov-97	0.39	0.27	5.71	0.18	0.01	1	0.00	0.27	2.16
27-Nov-97	0.96	0.32	6.63	0.18	0.01	1.05	0.00	0.26	2.08
28-Nov-97	ND	ND	ND	ND	ND	ND	0.00	0.25	2.00
29-Nov-97	ND	ND	ND	ND	ND	ND	0.00	0.28	2.20
30-Nov-97	ND	ND	ND	ND	ND	ND	0.00	0.28	2.20
01-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.28	2.22
02-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.28	2.24
03-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.28	2.20
04-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.27	2.16
05-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.27	2.16
06-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.27	2.14
07-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.10
08-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.08
09-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.07
10-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.10
11-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.27	2.14
12-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.28	2.24
13-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.30	2.40
14-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.31	2.44
15-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.30	2.40
16-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.29	2.34
17-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.29	2.30
18-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.28	2.24
19-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.27	2.17
20-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.08
21-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.26	2.06
22-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.25	2.00
23-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.24	1.94
24-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.24	1.92

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Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
25-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.24	1.90
26-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.23	1.84
27-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.22	1.78
28-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.22	1.76
29-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.22	1.74
30-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.21	1.66
31-Dec-97	ND	ND	ND	ND	ND	ND	0.00	0.20	1.62
01-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.55
02-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.50
03-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.18	1.46
04-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.18	1.42
05-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.38
06-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.35
07-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.31
08-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.26
09-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.23
10-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.19
11-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.16
12-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.14	1.15
13-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.14	1.14
14-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.14	1.14
15-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.14	1.14
16-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
17-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.21
18-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.22
19-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.23
20-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.24
21-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.25
22-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.24
23-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.25
24-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.24
25-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.24
26-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.26
27-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.26
28-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.28
29-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.20	1.58
30-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.54
31-Jan-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.52
01-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.48
02-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.18	1.44

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
03-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.18	1.42
04-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.39
05-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.38
06-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.36
07-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.34
08-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.34
09-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.32
10-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.31
11-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.30
12-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.30
13-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.31
14-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.34
15-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.36
16-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.34
17-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.30
18-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.28
19-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.26
20-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.23
21-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.21
22-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.26
23-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.25
24-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.23
25-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.22
26-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.22
27-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.21
28-Feb-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.20
01-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
02-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
03-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
04-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
05-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
06-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
07-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
08-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
09-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
10-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
11-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.18
12-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.15	1.22
13-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.16	1.26
14-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.17	1.33

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
15-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.18	1.47
16-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.49
17-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.18	1.47
18-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.18	1.42
19-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.18	1.46
20-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.50
21-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.20	1.60
22-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.55
23-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.48
24-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.20	1.58
25-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.21	1.69
26-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.21	1.66
27-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.20	1.63
28-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.21	1.65
29-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.49
30-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.20	1.56
31-Mar-98	ND	ND	ND	ND	ND	ND	0.00	0.21	1.68
01-Apr-98	ND	ND	ND	ND	ND	ND	0.00	0.22	1.74
02-Apr-98	ND	ND	ND	ND	ND	ND	0.00	0.24	1.89
03-Apr-98	ND	ND	ND	ND	ND	ND	0.00	0.27	2.19
04-Apr-98	ND	ND	ND	ND	ND	ND	0.00	0.30	2.41
05-Apr-98	ND	ND	ND	ND	ND	ND	0.00	0.33	2.65
06-Apr-98	ND	ND	ND	ND	ND	ND	0.00	0.38	3.02
07-Apr-98	ND	ND	ND	ND	ND	ND	0.00	0.42	3.33
08-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	0.42	3.39
09-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	0.40	3.22
10-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	0.42	3.32
11-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	0.39	3.15
12-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	0.38	3.03
13-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	0.38	3.05
14-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	0.41	3.27
15-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	0.48	3.86
16-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	0.61	4.87
17-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	0.77	6.13
18-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	1.19	9.52
19-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	2.02	16.16
20-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	1.94	15.52
21-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	1.81	14.48
22-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	2.34	18.72
23-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	2.64	21.12

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
24-Apr-98	0.46	0.6	12.61	ND	ND	ND	0.00	2.78	22.24
25-Apr-98	0.47	0.66	13.88	ND	ND	ND	0.00	2.59	20.72
26-Apr-98	0.47	0.67	14.06	ND	ND	ND	0.00	2.34	18.72
27-Apr-98	0.47	0.67	14.06	ND	ND	ND	0.00	2.52	20.16
28-Apr-98	0.47	0.67	14.06	ND	ND	ND	0.00	3.22	25.76
29-Apr-98	0.47	0.67	14.06	ND	ND	ND	0.00	4.15	33.20
30-Apr-98	0.47	0.67	14.06	ND	ND	ND	0.00	4.44	35.52
01-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	5.23	41.84
02-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	6.11	48.88
03-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	6.66	53.28
04-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	7.34	58.72
05-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	7.63	61.04
06-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	7.25	58.00
07-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	6.74	53.92
08-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	5.62	44.96
09-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	5.00	40.00
10-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	5.05	40.40
11-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	5.46	43.68
12-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	6.60	52.80
13-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	7.05	56.40
14-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	5.85	46.80
15-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	5.00	40.00
16-May-98	0.47	0.67	14.06	ND	ND	ND	0.00	5.00	40.00
17-May-98	0.47	0.68	14.26	ND	ND	ND	0.00	5.73	45.84
18-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	7.19	57.52
19-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	6.52	52.16
20-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	6.06	48.48
21-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	6.40	51.20
22-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	6.78	54.24
23-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	6.54	52.32
24-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	7.54	60.32
25-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	8.02	64.16
26-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	10.20	81.60
27-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	11.20	89.60
28-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	9.42	75.36
29-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	7.50	60.00
30-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	6.87	54.96
31-May-98	0.48	0.74	15.64	ND	ND	ND	0.00	6.94	55.52
01-Jun-98	0.48	0.74	15.64	ND	ND	ND	0.00	5.46	43.68
02-Jun-98	0.48	0.74	15.64	ND	ND	ND	0.00	4.45	35.60

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
03-Jun-98	0.48	0.74	15.64	ND	ND	ND	0.00	4.27	34.16
04-Jun-98	0.48	0.74	15.64	ND	ND	ND	0.00	4.22	33.76
05-Jun-98	0.48	0.74	15.64	ND	ND	ND	0.00	4.32	34.56
06-Jun-98	0.48	0.74	15.64	ND	ND	ND	0.00	4.58	36.64
07-Jun-98	0.48	0.74	15.64	ND	ND	ND	0.00	4.44	35.52
08-Jun-98	0.48	0.74	15.64	ND	ND	ND	0.00	4.42	35.36
09-Jun-98	0.43	0.48	10.13	ND	ND	ND	0.00	4.51	36.08
10-Jun-98	0.38	0.24	5.06	0.19	0.02	1.54	0.00	3.74	29.92
11-Jun-98	0.37	0.2	4.3	0.19	0.01	1.23	0.00	3.07	24.56
12-Jun-98	0.37	0.19	4.04	0.18	0.01	1.09	0.00	2.54	20.32
13-Jun-98	0.37	0.21	4.33	0.18	0.01	1.01	0.00	2.45	19.60
14-Jun-98	0.38	0.23	4.75	0.18	0.01	1.1	0.00	2.71	21.68
15-Jun-98	0.36	0.18	3.75	0.18	0.01	1.11	0.00	3.25	26.00
16-Jun-98	0.36	0.17	3.66	0.17	0.01	0.85	0.00	2.56	20.48
17-Jun-98	0.36	0.18	3.88	0.18	0.01	0.92	0.00	2.46	19.68
18-Jun-98	0.37	0.2	4.2	0.18	0.01	0.92	0.00	2.60	20.80
19-Jun-98	0.36	0.19	3.91	0.18	0.01	0.92	0.00	2.94	23.52
20-Jun-98	0.36	0.17	3.66	0.18	0.01	1.01	0.00	3.09	24.72
21-Jun-98	0.36	0.16	3.45	0.17	0.01	0.85	0.00	2.99	23.92
22-Jun-98	0.36	0.16	3.45	0.17	0.01	0.78	0.00	2.88	23.04
23-Jun-98	0.26	0.04	0.78	0.17	0.01	0.67	0.00	2.64	21.12
24-Jun-98	ND	ND	ND	0.17	0.01	0.67	0.00	2.33	18.64
25-Jun-98	ND	ND	ND	0.17	0.01	0.67	0.00	2.25	18.00
26-Jun-98	ND	ND	ND	0.17	0.01	0.67	0.00	2.45	19.60
27-Jun-98	ND	ND	ND	0.17	0.01	0.67	0.00	2.58	20.64
28-Jun-98	ND	ND	ND	0.17	0.01	0.77	0.00	2.42	19.36
29-Jun-98	ND	ND	ND	0.17	0.01	0.67	0.00	2.43	19.44
30-Jun-98	ND	ND	ND	0.17	0.01	0.67	0.00	3.42	27.36
01-Jul-98	ND	ND	ND	0.18	0.01	0.95	0.00	4.82	38.56
02-Jul-98	ND	ND	ND	0.21	0.03	2.36	0.00	4.58	36.64
03-Jul-98	ND	ND	ND	0.21	0.02	2.17	0.00	4.51	36.08
04-Jul-98	ND	ND	ND	0.2	0.02	2.06	0.00	3.61	28.88
05-Jul-98	ND	ND	ND	0.19	0.02	1.48	0.00	3.11	24.88
06-Jul-98	ND	ND	ND	0.18	0.01	1.2	0.00	3.00	24.00
07-Jul-98	ND	ND	ND	0.18	0.01	0.92	0.00	2.58	20.64
08-Jul-98	ND	ND	ND	0.17	0.01	0.69	0.00	2.07	16.56
09-Jul-98	ND	ND	ND	0.17	0.01	0.68	0.00	1.90	15.20
10-Jul-98	ND	ND	ND	0.17	0.01	0.67	0.00	2.07	16.56
11-Jul-98	ND	ND	ND	0.17	0.01	0.82	0.00	2.02	16.16
12-Jul-98	ND	ND	ND	0.16	0.01	0.67	0.00	1.72	13.76

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
13-Jul-98	0.27	0.04	0.86	0.17	0.01	0.69	0.00	1.48	11.84
14-Jul-98	0.28	0.04	0.94	0.16	0.01	0.67	0.00	1.18	9.44
15-Jul-98	0.28	0.05	0.98	0.16	0.01	0.59	0.00	1.87	14.96
16-Jul-98	0.31	0.08	1.72	0.17	0.01	0.87	0.00	1.97	15.76
17-Jul-98	0.29	0.06	1.21	0.17	0.01	0.89	0.00	3.85	30.80
18-Jul-98	0.28	0.05	1.08	0.19	0.02	1.52	0.00	3.01	24.08
19-Jul-98	0.28	0.05	1.01	0.19	0.01	1.23	0.00	2.60	20.80
20-Jul-98	0.27	0.04	0.91	0.18	0.01	1.15	0.00	2.30	18.40
21-Jul-98	0.27	0.04	0.86	0.17	0.01	0.86	0.00	1.94	15.52
22-Jul-98	0.27	0.04	0.87	0.17	0.01	0.74	0.00	1.77	14.16
23-Jul-98	0.27	0.04	0.84	0.17	0.01	0.67	0.00	1.93	15.44
24-Jul-98	0.27	0.04	0.81	0.16	0.01	0.67	0.00	1.75	14.00
25-Jul-98	0.27	0.04	0.79	0.16	0.01	0.67	0.00	1.58	12.64
26-Jul-98	0.26	0.04	0.76	0.16	0.01	0.59	0.00	1.61	12.88
27-Jul-98	0.26	0.03	0.72	0.16	0.01	0.57	0.00	1.67	13.36
28-Jul-98	0.26	0.03	0.71	0.16	0.01	0.59	0.00	1.64	13.12
29-Jul-98	0.26	0.03	0.7	0.16	0.01	0.58	0.00	1.63	13.04
30-Jul-98	0.26	0.03	0.66	0.16	0.01	0.57	0.00	1.45	11.60
31-Jul-98	0.26	0.03	0.65	0.16	0.01	0.49	0.00	1.25	10.00
01-Aug-98	0.25	0.03	0.62	0.15	0	0.45	0.00	1.11	8.88
02-Aug-98	0.25	0.03	0.62	0.15	0	0.39	0.00	0.96	7.66
03-Aug-98	0.25	0.03	0.6	0.15	0	0.4	0.00	0.94	7.55
04-Aug-98	0.26	0.03	0.64	0.15	0	0.45	0.00	1.00	7.99
05-Aug-98	0.27	0.04	0.82	0.15	0.01	0.46	0.00	1.14	9.12
06-Aug-98	0.26	0.03	0.7	0.16	0.01	0.65	0.00	1.65	13.20
07-Aug-98	0.26	0.03	0.69	0.17	0.01	0.72	0.00	1.09	8.72
08-Aug-98	0.26	0.03	0.71	0.16	0.01	0.57	0.00	0.97	7.75
09-Aug-98	0.26	0.03	0.69	0.16	0.01	0.5	0.00	1.27	10.16
10-Aug-98	0.25	0.03	0.64	0.16	0.01	0.63	0.00	1.90	15.20
11-Aug-98	0.27	0.04	0.84	0.15	0.01	0.47	0.00	1.45	11.60
12-Aug-98	0.26	0.03	0.71	0.15	0.01	0.49	0.00	2.28	18.24
13-Aug-98	0.26	0.04	0.77	0.16	0.01	0.62	0.00	1.86	14.88
14-Aug-98	0.27	0.04	0.8	0.16	0.01	0.49	0.00	1.98	15.84
15-Aug-98	0.26	0.03	0.71	0.16	0.01	0.62	0.00	2.09	16.72
16-Aug-98	0.26	0.03	0.71	0.17	0.01	0.68	0.00	1.48	11.84
17-Aug-98	0.26	0.03	0.7	0.16	0.01	0.57	0.00	1.09	8.72
18-Aug-98	0.31	0.1	2.13	0.16	0.01	0.48	0.00	1.07	8.56
19-Aug-98	0.35	0.15	3.23	0.15	0.01	0.48	0.00	1.10	8.80
20-Aug-98	0.35	0.16	3.29	0.15	0	0.42	0.00	0.84	6.72
21-Aug-98	0.35	0.15	3.17	0.15	0	0.41	0.00	0.92	7.33

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
22-Aug-98	0.35	0.15	3.17	0.15	0	0.37	0.00	0.81	6.50
23-Aug-98	0.35	0.15	3.17	0.15	0	0.34	0.00	0.79	6.31
24-Aug-98	0.36	0.17	3.62	0.15	0	0.36	0.00	0.73	5.80
25-Aug-98	0.36	0.18	3.73	0.15	0	0.39	0.00	0.93	7.43
26-Aug-98	0.35	0.15	3.17	0.17	0.01	0.72	0.00	0.98	7.82
27-Aug-98	0.35	0.16	3.37	0.16	0.01	0.67	0.00	0.80	6.42
28-Aug-98	0.36	0.17	3.54	0.16	0.01	0.48	0.00	0.77	6.14
29-Aug-98	0.35	0.16	3.33	0.16	0.01	0.48	0.00	0.87	6.96
30-Aug-98	0.35	0.15	3.23	0.15	0	0.44	0.00	0.86	6.86
31-Aug-98	0.35	0.16	3.35	0.15	0	0.41	0.00	0.76	6.11
01-Sep-98	0.36	0.17	3.47	0.15	0.01	0.48	0.00	0.82	6.56
02-Sep-98	0.35	0.15	3.17	0.15	0.01	0.48	0.00	0.99	7.90
03-Sep-98	0.35	0.15	3.17	0.15	0.01	0.48	0.00	0.75	6.02
04-Sep-98	0.35	0.15	3.17	0.15	0	0.37	0.00	0.63	5.02
05-Sep-98	0.36	0.16	3.47	0.15	0	0.38	0.00	0.60	4.82
06-Sep-98	0.36	0.18	3.69	0.15	0	0.42	0.00	0.74	5.90
07-Sep-98	0.36	0.16	3.43	0.16	0.01	0.57	0.00	1.33	10.64
08-Sep-98	0.35	0.15	3.19	0.15	0	0.42	0.00	0.97	7.73
09-Sep-98	0.36	0.17	3.66	0.15	0	0.43	0.00	0.86	6.84
10-Sep-98	0.36	0.18	3.72	0.15	0.01	0.48	0.00	0.90	7.17
11-Sep-98	0.36	0.17	3.66	0.15	0	0.45	0.00	1.23	9.84
12-Sep-98	0.36	0.17	3.6	0.15	0	0.38	0.00	1.09	8.72
13-Sep-98	0.35	0.15	3.23	0.15	0	0.4	0.00	1.00	8.00
14-Sep-98	0.35	0.15	3.17	0.15	0	0.36	0.00	0.89	7.12
15-Sep-98	0.35	0.15	3.17	0.15	0	0.34	0.00	0.78	6.26
16-Sep-98	0.35	0.15	3.17	0.15	0	0.34	0.00	0.73	5.86
17-Sep-98	0.35	0.15	3.17	0.15	0	0.34	0.00	0.72	5.72
18-Sep-98	0.35	0.15	3.17	0.15	0	0.34	0.00	0.69	5.50
19-Sep-98	0.35	0.15	3.17	0.15	0	0.34	0.00	0.68	5.46
20-Sep-98	0.35	0.15	3.17	0.15	0	0.34	0.00	0.66	5.30
21-Sep-98	0.35	0.15	3.17	0.15	0	0.34	0.00	0.62	4.97
22-Sep-98	0.35	0.15	3.17	0.15	0	0.34	0.00	0.60	4.79
23-Sep-98	0.35	0.15	3.17	0.14	0	0.34	0.00	0.58	4.61
24-Sep-98	0.35	0.14	2.96	0.15	0	0.34	0.00	0.57	4.56
25-Sep-98	0.34	0.13	2.74	0.15	0	0.34	0.00	0.58	4.62
26-Sep-98	0.34	0.14	2.85	0.15	0	0.34	0.00	0.58	4.63
27-Sep-98	0.34	0.13	2.74	0.15	0	0.34	0.00	0.65	5.21
28-Sep-98	0.34	0.13	2.74	0.15	0	0.34	0.00	0.68	5.40
29-Sep-98	0.34	0.13	2.74	0.15	0	0.34	0.00	0.66	5.27
30-Sep-98	0.34	0.14	2.87	0.15	0	0.34	0.00	0.65	5.21

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
01-Oct-98	0.34	0.13	2.74	0.15	0	0.34	0.00	0.64	5.08
02-Oct-98	0.34	0.13	2.74	0.15	0	0.34	0.00	0.63	5.06
03-Oct-98	0.34	0.13	2.74	0.15	0	0.34	0.00	0.63	5.02
04-Oct-98	0.36	0.17	3.48	0.15	0	0.34	0.00	0.59	4.75
05-Oct-98	0.39	0.25	5.2	0.15	0	0.36	0.00	0.76	6.09
06-Oct-98	0.39	0.26	5.38	0.16	0.01	0.58	0.00	2.36	18.88
07-Oct-98	0.38	0.23	4.92	0.16	0.01	0.63	0.00	2.54	20.32
08-Oct-98	0.38	0.22	4.65	0.16	0.01	0.52	0.00	2.00	16.00
09-Oct-98	0.37	0.2	4.2	0.18	0.01	1	0.00	1.79	14.32
10-Oct-98	0.37	0.2	4.18	0.16	0.01	0.67	0.00	1.43	11.44
11-Oct-98	0.37	0.19	3.97	0.16	0.01	0.67	0.00	1.28	10.24
12-Oct-98	0.37	0.19	3.93	0.16	0.01	0.67	0.00	1.22	9.76
13-Oct-98	0.37	0.2	4.2	0.16	0.01	0.67	0.00	1.23	9.84
14-Oct-98	0.36	0.18	3.86	0.16	0.01	0.67	0.00	1.33	10.64
15-Oct-98	0.36	0.17	3.66	0.16	0.01	0.67	0.00	1.23	9.84
16-Oct-98	0.37	0.2	4.2	0.16	0.01	0.67	0.00	1.18	9.44
17-Oct-98	0.36	0.18	3.84	0.16	0.01	0.67	0.00	1.17	9.36
18-Oct-98	0.37	0.2	4.13	0.16	0.01	0.67	0.00	1.15	9.20
19-Oct-98	0.37	0.2	4.2	0.16	0.01	0.57	0.00	1.13	9.04
20-Oct-98	0.37	0.2	4.2	0.16	0.01	0.65	0.00	1.13	9.04
21-Oct-98	0.37	0.2	4.2	0.16	0.01	0.67	0.00	1.17	9.36
22-Oct-98	0.37	0.2	4.2	0.16	0.01	0.64	0.00	1.18	9.44
23-Oct-98	0.37	0.2	4.2	0.16	0.01	0.5	0.00	1.20	9.60
24-Oct-98	0.37	0.2	4.2	0.16	0.01	0.48	0.00	1.19	9.52
25-Oct-98	0.37	0.21	4.35	0.16	0.01	0.48	0.00	1.17	9.36
26-Oct-98	0.38	0.23	4.87	0.16	0.01	0.48	0.00	1.30	10.40
27-Oct-98	0.38	0.23	4.89	0.16	0.01	0.65	0.00	1.44	11.52
28-Oct-98	0.37	0.2	4.22	0.18	0.01	1.03	0.00	1.49	11.92
29-Oct-98	0.37	0.2	4.2	0.17	0.01	0.79	0.00	1.23	9.84
30-Oct-98	0.37	0.2	4.2	0.16	0.01	0.67	0.00	1.08	8.64
31-Oct-98	0.37	0.2	4.2	0.17	0.01	0.82	0.00	1.17	9.36
01-Nov-98	0.37	0.2	4.2	0.18	0.01	0.92	0.00	1.14	9.12
02-Nov-98	0.37	0.2	4.2	0.18	0.01	0.92	0.00	1.04	8.32
03-Nov-98	0.37	0.19	4.09	0.18	0.01	0.92	0.00	0.98	7.82
04-Nov-98	0.36	0.17	3.66	0.18	0.01	0.92	0.00	0.94	7.50
05-Nov-98	0.36	0.17	3.66	0.17	0.01	0.72	0.00	0.92	7.38
06-Nov-98	0.36	0.17	3.66	0.16	0.01	0.67	0.00	0.88	7.03
07-Nov-98	0.36	0.17	3.66	0.16	0.01	0.67	0.00	0.83	6.62
08-Nov-98	0.36	0.16	3.45	0.16	0.01	0.67	0.00	0.79	6.29
09-Nov-98	0.35	0.18	3.79	0.16	0.01	0.67	0.00	0.71	5.66

Attachment C: AGRA Data Analysis
Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
10-Nov-98	ND	ND	ND	0.16	0.01	0.52	0.00	0.57	4.52
11-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.55	4.36
12-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.52	4.19
13-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.50	4.02
14-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.48	3.86
15-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.46	3.71
16-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.44	3.55
17-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.43	3.42
18-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.41	3.29
19-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.46	3.70
20-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.52	4.18
21-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.48	3.81
22-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.43	3.46
23-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.42	3.32
24-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.41	3.24
25-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.40	3.17
26-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.39	3.10
27-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.37	2.96
28-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.35	2.80
29-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.33	2.66
30-Nov-98	ND	ND	ND	ND	ND	ND	0.00	0.32	2.52
01-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.31	2.50
02-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.31	2.47
03-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.31	2.45
04-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.30	2.42
05-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.30	2.40
06-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.30	2.38
07-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.29	2.34
08-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.29	2.30
09-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.28	2.27
10-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.30	2.42
11-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.32	2.58
12-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.34	2.75
13-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.32	2.58
14-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.30	2.42
15-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.27	2.18
16-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.26	2.06
17-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.30	2.43
18-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.29	2.34
19-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.27	2.12

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Tenas Hydrometeorological Baseline Report

Date	Tenas Creek			Four Creek			Goathorn Creek		
	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]	Water Level [m]	Discharge [m3/s]	Discharge [L/s/km2]
20-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.24	1.92
21-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.23	1.84
22-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.22	1.77
23-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.21	1.70
24-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.21	1.66
25-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.20	1.62
26-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.20	1.58
27-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.54
28-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.19	1.51
29-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.18	1.47
30-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.18	1.44
31-Dec-98	ND	ND	ND	ND	ND	ND	0.00	0.18	1.41

APPENDIX 3: GEOCHEMICAL FIELD BARREL RESULTS INTERPRETATION – TENAS PROJECT, SRK

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FINAL

Memo

To	Dan Farmer, Project and Development Manager	**Client**	Telkwa Mining Ltd.
From	Carlos Paulo, Laura Volden, Michael Herrell	**Project**	CAPR002933
		Date	April 22, 2024

Subject Geochemical Field Barrel Results Interpretation – Tenas Project

File name: TCL Task 100 Field barrels analysis MEMO CAPR002933 FINAL 20240422.docx

1 Introduction

Telkwa Mining Ltd (TCL) submitted an Environmental Assessment Certificate (EAC), application for the Tenas Project, located at the Telkwa Property, near the town of Telkwa, British Columbia in May of 2022. In support of the EA application, SRK Consulting (Canada) Inc. (SRK) conducted a comprehensive geochemical program to evaluate the risk of ML/ARD from mine materials that will be produced by the Project. The program included static geochemical characterization, kinetic testing through humidity cell tests (HCTs) and the development of source terms (SRK 2022a, SRK 2022b).

The kinetic testing program was expanded in 2019 to include field barrel tests and is currently on-going. The barrel tests were initiated to advance the understanding of ML/ARD rates from select stratigraphic zones under field conditions and to modify scaling factors used to adjust release rates based on laboratory testing (HCTs) to the field scale, which were used in the development of geochemical source terms. This memo provides a review and interpretation of existing field barrel data.

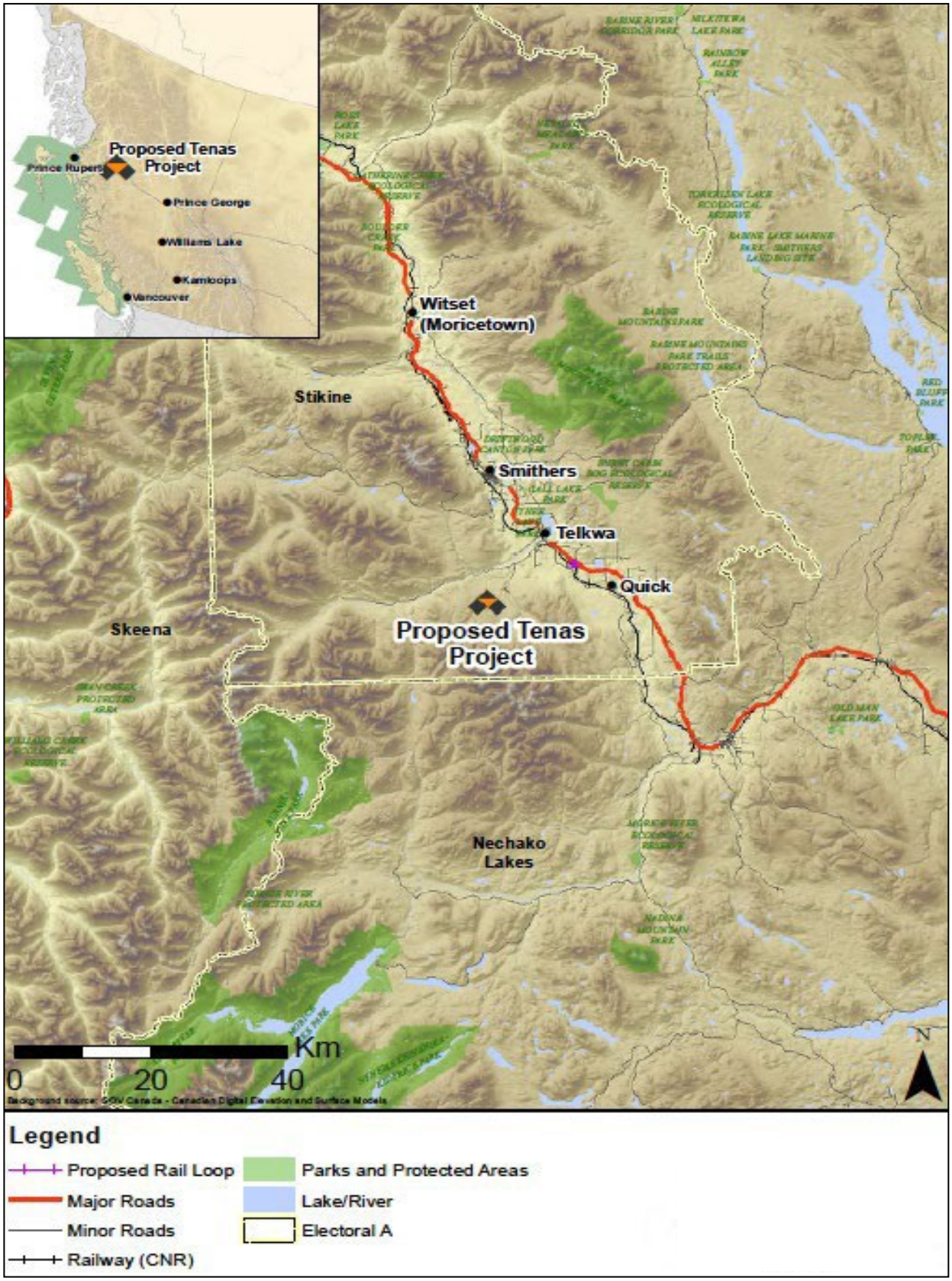
2 Background

2.1 Site Overview

The Tenas Project is in the Regional District of Bulkley-Nechako in northwestern British Columbia (BC), approximately 25 kilometers (km) south of Smithers and 7 km southwest of Telkwa, within the Wet'suwet'en's traditional territory, which includes the majority of the Bulkley River drainage Figure 2-1). Coal was reportedly discovered in the Telkwa area around 1900. Small-scale underground and surface mining began in 1918 and continued sporadically until 1985, resulting in the recovery of over 400,000 tonnes of coal. Modern exploration of the Project to delineate further exploitable coal reserves started in 1978, and with recent exploration programs, over 800 exploration drillholes, three bulk samples, trenching, geological mapping, and surface geophysics are available. The Project will extract run-of-mine (ROM) coal from a surface open pit through conventional shovel and truck methods (TCL 2018). Mining and processing of ROM coal will produce overburden, mine rock and processed rock that will need to be managed as appropriately to minimize long term environmental effects and geotechnical risks.

2.2 Bedrock Geology

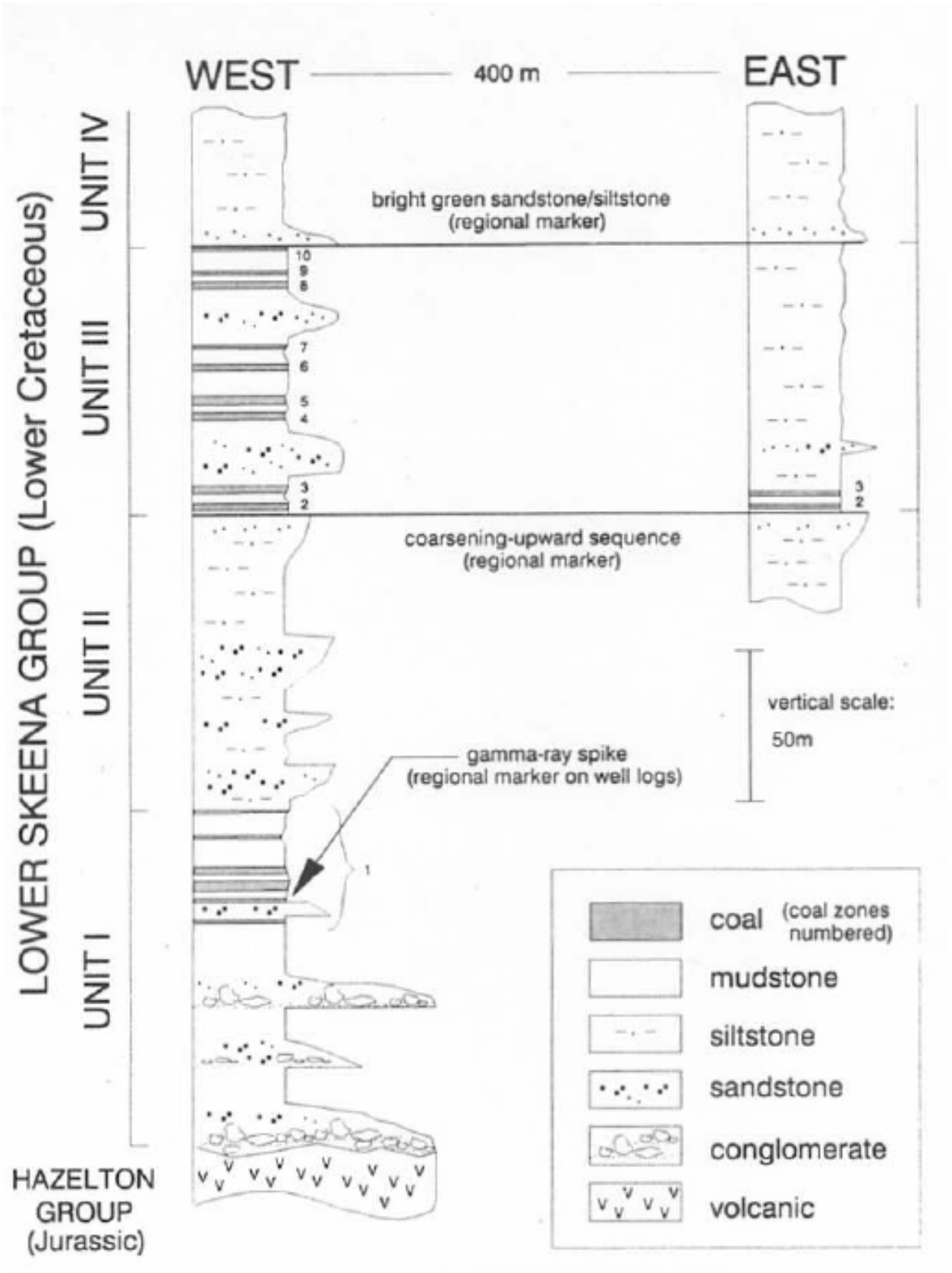
The Tenas Project is located within the northeast/southwest trending Skeena Arch, which separates Jurassic-age sedimentary rocks of the Bowser Basin in the north from the Jurassic to Cretaceous-age sedimentary rocks of the Nechako Basin to the south. The coal-bearing sedimentary rock sequence of the Project is associated with the Lower Cretaceous age Skeena Group, and unconformably overlies the Jurassic-age Hazelton volcanic group. A simplified stratigraphic column of the Tenas deposit is presented in Figure 2-2.



Adapted from Telkwa Mining Ltd.

Source: C:\Users\lvolden\SRK Consulting\NA CAPR002933 Telkwa Mining Project 2023 Geochemistry Support - Figures

srk consulting	TELKWA MINING LIMITED	Geochemical Field Barrel Testing
		Project Location
Job No: CAPR2933 Filename: CAPR002933_TelkwaFieldBarrel_Figures_Portrat_rev00_lv.pptx	Tenas Project	Date: March 2024 / Approved: LV / Figure: **2.1**



Adapted from Telkwa Mining Ltd.

Source: C:\Users\lvolden\SRK Consulting\NA CAPR002933 Telkwa Mining Project 2023 Geochemistry Support - Figures

srk consulting	TELKWA MINING LIMITED	Geochemical Field Barrel Testing
		Stratigraphic Sequence
Job No: CAPR2933 Filename: CAPR002933_TelkwaFieldBarrel_Figures_Portrat_rev00_lv.pptx	Tenas Project	Date: March 2024 / Approved: LV / Figure: **2.2**

2.2.1 Jurassic Hazelton Volcanic Group

The volcanic rocks include andesite, trachyte, and basalt with associated tuffs and breccias.

2.2.2 Lower Cretaceous Skeena Group

The Lower Cretaceous Skeena Group includes marine and continental sediments interbedded with coal seams, often correlated over long lateral distances. It is subdivided into four units (Units I through IV) and a unit of undivided sediments overlying the four units.

The economic coal seams in the Tenas Deposit are located in Coal Zone 1 of Unit I and includes two seams: C seam and 1 seam (upper and lower). Coal Zones 2 through 10, located in Unit III are absent from the Tenas area. Units I through IV are summarized below.

Unit I (modified after Ledda, 1998)

The basal unit, Unit I, was deposited in a fluvial environment and, in the Telkwa Property, rests unconformably over the eroded Hazelton volcanic basement of Jurassic age. Because it was deposited over an undulating surface, the Unit l stratigraphy has been observed to display variability in thickness, often over short lateral distances. This variability is most evident in the lower sedimentary assemblage, between the basement contact and the lowermost Unit l coals. As such, Unit l can be more than 100 m in thickness and consists mainly of conglomerate, sandstone, mudstone, and coal.

Coals within this unit, collectively referred to as Coal Zone 1, formed in poorly drained backswamps and are characterized by lateral variation throughout the study area. The Unit l coals can consist of up to 12 individual coal seams that collectively contribute up to 11.9 m of coal to the unit's overall thickness. Sands and gravels were typically deposited in braided channels and bars while mudstones accumulated in floodplains. Indications are that there was periodic marine influence during deposition of the unit. Deposition of Unit I ended with a marine transgression and deposition of Unit II.

Unit II (Ledda, 1998)

Unit II was deposited within a deltaic / shallow marine environment and consists of up to 140 m of sandstone, silty mudstone and occasional thin coaly mudstone. Sands were deposited in distributary channels and mouth-bars while mudstones and silty mudstones accumulated in interdistributary bays. Thin discontinuous peat beds, none of which are of economic significance, accumulated in local salt marshes.

Unit III (modified after Ledda, 1998)

Unit III is indicative of the second regressive episode for the area and represents the deposition of the second main coal-bearing stratigraphic sequence. The unit averages 85 m in thickness and is comprised of sandstone, siltstone, carbonaceous mudstone, and thick, laterally extensive coal seams. Restricted nearshore marine, tidal flat and coastal swamp environments persisted throughout much of the deposition of Unit III. Sandstone units were deposited within tidal channels while interbedded sandstones and siltstones were deposited nearshore within intertidal environments. Mudstones are representative of tidal flat deposits. Significant marine influence during deposition of the entire unit is indicated.

Coal Zones 2 through 11 are represented in Unit III, collectively contributing to up to 17 coal seams of economic significance. The coal zones were likely formed in freshwater peat swamps, located landward of the tidal flat, somewhat isolated from influxes of brackish water. The presence of sulphur in some of the coal seams suggests, however, that the peat was infiltrated periodically by marine water. Thus, the major coal seams are interpreted to have formed from peat accumulated in a freshwater marsh that was proximal to a brackish environment. The Snuggedy Swamp of South Carolina is considered a modern analogue for the paleoenvironment in which Unit III was deposited.

2.2.3 Intrusions

Tertiary and Cretaceous-age porphyritic dykes and sills commonly intrude this sequence, the most notable of which includes a Tertiary granodiorite intrusion located on the north side of the Telkwa River. These intrusions are not present in the Tenas area.

2.2.4 Geological Structures

The sedimentary sequence in the Tenas area is folded into a syncline in which the gently (typically 10 to 20°) northeast-dipping western limb of the syncline subcrops on the western side of the pit area, while the moderately (40 to 45°) southwest-dipping eastern limb subcrops on the eastern side of the pit. Faulting is generally near-vertical, and can be subdivided into two main groups, one which strikes approximately northwest/southeast and the other which strikes approximately northeast/southwest.

2.3 Surficial Geology

The surficial geology in the Project area consists primarily of two types of deposits, glacial clay- or silt-rich till, and sand and glaciofluvial sand and gravel outwash. At upper elevations and south of the proposed pit, the terrain is mapped as having bedrock outcrops to a limited extent or thin mantles of clay- and silt-rich tills deposits, between 3 m and 10 m thick. North of the proposed pit and towards Tenas Creek and Goathorn Creek, drillholes report thin mantles of clay- and silt-rich tills deposits, between 3 m and 10 m thick underlain by a thick sand and gravel outwash deposit that can exceed 100 m.

Other types of deposits are present locally. Patches of glaciolacustrine deposits are scattered throughout the morainal landscape in low ridges and in depressions; the sediments comprise bedded and laminated mud, and minor sand and gravel (Clague 1984). Recent fluvial deposits form the narrow floodplains of Goathorn Creek and Tenas Creek, which are 40 m to 80 m deep incised into the subdued morainal landscape, and the wide floodplains of the Telkwa and Bulkley Rivers. The fluvial deposits range from extremely coarse, poorly sorted gravel on steep alluvial fans to moderately to well-sorted sand and mud on low-gradient floodplains (Clague 1984).

2.4 Material Zone Designations

Geochemical properties are stratigraphically constrained in coal deposits versus lithologically constrained. For example, the deposition environment of the Tenas Deposit includes marine and deltaic sedimentary sequences and rocks formed in these two different environments will be compositionally different. The deposit was demarcated into stratigraphic zones of sedimentary sequences between the mineable coal seams. The stratigraphic zones were further divided into additional zones if they had different distinct geochemical properties (e.g., Zone 1 and Zone 1a) or grouped if geochemical properties were similar between zones identified between coal seams (e.g., Zone 2 and Zone 3). The stratigraphic zones and classification of PAG and non-PAG based on an NPR of 2.0 identified for the Project are presented in Figure 2-3.

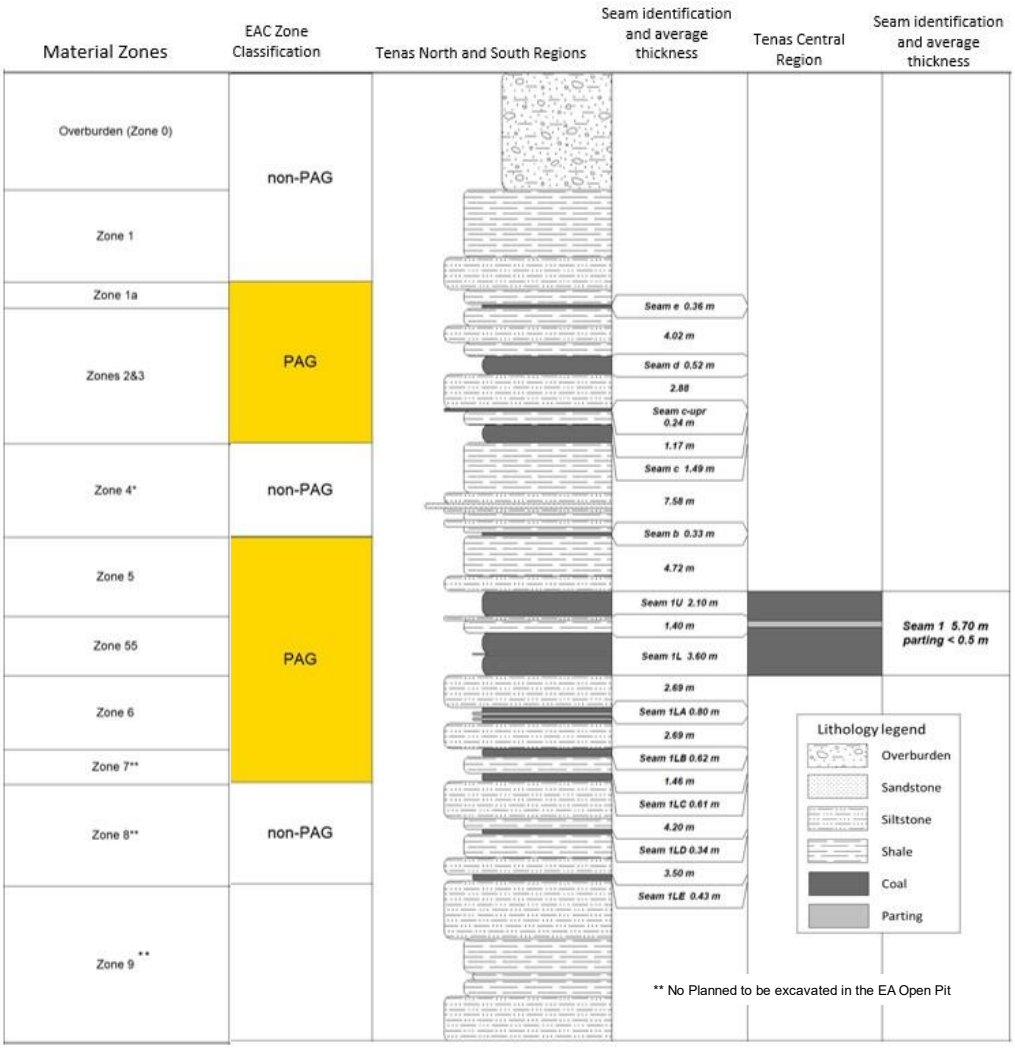


Figure 2-3. Tenas Deposit Stratigraphic Zones

2.5 Summary of Previous Geochemical Characterization Studies

Two geochemical studies have been completed to characterize the acid generating and metal leaching potential of the Tenas deposit:

- Norecol Dames and Moore (1999). Draft Report. Assessment of ARD Potential and Water Quality Predictions. Telkwa Coal Project.
- SRK (2022a). Telkwa Coal – Tenas Project Supplemental Geochemical Characterization.

The Norecol Dames and Moore (1999) study included the collection and analysis of over 700 samples. An additional 173 samples were collected as part of the supplemental geochemical characterization study (SRK 2022a). The supplemental samples were used to confirm the results of the 1999 study and calibrate the test results to more up-to-date testing methods. For example, samples collected as part of the Norecol Dames and Moore (1999) study were analyzed for total sulfur only and neutralization potential was determined using the Sobek-NP (1978) method. Results from both studies were combined to form a robust geochemical characterization that is documented in SRK (2022a). The reader is referred to SRK (2022a) for additional detail on the geochemical characterization program including sample selection, collection, geochemical testing methods and results.

The outcomes of these studies indicated that a large volume of the mine rock to be mined from the Tenas deposit is potentially acid generating (PAG) and that acid generating potential is stratigraphically constrained in zones generally separated by the coal seams (Figure 2-3). The geochemical testing results indicate that all zones contain some PAG rock; however, there are units that are predominantly PAG versus non-PAG. Based on a neutralization potential ratio (NPR) (SRK 2022a) of 2, the following zones were characterized as PAG and non- PAG based on their average bulk properties:

- Non-PAG: Zone 1, portions of Zone 4, overburden, construction materials, and topsoil;
- PAG: Zone 1a, Zone 2/3, portions of Zone 4, Zone 5, Zone 55, Zone 6, processed rock, processed coal and ROM coal

All zones contain both PAG and non-PAG materials with the exception of overburden, construction materials, and topsoil. The above zones were classified as non-PAG or PAG were based on an neutralization potential ratio (NPR) cutoff of 2. This cutoff was used to initially classify zones as non-PAG or PAG. PAG and non-PAG rock volume estimates based on this criterion were used to inform the waste management strategy (e.g., sizing of the management ponds).

SRK subsequently developed a site-specific NPR of 1.2 for mine rock based on carbonate molar ratios (CMRs) observed in humidity cell tests. Application of the site-specific NPR results in the following zones being classified as non-PAG and PAG based on their average bulk properties:

- Non-PAG: Zone 1, portions of Zone 4, Zone 5, Zone 55 and Zone 6;
- PAG: Zone 1a, Zone 2/3 and portions of Zone 4

The site-specific NPR of 1.2 is specific to mine rock does not apply to other mine materials (i.e., overburden, construction materials, topsoil, processed rock, processed coal and ROM coal). An NPR of 2 is used to characterize these materials as PAG or non-PAG and their classification (see above) does not change. The NPR of 2 is used for planning purposes and TML is proposing the site-specific

NPR of 1.2 be used as an operational segregation criterion, pending approval by the British Columbia Ministry of Energy Mines and Lower Carbon Innovation.

2.6 Overview of Field Barrel Testing Program

Nine field barrels were constructed at the Project site and have been monitored intermittently since October 2019. Details of each barrel, including material zone, ARD classification, and data availability are summarized by Table 2-1.

Composite samples for each barrel were prepared from sample rejects stored at Bureau Veritas Laboratories in Burnaby, British Columbia. Sample rejects, varying in mass from one to 110 kg were selected for use in the barrels until a minimum mass of 200 kg was achieved. Zones with insufficient mass (e.g., Zone 4 PAG and Zone 4 non-PAG) were supplemented with sample rejects from other zones with similar geochemical properties (Table 2-1). Individual waste rock samples were homogenized using cone and quartering methods prior to placing the samples in the barrels. A barrel consisting of overburden collected at site was also constructed. As part of the QA/QC program, a duplicate barrel was constructed from Zone 1 rock and a blank barrel, containing no materials, was also constructed at site to identify any systematic laboratory testing errors.

The PAG management strategy for the Project is to place PAG rock underwater in the management ponds prior to the rock becoming acidic. A key objective of the barrel testing program was to confirm the lag time to onset of acid generation estimates derived using lab based kinetic tests (SRK 2022a) that have been used to inform the PAG management strategy. With this objective in mind, conservatism was included in the evaluation by selecting sample rejects for some barrels which resulted in weighted sulfide concentrations greater than the bulk sulfide content of the zone and a weighted NPR lower than the bulk properties of each zone (Table 2-1). Samples used in the construction of each barrel are provided in Appendix A.

Leachate sampling has been conducted intermittently from October 2019 until November 2023. Seven to nine samples have been collected from each barrel during this period. The volume of leachate collected in each barrel between sampling periods was calculated from the water column height at the time of collection. Table 2-2 presents the calculated volume of each barrel for the sampling date, as well as the dates when volumes were not recorded but leachate samples were collected for analytical chemistry.

During sample collection the following field parameters were measured and recorded: pH, temperature, oxidation reduction potential (ORP), dissolved oxygen and electrical conductivity (EC). Olfactory and other visual (e.g., colour) observations were made during sampling. Laboratory analysis was conducted at Bureau Veritas Laboratories in Richmond, BC, using standard analytical methodologies. The following parameters were measured:

- General parameters: electrical conductivity (EC), pH, hardness, acidity, alkalinity
- major anions (chloride, fluoride, sulfate, phosphate) and nitrogen species (nitrate, nitrite, ammonia),
- total and dissolved major and trace elements concentrations.

Before data analysis and interpretation, SRK screened the analytical results against internal QA/QC procedures to validate that data quality is acceptable for the purpose of the Project.

Table 2-1. Field Barrel Attributes

Barrel	Description	ID	Mass (kg)	Zone Classification	Starting Date	Weeks of Data	No. Leachate Samples	Barrel Geochemical Attributes		Zone Average Geochemical Properties	
								S^{2-} (w.t.%)	NPR	S^{2-} (w.t.%)	NPR
Barrel 1	Zone 1	B1	193.5	Non-PAG	8/7/2019	158	9	0.55	2.7	0.43	3.2
Barrel 2	Zone 1 (duplicate)	B2	193.5	Non-PAG	8/7/2019	158	8	0.55	2.7	0.43	3.2
Barrel 30.32	Zone 1a	B3	234.3	PAG	8/7/2019	158	8	1.46	0.47	1.6	0.7
Barrel 4	Zone 2/3	B4	190.7	PAG	8/7/2019	158	9	1.40	0.82	0.88	0.80
Barrel 5	Zone 4 PAG + Zone 5	B5	146.1	PAG/ Non-PAG	8/20/2019	156	8	1.23	1.01	1.75 (Zone 4 PAG) 1.13 (Zone 5)	0.6 (Zone 4 PAG) 1.5 (Zone 5)
Barrel 6	Zone 6 + Zone 7	B6	138.7	Non-PAG	8/20/2019	156	8	1.66	0.51	0.97 (Zone 6) 0.86 (Zone 7)	1.6 (Zone 6) 1.4 (Zone 7)
Barrel 7	Zone 4 non-PAG + Zone 8	B7	183.8	Non-PAG	8/20/2019	156	9	0.32	5.6	0.5 (Zone 4 non-PAG) 0.3 (Zone 8)	3.5 (Zone 4 non-PAG) 4.7 (Zone 8)
Barrel 8	Overburden	B8	167	Non-PAG	10/18/2019	147	9	N/A	N/A	N/A	N/A
Barrel 9	Blank	B9	0		8/20/2019	156	7	N/A	N/A	N/A	N/A

Source**:** compiled in the text.

Table 2-2. Sampling Events and Leachate Volumes

Volume (L)	Barrel 1: Zone 1	Barrel 2: Zone 1 (duplicate)	Barrel 3: Zone 1a	Barrel 4: Zone 2-3	Barrel 5: Zone 4PAG + Zone 5	Barrel 6: Zone 6 + Zone 7	Barrel 7: Zone 4 NPAG + Zone 8	Barrel 8: Overburden	Barrel 9: Blank
12/31/2019	10.7	10.9	20.4	6.4	5.1	6.9	6.4	n.r.	n.r.
4/29/2020	13.4	8.1	11.5	7.8	10.9	6.4	4.7	16.8	n.r.
9/23/2020	13.4	8.1	11.5	7.8	10.9	6.4	4.7	16.8	n.r.
11/29/2020	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
4/5/2021	12.8	11.3	11.8	10.4	9.3	10.2	6.9	15.7	n.r.
7/15/2021	21.2	9.9	17.1	15.7	14.5	18.5	18.2	9.0	n.r.
12/20/2021	3.9	n. r.	15.1	18.1	17.5	6.3	19.3	8.1	n.r.
5/24/2022	4.0	5.5	n.r.	2.5	n.r.	2.5	7.0	8.5	n.r.
8/15/2022	n.r.	12.5	5.1	8.1	14.5	9.2	n.r.	n.r.	n.r.
8/16/2022	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	19.8	6.9	n.r.

n.r. - volume not recorded during sampling,

Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 100 Field barrel analysis/Loads_comparison/[Conc_Loadings_Telkwa Tenas_Field Barrel_1CT027.007_rtc_CP_CCM_05.xlsx

3 Field Barrel Results

Barrel release rates for select parameters are presented on Figure 3-1 and a complete summary of results is provided in Appendix B. Select parameters are defined as those that provide insight to acid generation potential (pH, alkalinity, acidity and sulfate), were screened to be greater than 10 times the average crustal abundances during static geochemical characterization (arsenic, phosphorus and selenium) or had increasing concentrations during the testing period in at least one barrel (cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, nickel, tin, thallium, uranium, vanadium and zinc).

Release rates were calculated using the following formula:

$$L_j = C_j * \frac{V}{m} / t$$

Where: L_j is the load of parameter j expressed in mg/kg/week

C_j is the concentration of parameter j in the leachate sample in mg/L

V is the volume of the sample in L

m is the total mass in the barrel in kg

t is the time between sample events in weeks

Trends in release rates were relatively consistent, or decreasing, in all barrels until the most recent sampling event (October 2023), where acidity increased in B4 (Zone 2/3) and B6 (Zone 6/7) along with several other parameters (Figure 3-1). Sulfate, as well as calcium and magnesium loadings were higher in barrels containing PAG rock (i.e., B3, B4, B5 and B6) in comparison to non-PAG barrels (i.e., B1, B2 and B7). Higher sulfate production rates are expected in the PAG barrels because they have higher sulfide concentrations (Table 2-1). The higher calcium and magnesium loading rates are indicative of carbonate mineral dissolution in response to acid production from sulfide oxidation.

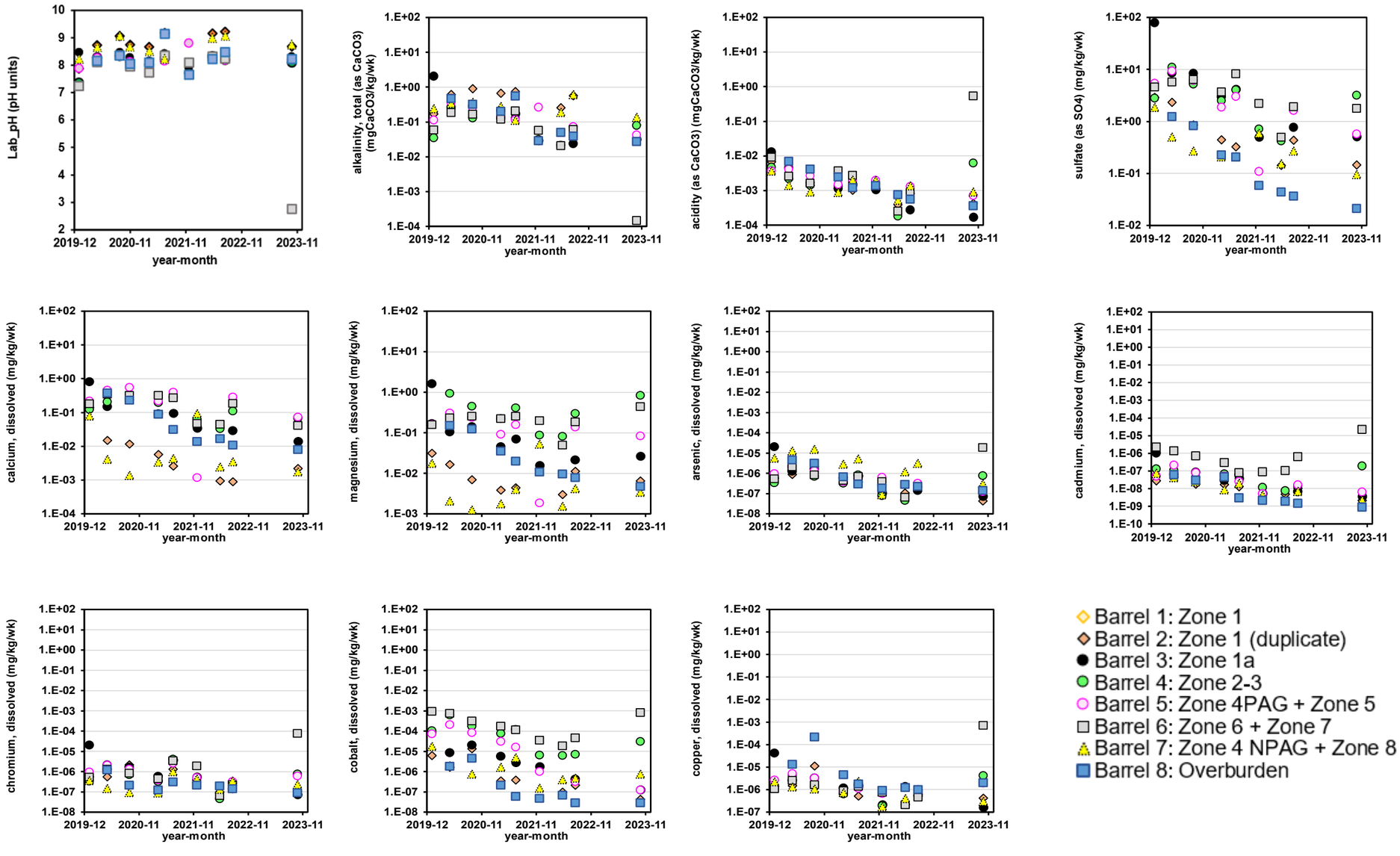
The pH in B6 decreased from 8.2 in August 2022 to 2.8 in October 2023. B6 represents a composite of waste rock Zones 6 and 7, which were classified as non-PAG based on static data and is currently the only barrel with an acidic pH. The NPR of the barrel containing waste rock reject samples from these zones was 0.5 (Table 2-1), which is lower than the bulk average NPR for Zone 6 (1.6) and Zone 7 (1.4). Although the Zone 6 and 7 composite barrel went acidic this does not change the overall PAG classification for Zone 6 and Zone 7 since the barrel NPR is closer to the 5th percentile NPRs in these two zones based on static properties (SRK 2022a).

Decreasing pH in B6 coincided with an increase in several constituent loadings including cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, phosphorus, nickel, tin, thallium, uranium, vanadium and zinc (Figure 3-1). Increases in some of these parameters were also observed at lower magnitudes in B4. The results suggest that if acidic drainage occurs from mine rock prior to placement in the management ponds, concentrations of these parameters will increase. The current interpretation is only based on one monitoring point with an acidic pH, and continued monitoring is required to confirm the trends.

Increasing acidity and sulfate loads in B4, along with several other parameters indicates B4 may go acidic in the near future. B4 represents waste Zone 2/3 which is classified as PAG based on static data. In all other barrels, alkalinity loadings remained generally consistent during the testing period with a slight decrease over time. Loadings of other constituents have generally maintained a slight decreasing trend throughout the testing period. This generally occurs when the pH remains stable and the mass inventory is depleted through time.

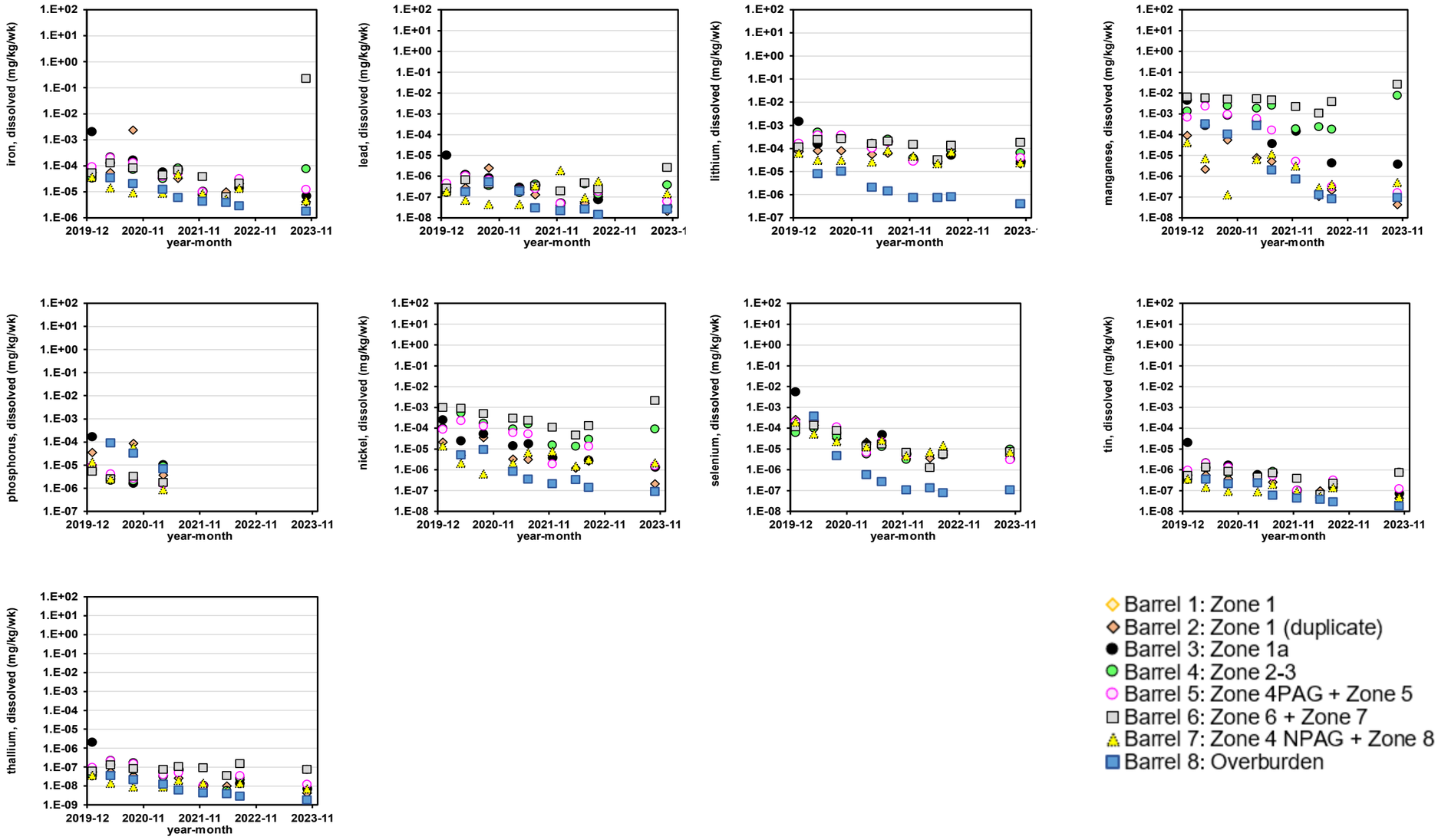
As discussed in Section 2.5, SRK (2022a) developed a site-specific NPR criterion based on kinetic testing results. CMRs calculated using the methods described in SRK (2022a) are presented in Figure 0-1. The HCT CMRs are also presented.

The field barrels had low sulfate production rates in comparison to the HCTs (Figure 0-1). The non-PAG barrels (1, 2 and 7) had sulfate release rates less than 1 mg/kg/week and PAG barrels (3, 4, 5 and 6) had sulfate release rates ranging from 3.5 to 13 mg/kg/week. The lower barrel production rates occur because of much lower water to rock ratios and water yields in the barrel tests compared to the HCTs. The CMRs of the PAG barrels were approximately 1.0 mol/mol for all barrels. The non-PAG CMRs were higher as a result of the lower sulfate production rates. The empirical sulfate production and carbonate dissolution rates converge on a CMR of 1.0 indicating the site-specific NPR of 1.2 estimated based on the HCTs is reasonable.



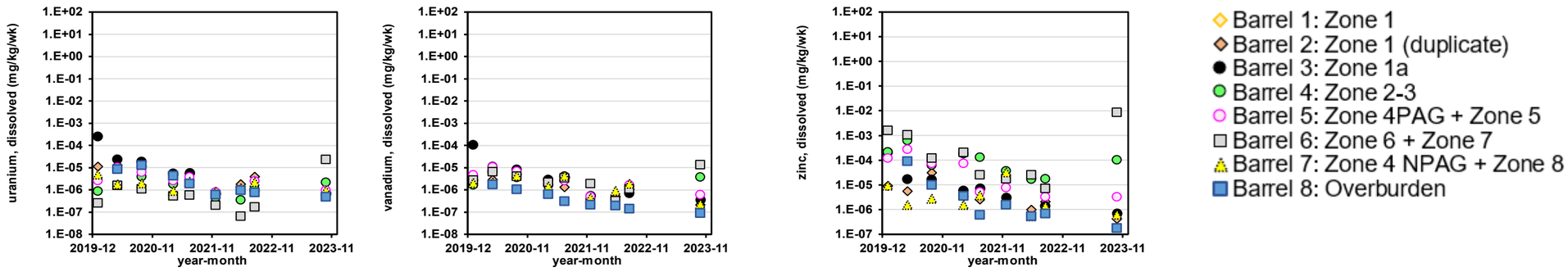
Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 100 Field barrel analysis/Loads_comparison/[Conc_Loadings_Telkwa Tenas_Field Barrel_1CT027.007_rtc_CP_CCM_05.xlsx]Load_S

Figure 3-1. Loading Results from Barrel Tests for Select Parameters



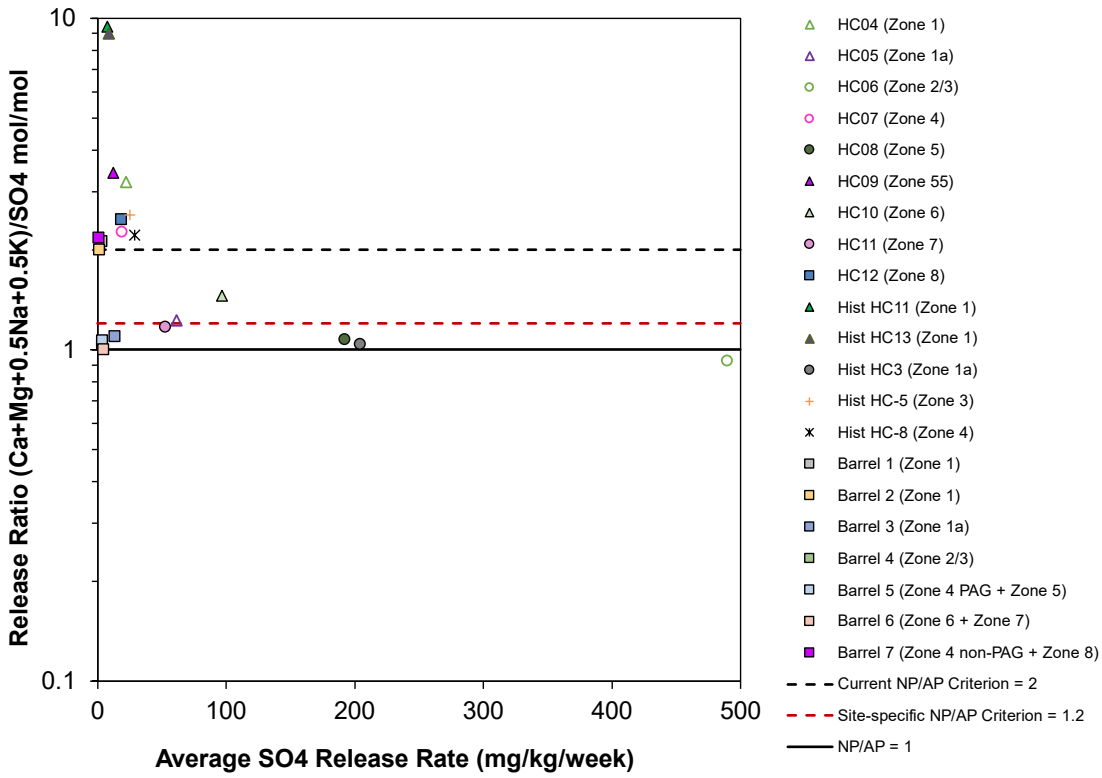
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Figure 3-1 (cont.) Loading Results from Barrel Tests for Select Parameters



Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 100 Field barrel analysis/Loads_comparison/[Conc_Loadings_Telkwa Tenas_Field Barrel_1CT027.007_rtc_CP_CCM_05.xlsx]Load_S

Figure 3-1 (cont.) Loading Results from Barrel Tests for Select Parameters



Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 100 Field barrel analysis/Loads_comparison/[NPR_Crit_1CT027.002_JED_MKH_r01.xlsx]

Figure 0-1. Comparison of CMR Estimates from HCTs and Field Barrels

4 Comparison to Source Term Loadings

SRK (2022b) developed geochemical source terms using humidity cell testing (HCT) results that were scaled to account for the differences between lab and site conditions (e.g., temperature and grain size). The reader is referred to SRK (2022b) for additional details on the source term derivation methods, including the scaling approach that was used. The barrel release rates provide insight into parameter release rates under ambient conditions. These were compared to the scaled HCT results to determine if the scaling approach used in the source term derivation was accurate. Prior to the comparison, a grain size scaling factor (0.2) was applied to the barrel release rates since the barrels were constructed using HCT rock rejects (i.e., <1/4”). The barrels are much smaller than a full scale rock pile and will not exhibit the same internal heating that occurs in full scale piles containing pyritic rock. The field temperature of the barrels was approximately 10ºC and the release rates were not adjusted for temperature differences since this is the expected temperature of the full scale pile.

Figures comparing the scaled barrel and HCT release rates for non-PAG zones (Zones 1 and 4) is included in Appendix C. A release rate higher in the barrel in comparison to the HCT indicates the lab rates were over scaled. The following list the parameters that were similar, lower or higher in the barrels compared to the HCT.

- Higher: sulfate, arsenic, cobalt, lead, molybdenum, nickel, selenium and uranium,
- Lower: calcium, magnesium, potassium, barium, boron, cadmium, iron, lithium, manganese, mercury, phosphorus, silicon, strontium, tin and thallium.
- Similar: sodium, chloride, antimony, chromium, copper, silver, vanadium and zinc.

The comparison indicated several constituents were either over or under scaled in the HCTs. SRK has updated the geochemical source terms using the barrel release rates to be used in the Project water quality model to evaluate changes to water quality (SRK 2022c).

5 Summary

A field barrel testing program was initiated to evaluate release rates and acidic lag times from Project Materials under ambient conditions. The results were used for several purposes, including:

- Advance the understanding of ML/ARD from stratigraphic zones under field conditions.
- Provide additional empirical evidence to support lag times lag times to the onset of acid generation.
- Constrain scaling factors that were used in the geochemical source terms that were used as the basis of the EA water quality predictions.

With the exception of barrel 6 (Zone 6/7), all barrels remained alkaline during the four-year data collection period. Sulfate loadings were higher in barrels that are characterized as PAG based on the weighted NPRs (Table 2-1) in comparison to non-PAG barrels. In addition, the calcium and magnesium release rates were also higher in PAG barrels relative to non-PAG barrels. Release rates of these constituents as well as the alkaline pH of the leachates and alkalinity production rates indicate carbonate mineral dissolution is buffering acid production from sulfide oxidation. Acidity and sulfate release rates increased during the last sampling round (October 2023) in barrel 4 (Zone 2/3) indicating this barrel may go acidic in the near future.

The PAG management strategy for the project is to place all PAG rock underwater in the management ponds within a period of 12 months. Barrel 6 became acid generating in October 2023, four years after the barrel testing program was constructed and all other barrels maintained alkaline pH values. The barrel results support the proposed period for inundation of PAG rock is reasonable.

SRK (2022a) developed a site-specific NPR of 1.2 based on HCT results. CMRs on the steady state rates in the barrel tests converged on a value of 1. The similarities between the barrel and the HCT CMRs support that the site-specific NPR estimated based on the HCT results of 1.2 is reasonable.

A comparison of the scaled barrel and HCT release rates indicate the scaling factors applied in the source terms (SRK 2022b) were too high for some constituents and too low for others. SRK has updated the geochemical source terms and site-wide water quality predictions using the scaled barrel release rates. The results of these updates will be reported under separate cover.

6 Closing

We trust this memo satisfies your current requirements. Should you have any questions or require any additional information please do not hesitate to contact the undersigned.

Regards,
SRK Consulting (Canada) Inc.

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Attachments:

Appendix A	Barrel Attribute Data
Appendix B	Summary of Barrel release rates
Appendix C	Comparison of Scaled HCT Loads to Barrel Load Figures

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References

Norecol Dames and Moore, 1999. Draft Report. Assessment of ARD Potential and Water Quality Predictions. Telkwa Coal Project. Prepared for Luscar Coal Ltd. Project No. 25373-004-310. March 19, 1999.

SRK 2022a. Telkwa Coal – Tenas Project Supplemental Geochemical Characterization. Prepared for Telkwa Coal Ltd. By SRK Consulting (Canada) Inc. February 2022.

SRK 2022b. Telkwa Coal – Tenas Project Water Quality Model Source Term Derivation Methods. Prepared for Telkwa Coal Ltd. By SRK Consulting (Canada) Inc. February 2022.

SRK 2023c. Tenas Project – Water and Load Balance Modeling Report. FINAL. Prepared for Telkwa Coal Limited: Vancouver BC. Project Number 1CT027.003. Issued July 29, 2022.

Appendix A Barrel Attribute Data

Barrel #	Description	Sample IDs	Sample Mass (kg)	Total Mass (kg)
1 and 2	Zone 1 and duplicate	T18-02D-A-005	34.0	633.96725 (2 barrels for 316.983625 kg each) *247kg total or 123.5kg each barrel was disposed of and did not fit into barrels. ***28657 + 28669 samples were not on pallet*.**
		T18-02D-A-006	37.1	
		28651	97.6	
		28653	82.5	
		28655	49.8	
		28657	40.0	
		28658	47.7	
		28659	41.2	
		28660	17.9	
		28669	40.9	
		29502	33.8	
		29509	111.6	
3	Zone 1a	28841	51.6	332.2785 *98.0kgs total was disposed of and did not fit into barrel.
		28842	43.3	
		28843	52.3	
		28844	40.7	
		T18-02D-A-011	33.7	
		28672	35.4	
		29514	41.8	
		29515	33.6	
4	Zone 2-3	T18-01D-A-001	11.1	282.249875 *91.5kgs total was disposed of and did not fit into barrel.
		T18-01D-A-002	0.9	
		T18-02D-A-012	29.5	
		T18-02D-A-013	14.9	
		28673	26.6	
		28674	4.9	
		T18-01D-A-003	5.1	
		T18-01D-A-004	14.0	
		T18-01D-A-005	23.4	
		T18-01D-A-006	10.6	
		T18-01D-A-007	1.2	
		T18-02D-A-014	43.5	
		T18-02D-A-015	33.2	
		T18-02D-A-016	3.3	
		28675	30.1	
		28676	27.6	
		28677	2.3	
5	Zone 4PAG + Zone 5	T18-01D-A-009	24.9	282.11575 *136.0kgs total was disposed of and did not fit into barrel.
		T18-02D-A-020	47.2	
		28681	32.1	
		28682	2.7	
		28683	5.2	
		T18-01D-A-010	44.0	
		T18-01D-A-011	29.7	
		T18-02D-A-022	34.8	
		T18-02D-A-024	14.6	
		T18-02D-A-025	6.7	
		T18-03D-A-005	14.3	
		28684	6.3	
		28686	14.9	
		28687	4.8	
6	Zone 6 + Zone 7	T18-01D-A-012	7.1	335.677875 *197.0kgs was disposed of and did not fit into barrel.
		T18-02D-A-027	3.7	
		T18-02D-A-029	11.5	
		T18-03D-A-009	10.9	
		T18-03D-A-021	15.0	
		T18-03D-A-022	3.7	
		28688	2.2	
		28690	24.3	
		28691	1.8	
		28704	6.5	
		28692	2.8	
		28693	5.6	
		28696	1.9	
		28697	5.4	
		29516	41.3	
		29518	38.6	
		29519	15.2	
		29520	3.4	
		29521	4.9	
		T18-02D-A-030	13.4	
		T18-02D-A-031	18.9	
		T18-02D-A-032	16.3	
		T18-02D-A-033	11.3	
		T18-02D-A-034	9.4	
		T18-03D-A-023	2.1	
		T18-03D-A-024	11.6	
		28698	38.8	
		28699	2.4	
		28700	5.7	
7	Zone 4 NPAG + Zone 8	T18-01D-A-008	35.1	224.280125 *40.5kgs was disposed of and did not fit into the barrel.
		T18-02D-A-017	0.8	
		T18-02D-A-018	28.2	
		T18-02D-A-019	14.8	
		28678	3.0	
		28679	56.2	
		28680	30.9	
		T18-02D-A-035	17.8	
		T18-02D-A-036	5.6	
		T18-02D-A-037	12.0	
		28708	4.1	
		28709	15.7	
8	Overburden	B945450	167.4	167.367kgs- All overburden pail samples fit into barrel.
9	Blank	0	0.0	0

Appendix B Summary of Barrel release rates

Appendix B: Summary of Barrel release rates (mg/kg/week)

Table B1: Element release rates for non-PAG zones estimated from field kinetics testing

Parameter	Units	non-PAG Zones											
		Barrel 1: Zone 1			Barrel 2: Zone 1 (duplicate)			Barrel 6: Zone 6 + Zone 7			Barrel 7: Zone 4 NPAG + Zone 8		
		min	Average	Max	min	Average	Max	min	Average	Max	min	Average	Max
Conventional													
pH	s.u.	8.0	8.7	9.5	7.9	8.6	9.2	2.8	7.9	8.4	7.6	8.3	9.1
EC	mS/cm	2790	4706	6350	2160	3953	5190	1020	7893	11200	511	2095	3050
Alkalinity	mg$CaCO_3$/Kg/week	0.18	3.6	9.4	0.08	0.55	0.88	0.00014	0.11	0.20	0.032	0.27	0.61
Major Ions													
Calcium	mg/kg/week	0.0019	0.033	0.117	0.00089	0.025	0.14	0.041	0.21	0.34	0.0014	0.024	0.093
Magnesium	mg/kg/week	0.010	0.028	0.13	0.0029	0.011	0.031	0.049	0.19	0.44	0.0012	0.011	0.053
Potassium	mg/kg/week	0.008	0.023	0.043	0.0014	0.0051	0.0083	0.00052	0.010	0.016	0.0011	0.0028	0.0048
Sodium	mg/kg/week	1.1	3.1	5.3	0.11	0.72	1.3	0.06	1.1	2.4	0.11	0.37	0.81
Chloride	mg/kg/week	0.010	0.042	0.083	0.0019	0.0085	0.027	0.0031	0.018	0.034	0.00077	0.0044	0.0087
Sulfate	mg/kg/week	0.91	3.1	7.6	0.14	1.1	2.9	0.49	4.1	8.2	0.09	0.51	1.9
Nitrate	mg/kg/week	0.00024	0.015	0.046	0.000021	0.0075	0.024	0.000031	0.00018	0.00034	0.000024	0.0013	0.0031
Nitrite	mg/kg/week	0.000023	0.0014	0.0042	0.0000042	0.00023	0.00066	0.0000062	0.000039	0.000067	0.0000023	0.000076	0.00026
Ammonia	mg/kg/week	0.000007	0.0010	0.0035	0.0000010	0.00034	0.0011	0.0000019	0.00037	0.0014	0.0000013	0.000083	0.00044
Dissolved Elements													
Aluminum	mg/kg/week	0.0000053	0.00062	0.0041	0.00000048	0.00017	0.0011	0.00000062	0.0000063	0.022	0.00000045	0.000025	0.00011
Antimony	mg/kg/week	0.00000069	0.0000054	0.000011	0.000000042	0.0000014	0.0000029	0.0000001	0.0000005	0.0000013	0.000000086	0.00000091	0.0000018
Arsenic	mg/kg/week	0.00000074	0.0000054	0.000014	0.000000042	0.000001	0.000002	0.000000062	0.00000064	0.000018	0.000000086	0.0000057	0.000015
Barium	mg/kg/week	0.0000010	0.000065	0.00025	0.00000016	0.00001	0.00002	0.0000010	0.0000056	0.000010	0.0000010	0.000011	0.000025
Boron	mg/kg/week	0.00008	0.00085	0.0019	0.000011	0.000094	0.00018	0.0000116	0.0000738	0.00013	0.000022	0.00010	0.00026
Cadmium	mg/kg/week	0.000000025	0.00000015	0.00000030	0.0000000021	0.000000019	0.000000044	0.000000077	0.00000067	0.000022	0.0000000023	0.000000023	0.000000073
Chromium	mg/kg/week	0.0000005	0.0000034	0.000013	0.00000010	0.0000007	0.0000021	0.000000062	0.0000011	0.000074	0.00000009	0.00000032	0.0000010
Cobalt	mg/kg/week	0.0000012	0.000021	0.00012	0.000000042	0.0000032	0.000013	0.000018	0.00029	0.00093	0.00000015	0.00000342	0.000017
Copper	mg/kg/week	0.0000023	0.000015	0.00007	0.00000021	0.0000023	0.000011	0.00000021	0.0000011	0.00069	0.00000017	0.00000115	0.0000024
Iron	mg/kg/week	0.000049	0.00092	0.00577	0.0000042	0.00036	0.0023	0.0000062	0.000055	0.22354	0.00000454	0.00001802	0.000048
Lead	mg/kg/week	0.00000026	0.0000095	0.00005	0.000000021	0.00000049	0.0000024	0.00000019	0.00000035	0.0000025	0.00000004	0.00000040	0.0000019
Lithium	mg/kg/week	0.000078	0.00025	0.00053	0.000022	0.000064	0.000080	0.000031	0.00016	0.00026	0.000022	0.000046	0.000083
Manganese	mg/kg/week	0.0000012	0.000064	0.00031	0.000000042	0.000022	0.000089	0.0011	0.0042	0.025	0.00000013	0.0000089	0.000042
Mercury	mg/kg/week	0.0000000049	0.000000014	0.000000026	0.0000000010	0.0000000045	0.000000013	0.00000000062	0.0000000049	0.000000013	0.0000000013	0.0000000064	0.000000022
Phosphorus	mg/kg/week	0.0000066	0.0000	0.0000	0.0000034	0.000032	0.000087	0.0000017	0.0000032	0.0000052	0.00000088	0.000019	0.0001
Molybdenum	mg/kg/week	0.0000019	0.00031	0.00102	0.00000017	0.000040	0.00011	0.000000031	0.00000071	0.0000027	0.00000043	0.000059	0.00017
Nickel	mg/kg/week	0.0000059	0.00005	0.00023	0.00000021	0.000010	0.000034	0.000046	0.00040	0.0020	0.00000063	0.000005	0.00001
Selenium	mg/kg/week	0.0000005	0.00013	0.00039	0.0000034	0.000067	0.00025	0.0000012	0.000045	0.00013	0.0000047	0.000041	0.00019
Silicon	mg/kg/week	0.0012	0.0055	0.013	0.000094	0.0011	0.0026	0.00018	0.0012	0.0064	0.00026	0.00095	0.0018
Silver	mg/kg/week	0.000000049	0.00000014	0.00000026	0.0000000042	0.000000033	0.000000055	0.0000000062	0.000000055	0.00000013	0.0000000045	0.000000015	0.000000037
Strontium	mg/kg/week	0.00008	0.0011	0.0024	0.000017	0.00068	0.0031	0.00079	0.0032	0.0052	0.000049	0.00038	0.0015
Tin	mg/kg/week	0.00000049	0.0000014	0.0000026	0.000000042	0.00000033	0.00000055	0.000000062	0.00000055	0.0000013	0.000000045	0.00000015	0.00000037
Thallium	mg/kg/week	0.000000049	0.00000014	0.00000026	0.0000000042	0.000000033	0.000000055	0.000000034	0.000000090	0.00000015	0.0000000053	0.000000015	0.000000037
Uranium	mg/kg/week	0.000009	0.000035	0.000092	0.00000075	0.0000073	0.000013	0.000000064	0.00000055	0.000023	0.00000081	0.0000020	0.0000049
Vanadium	mg/kg/week	0.0000025	0.0000068	0.000013	0.00000021	0.0000021	0.0000047	0.00000031	0.0000027	0.000013	0.00000023	0.0000021	0.0000043
Zinc	mg/kg/week	0.0000049	0.000046	0.00025	0.00000042	0.000008	0.000030	0.0000071	0.00038	0.0085	0.00000053	0.0000066	0.000032

Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 100 Field barrel analysis/Loads_comparison/[Conc_Loadings_Telkwa Tenas_Field Barrel_1CT027.007_rtc_CP_CCM_05.xlsx

Appendix B: Summary of Barrel release rates (mg/kg/week)

Table B2: Element release rates for PAG zones estimated from field kinetics testing

Parameter	Units	PAG Zones								
		Barrel 3: Zone 1a			Barrel 4: Zone 2-3			Barrel 5: Zone 4PAG + Zone 5		
		min	Average	Max	min	Average	Max	min	Average	Max
Conventional										
pH	s.u.	7.9	8.2	8.5	7.4	7.9	8.3	7.9	8.1	8.8
EC	mS/cm	2000	13318	27200	1580	7857	19200	727	5471	8660
Alkalinity	mg $CaCO_3$/L	0.024	0.43	2.0	0.021	0.10	0.27	0.042	0.19	0.35
Major Ions										
Calcium	mg/kg/week	0.014	0.21	0.81	0.032	0.16	0.28	0.0011	0.30	0.55
Magnesium	mg/kg/week	0.016	0.29	1.61	0.081	0.33	0.93	0.0018	0.15	0.30
Potassium	mg/kg/week	0.0019	0.043	0.21	0.0015	0.010	0.025	0.0013	0.016	0.043
Sodium	mg/kg/week	0.140	7.1	38.3	0.017	1.1	4.4	0.034	1.4	3.9
Chloride	mg/kg/week	0.0018	0.049	0.23	0.0019	0.018	0.054	0.00049	0.018	0.051
Sulfate	mg/kg/week	0.49	15	79	0.41	3.5	11	0.11	3.9	9.3
Nitrate	mg/kg/week	0.00032	0.0028	0.0058	0.000057	0.0017	0.0079	0.000024	0.0065	0.023
Nitrite	mg/kg/week	0.0000035	0.0010	0.0059	0.0000038	0.000084	0.00031	0.0000020	0.00026	0.0011
Ammonia	mg/kg/week	0.00000042	0.0061	0.032	0.0000013	0.00039	0.0025	0.0000012	0.00040	0.0020
Dissolved Elements										
Aluminum	mg/kg/week	0.00000070	0.00004	0.00021	0.00000045	0.00001	0.000022	0.0000012	0.000010	0.000021
Antimony	mg/kg/week	0.000000070	0.0000036	0.000021	0.000000045	0.00000059	0.0000022	0.00000012	0.0000008	0.0000021
Arsenic	mg/kg/week	0.000000070	0.0000036	0.000021	0.000000045	0.00000059	0.0000022	0.00000012	0.00000087	0.0000021
Barium	mg/kg/week	0.00000023	0.0000074	0.000032	0.00000065	0.0000035	0.0000071	0.0000019	0.0000082	0.000015
Boron	mg/kg/week	0.000012	0.00042	0.0021	0.000014	0.00010	0.00022	0.000019	0.00013	0.00024
Cadmium	mg/kg/week	0.0000000035	0.00000018	0.0000010	0.0000000072	0.000000054	0.00000018	0.0000000049	0.000000062	0.00000021
Chromium	mg/kg/week	0.00000007	0.0000041	0.000021	0.000000045	0.0000010	0.0000041	0.00000032	0.0000011	0.0000025
Cobalt	mg/kg/week	0.00000012	0.000018	0.00009	0.0000062	0.00013	0.00060	0.00000012	0.000058	0.00021
Copper	mg/kg/week	0.00000016	0.0000073	0.000042	0.00000019	0.0000015	0.0000043	0.00000065	0.0000020	0.0000050
Iron	mg/kg/week	0.0000070	0.00036	0.00208	0.0000045	0.000059	0.00022	0.000010	0.000080	0.00021
Lead	mg/kg/week	0.000000035	0.0000019	0.000010	0.000000038	0.00000034	0.0000011	0.000000049	0.00000041	0.0000010
Lithium	mg/kg/week	0.000026	0.00034	0.00151	0.000023	0.00019	0.00051	0.000027	0.00019	0.00038
Manganese	mg/kg/week	0.0000037	0.0009	0.00433	0.00018	0.0017	0.0076	0.0000002	0.00066	0.00231
Mercury	mg/kg/week	0.00000000035	0.0000000059	0.000000021	0.00000000045	0.0000000037	0.0000000080	0.0000000012	0.000000006	0.000000010
Phosphorus	mg/kg/week	0.0000017	0.000045	0.00017	0.0000021	0.0000049	0.0000091	0.0000015	0.0000043	0.0000090
Molybdenum	mg/kg/week	0.000000055	0.000077	0.00046	0.000000061	0.0000023	0.000010	0.00000025	0.000011	0.000036
Nickel	mg/kg/week	0.0000013	0.000053	0.00025	0.000013	0.00014	0.00054	0.0000015	0.000080	0.00022
Selenium	mg/kg/week	0.0000033	0.00086	0.00566	0.0000013	0.000028	0.000099	0.0000029	0.000074	0.00020
Silicon	mg/kg/week	0.000090	0.0023	0.010	0.00016	0.00092	0.0017	0.00020	0.0012	0.0023
Silver	mg/kg/week	0.0000000070	0.00000036	0.0000021	0.0000000045	0.000000059	0.00000022	0.000000010	0.000000080	0.00000021
Strontium	mg/kg/week	0.00037	0.0068	0.032	0.00040	0.0021	0.0044	0.000031	0.0030	0.0052
Tin	mg/kg/week	0.000000070	0.0000036	0.000021	0.000000045	0.00000059	0.0000022	0.00000010	0.00000080	0.0000021
Thallium	mg/kg/week	0.0000000070	0.00000036	0.0000021	0.0000000057	0.000000059	0.00000022	0.000000010	0.000000082	0.00000021
Uranium	mg/kg/week	0.00000066	0.000043	0.00025	0.00000034	0.0000026	0.000010	0.0000008	0.0000041	0.000010
Vanadium	mg/kg/week	0.00000035	0.000018	0.00010	0.00000022	0.0000029	0.000011	0.00000049	0.0000040	0.000010
Zinc	mg/kg/week	0.00000070	0.000037	0.00021	0.000017	0.00016	0.00063	0.0000032	0.000078	0.00027

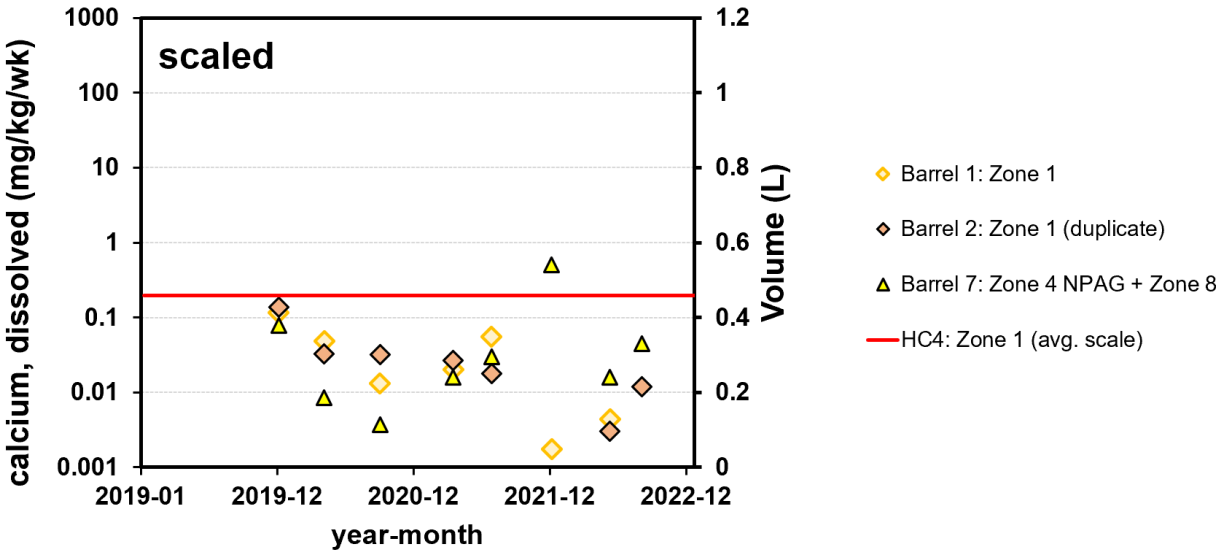
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Appendix B: Summary of Barrel release rates (mg/kg/week)

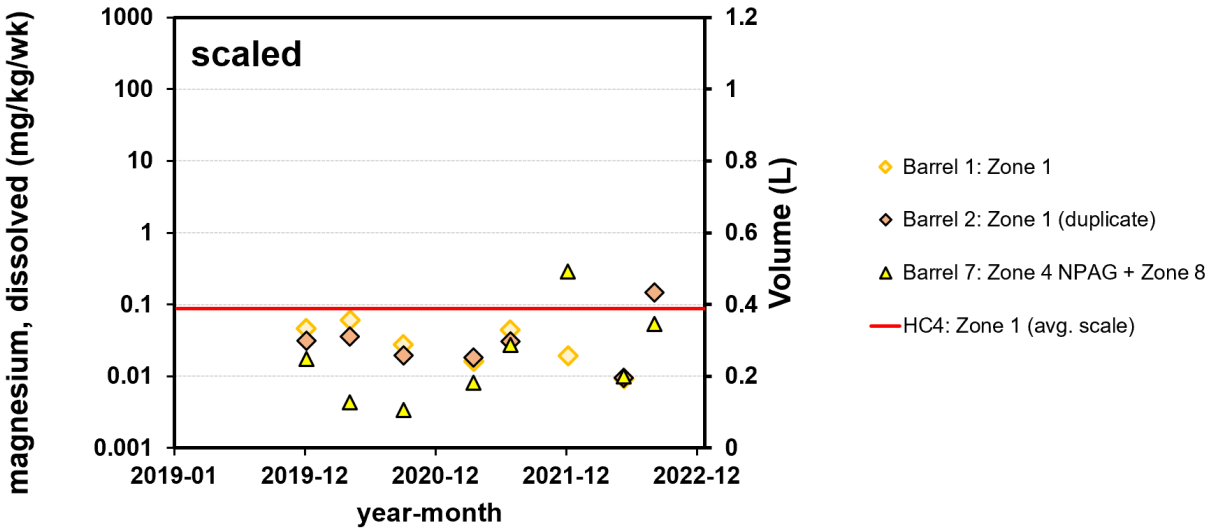
Table B3: Element release rates for overburden estimated from field kinetics testing

Parameter	Units	Overburden		
		Barrel 8: Overburden		
		min	Average	Max
Conventional				
pH	s.u.	7.7	8.1	9.1
EC	mS/cm	29	896	2320
Alkalinity	mg $CaCO_3$/L	0.027	0.23	0.55
Major Ions				
Calcium	mg/kg/week	0.0079	0.11	0.37
Magnesium	mg/kg/week	0.0046	0.051	0.15
Potassium	mg/kg/week	0.00028	0.0041	0.018
Sodium	mg/kg/week	0.0033	0.034	0.10
Chloride	mg/kg/week	0.000089	0.008	0.037
Sulfate	mg/kg/week	0.021	0.37	1.2
Nitrate	mg/kg/week	0.0000014	0.0025	0.012
Nitrite	mg/kg/week	0.00000028	0.00014	0.00061
Ammonia	mg/kg/week	0.0000014	0.000022	0.000080
Dissolved Elements				
Aluminum	mg/kg/week	0.00000018	0.0000023	0.0000059
Antimony	mg/kg/week	0.000000037	0.00000024	0.00000070
Arsenic	mg/kg/week	0.00000014	0.0000013	0.0000044
Barium	mg/kg/week	0.0000027	0.000039	0.00011
Boron	mg/kg/week	0.0000059	0.000034	0.00010
Cadmium	mg/kg/week	0.00000000089	0.000000020	0.000000060
Chromium	mg/kg/week	0.000000089	0.00000033	0.0000012
Cobalt	mg/kg/week	0.000000028	0.00000093	0.0000044
Copper	mg/kg/week	0.00000088	0.000033	0.00021
Iron	mg/kg/week	0.0000018	0.000012	0.000034
Lead	mg/kg/week	0.000000014	0.00000014	0.00000052
Lithium	mg/kg/week	0.00000039	0.0000034	0.000010
Manganese	mg/kg/week	0.000000081	0.00010	0.00032
Mercury	mg/kg/week	0.00000000089	0.0000000060	0.0000000172
Phosphorus	mg/kg/week	0.0000066	0.000042	0.000088
Molybdenum	mg/kg/week	0.00000029	0.0000031	0.0000084
Nickel	mg/kg/week	0.000000089	0.0000023	0.0000092
Selenium	mg/kg/week	0.000000075	0.0000525	0.00036
Silicon	mg/kg/week	0.0011	0.0064	0.016
Silver	mg/kg/week	0.0000000018	0.000000012	0.000000034
Strontium	mg/kg/week	0.000062	0.00055	0.0016
Tin	mg/kg/week	0.000000018	0.00000014	0.00000034
Thallium	mg/kg/week	0.0000000018	0.000000012	0.000000034
Uranium	mg/kg/week	0.00000048	0.0000042	0.000013
Vanadium	mg/kg/week	0.000000089	0.00000060	0.0000017
Zinc	mg/kg/week	0.00000018	0.000015	0.000090

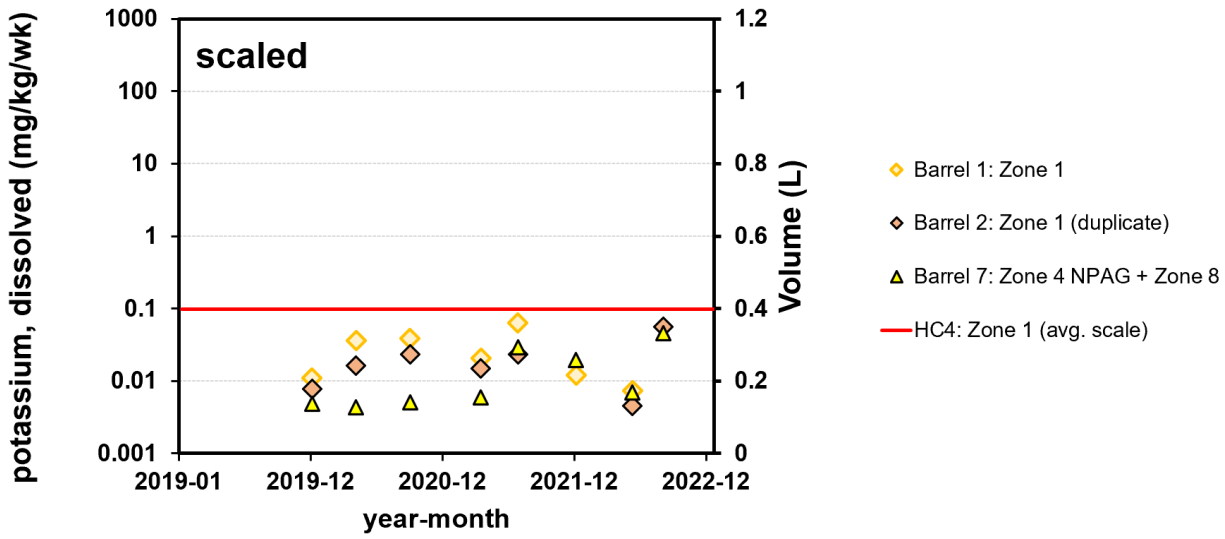
Appendix C Comparison of Scaled HCT Loads to Barrel Load Figures



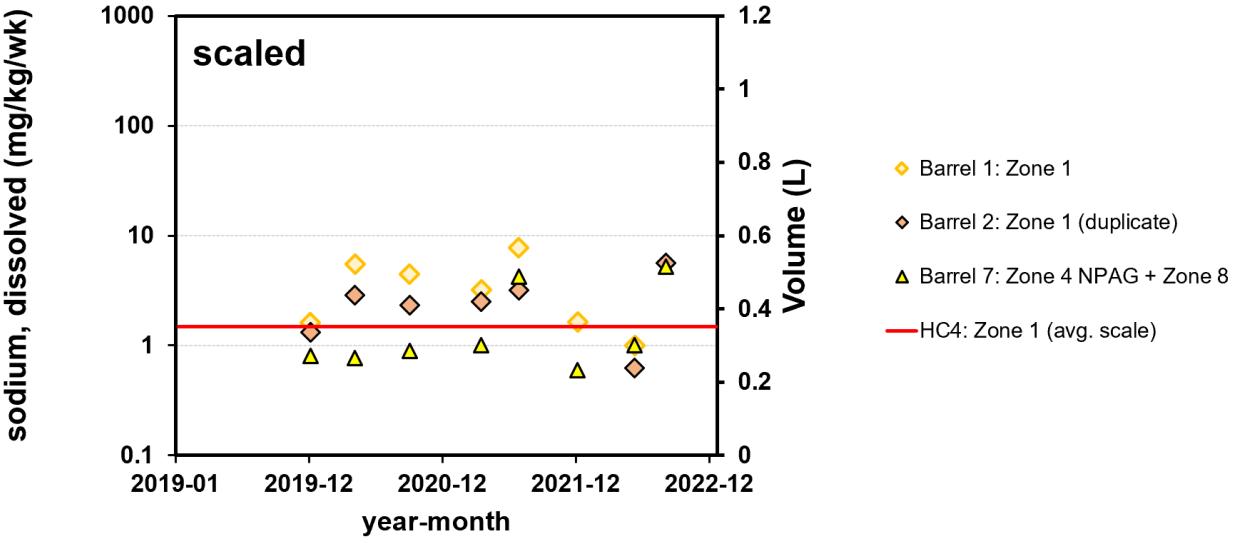
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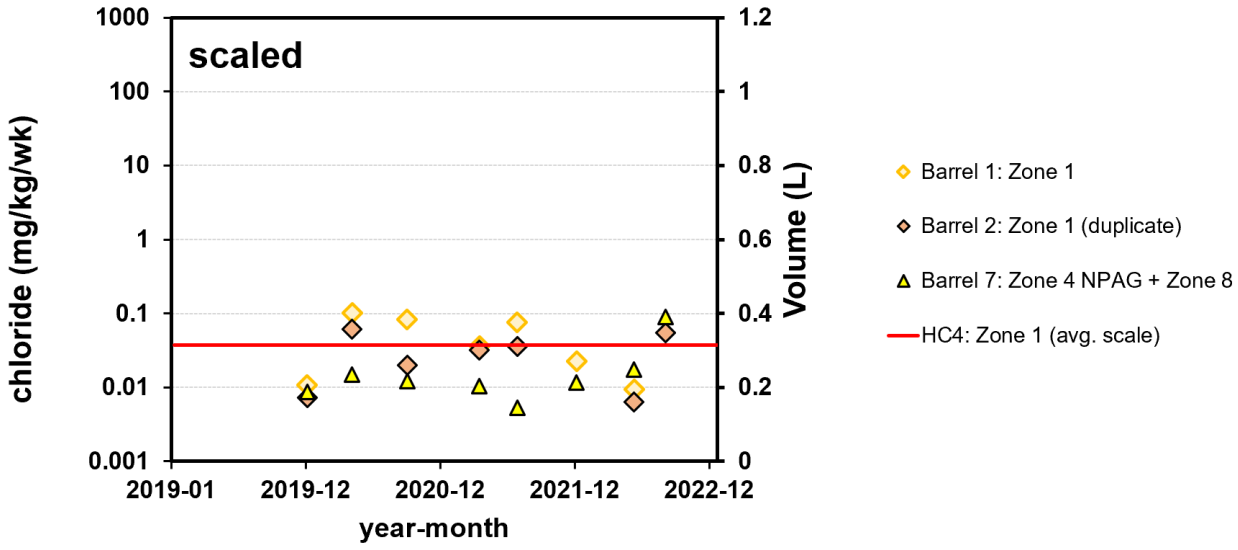
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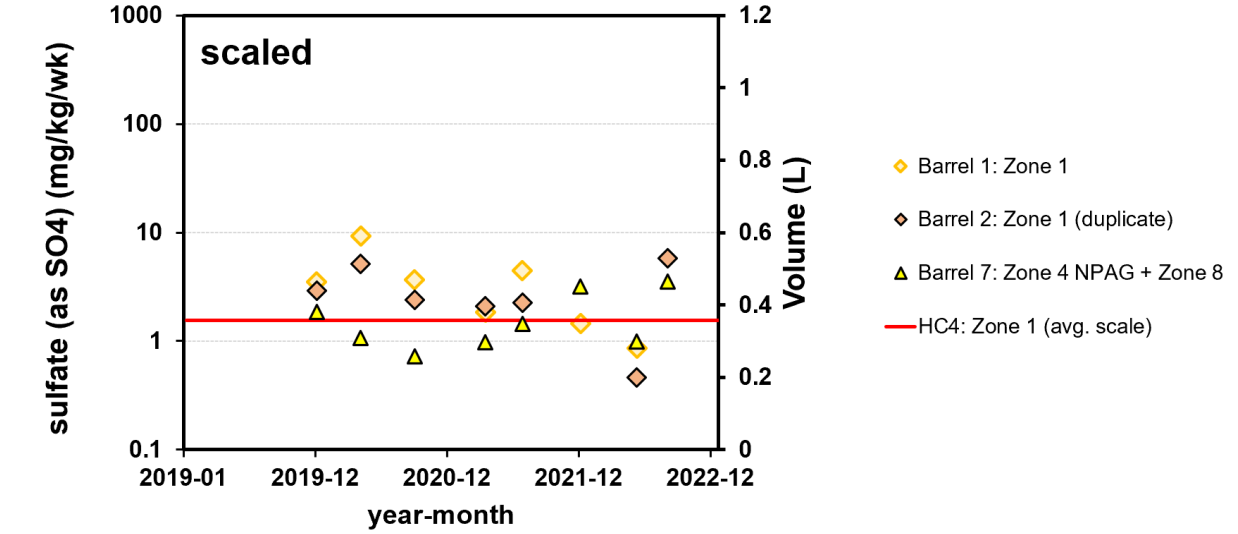
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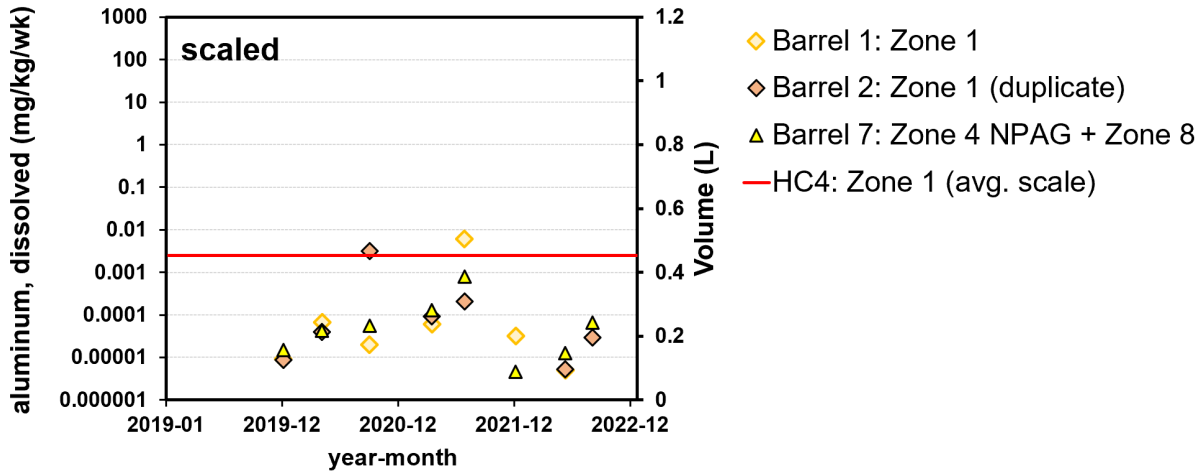


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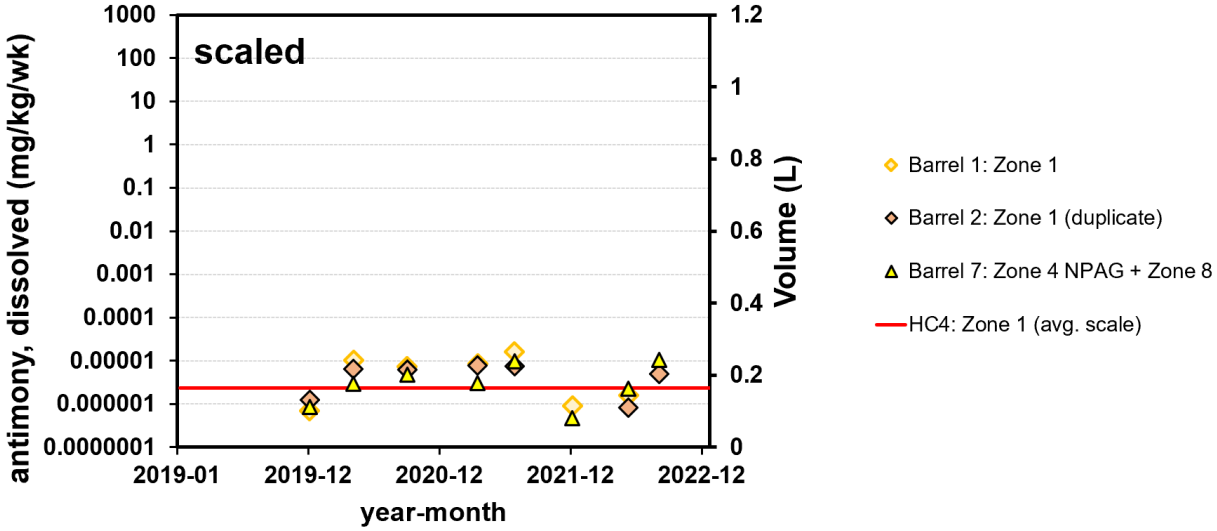


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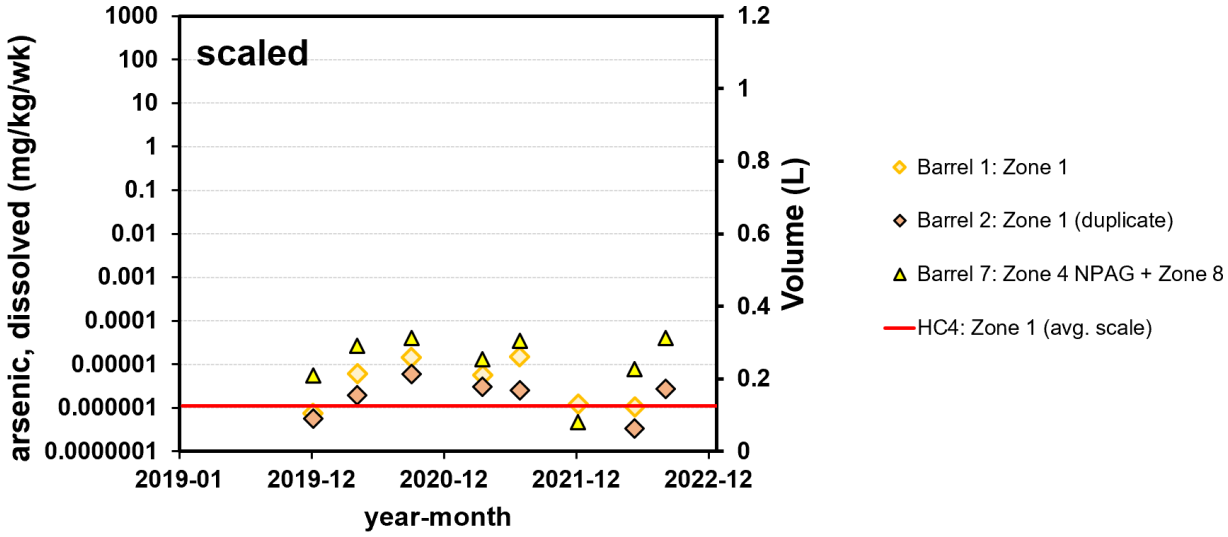
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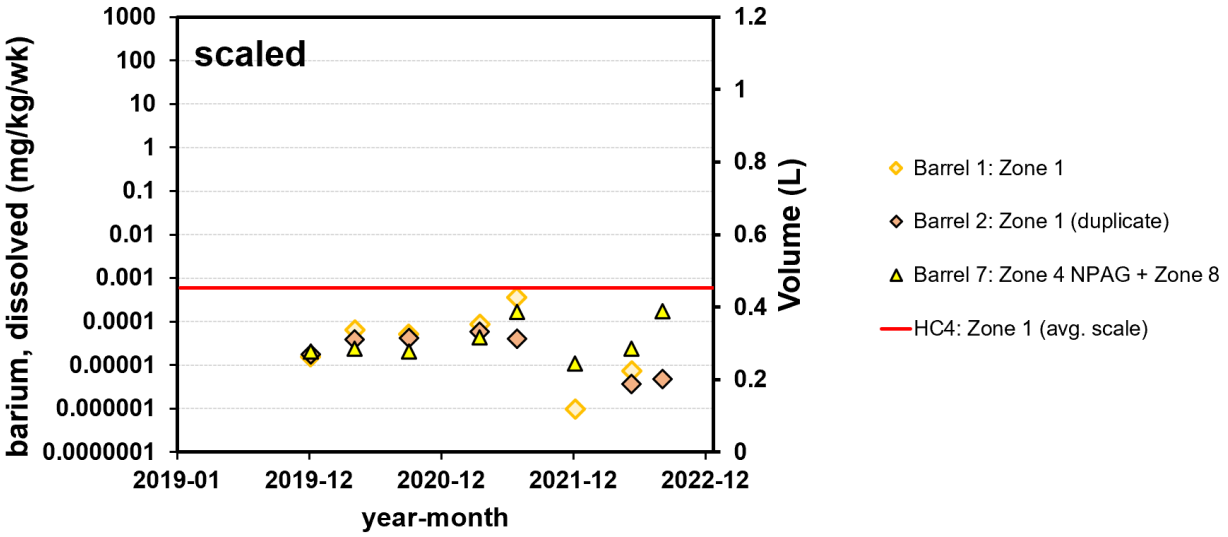
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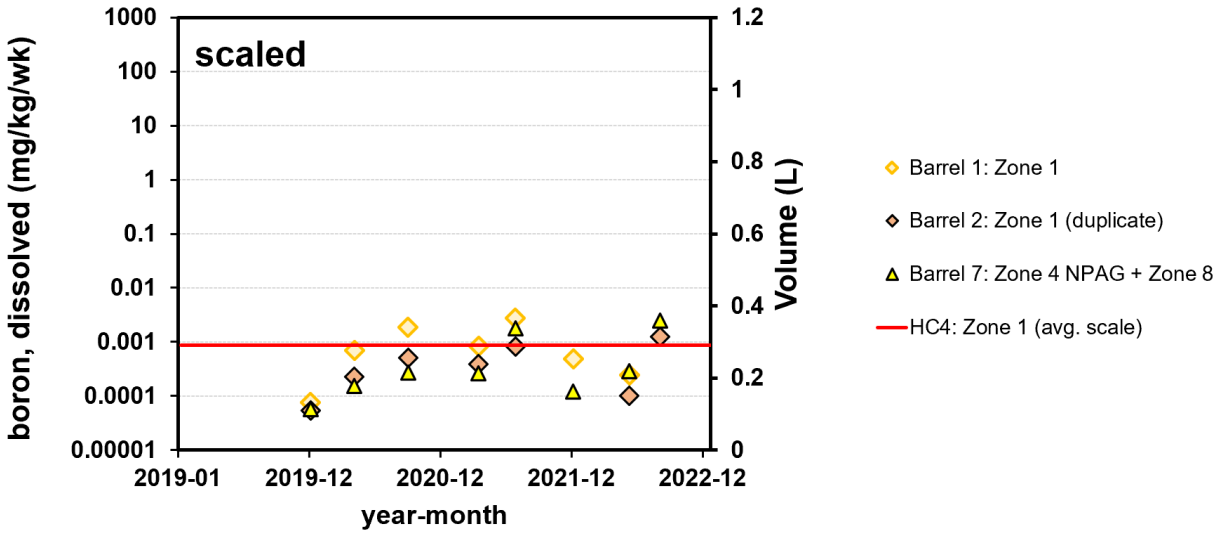
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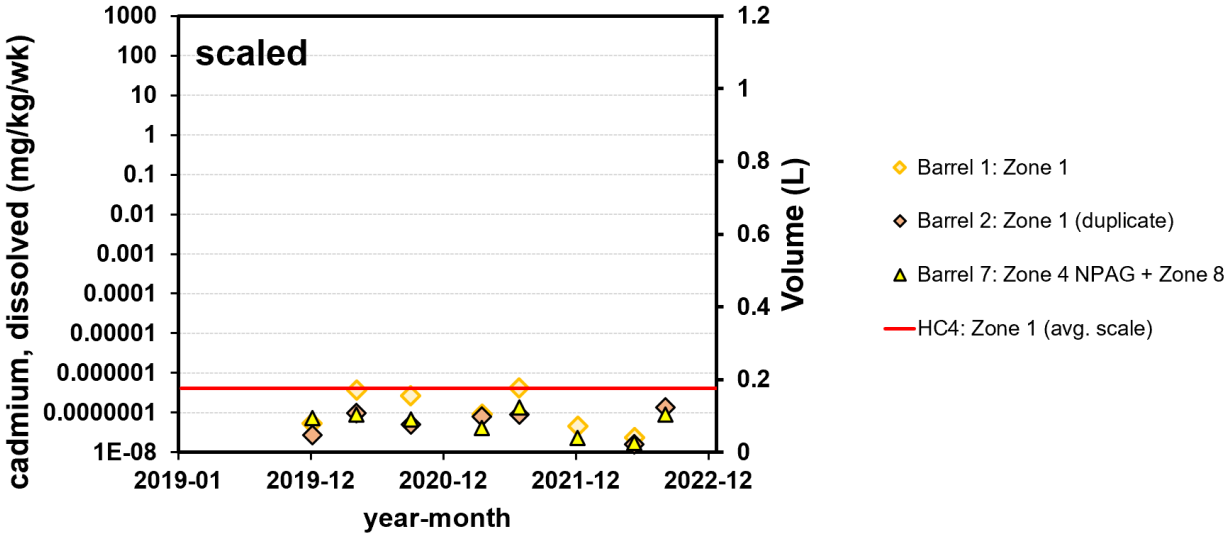
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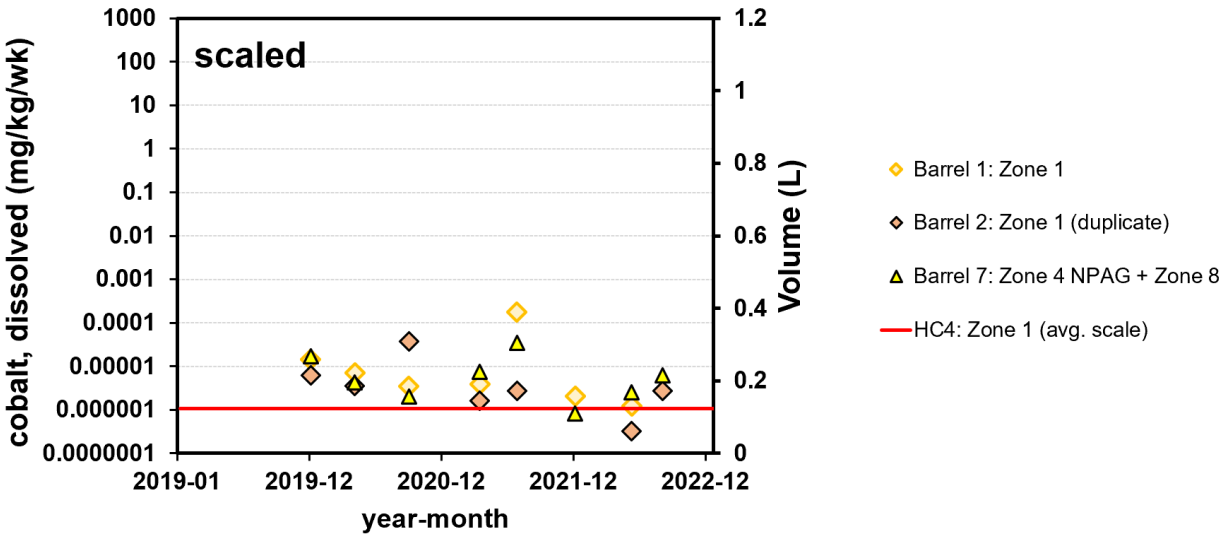
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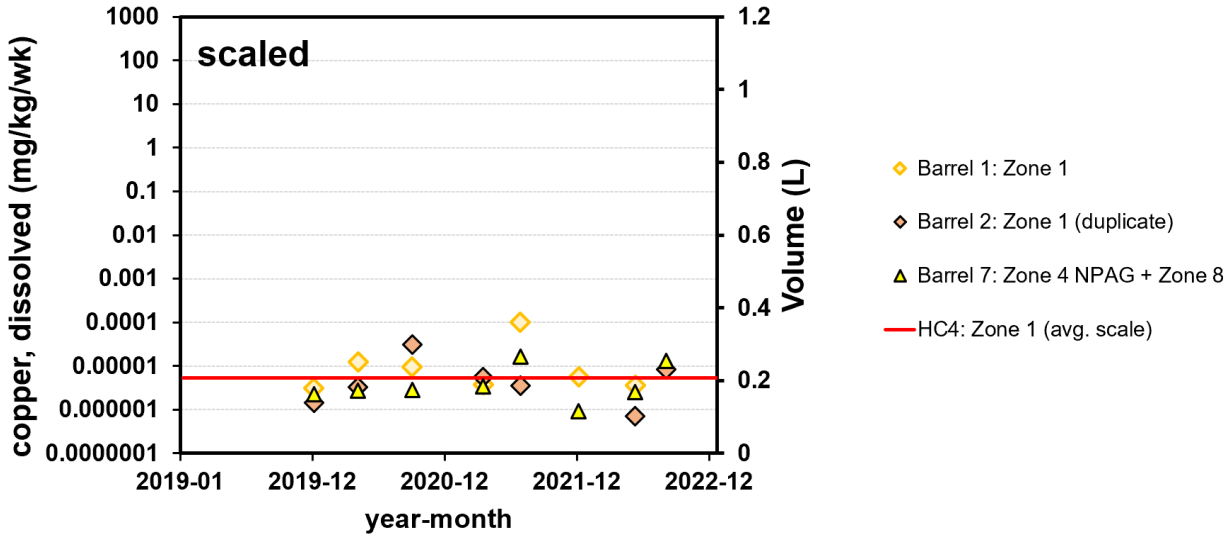
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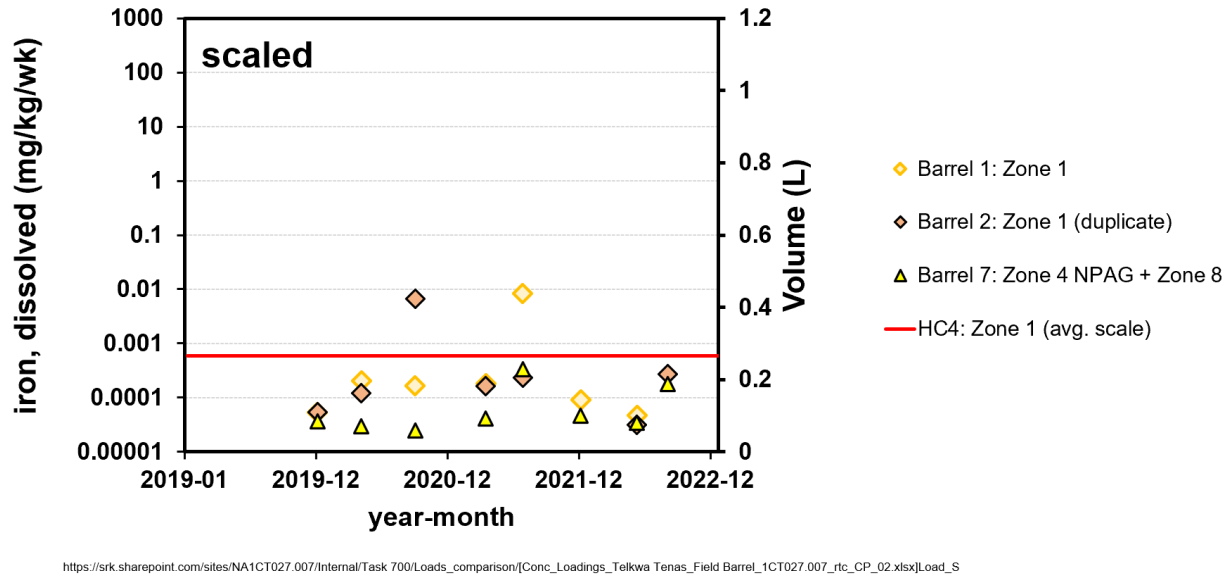
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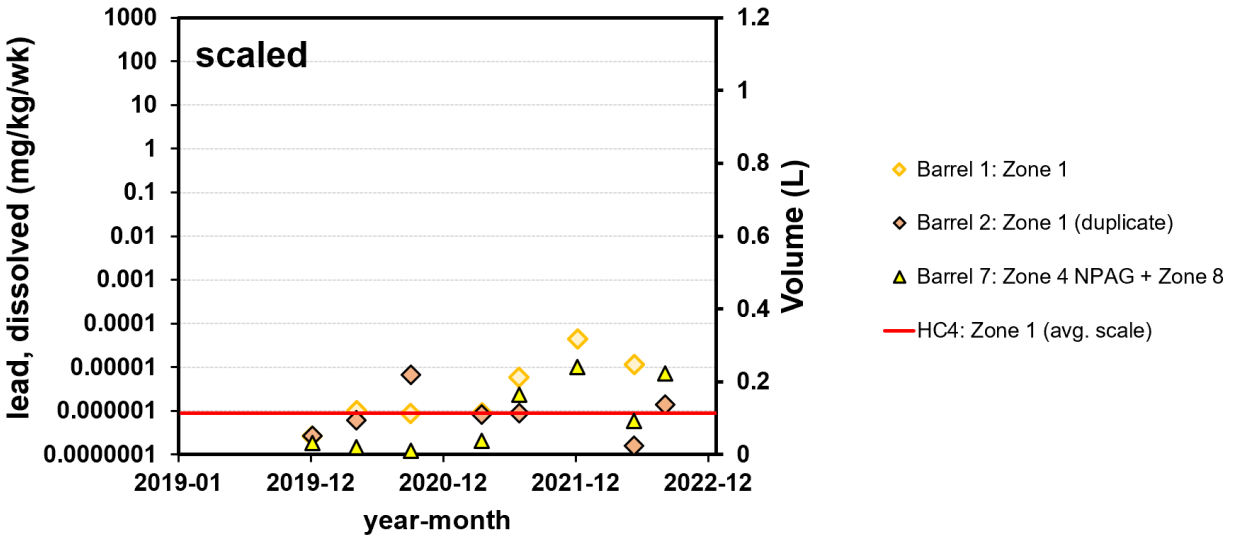
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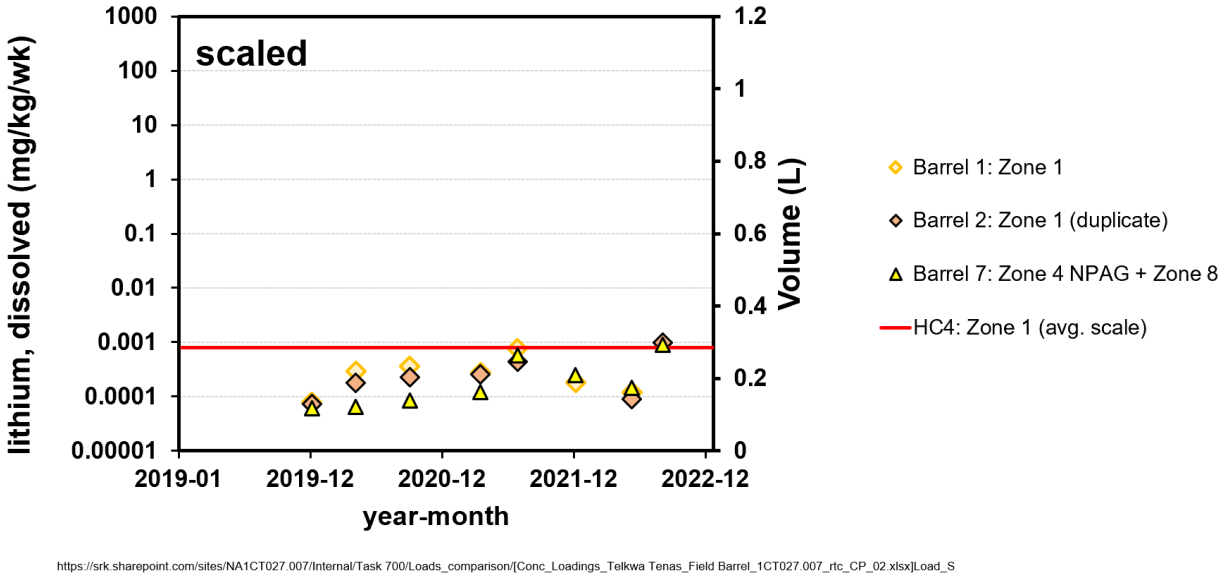
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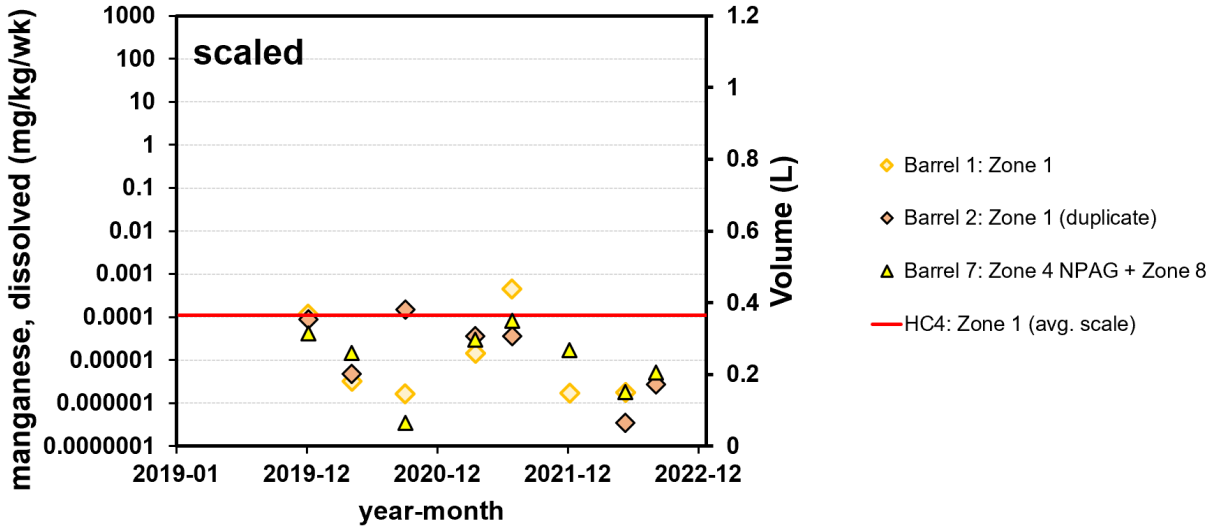
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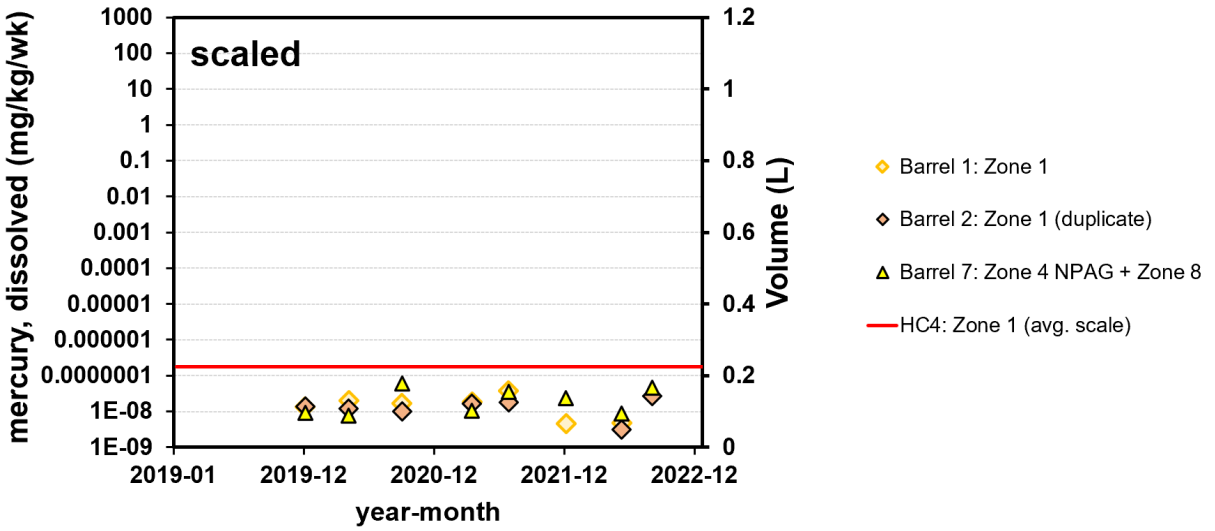


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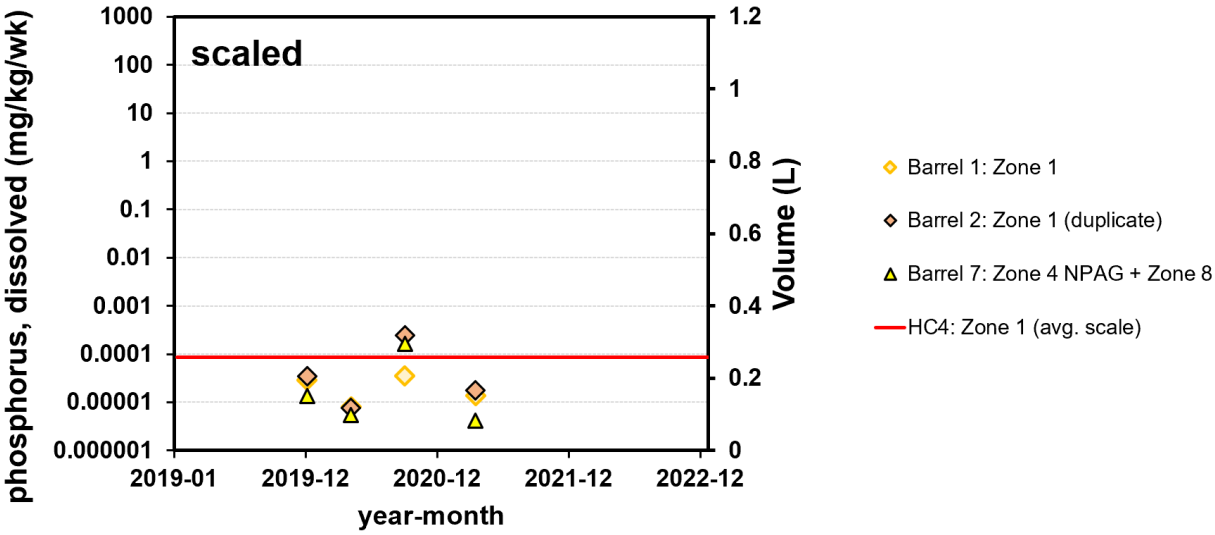


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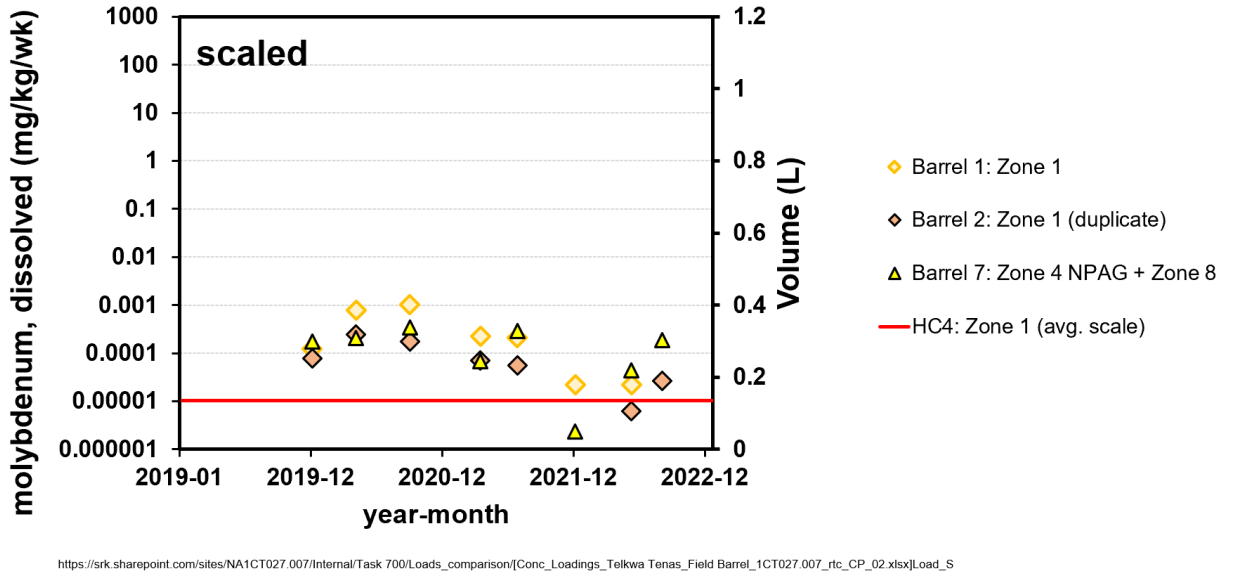
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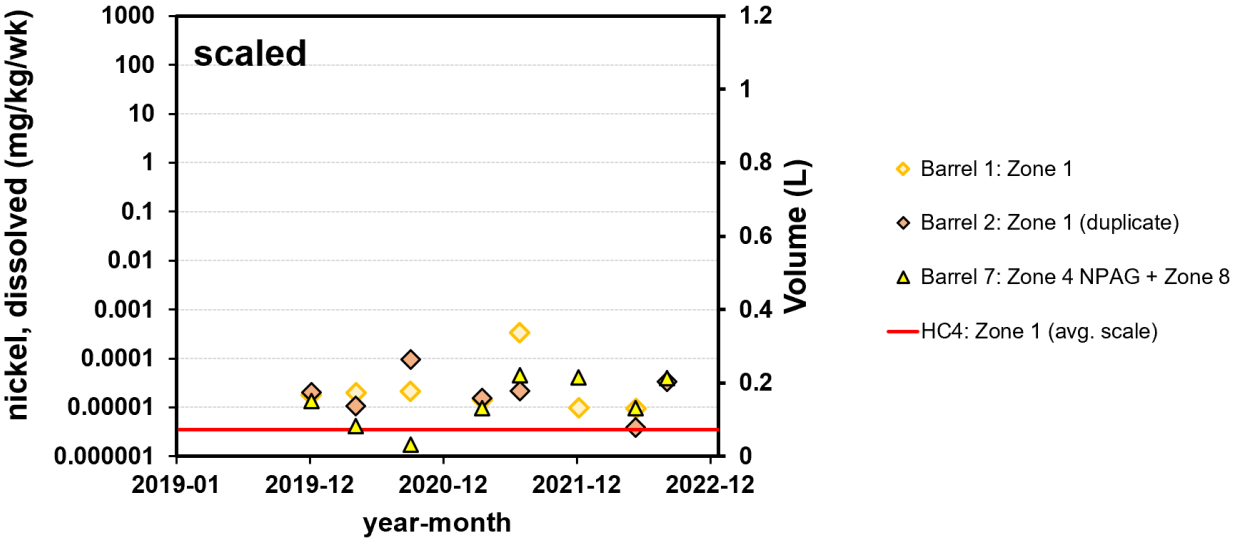
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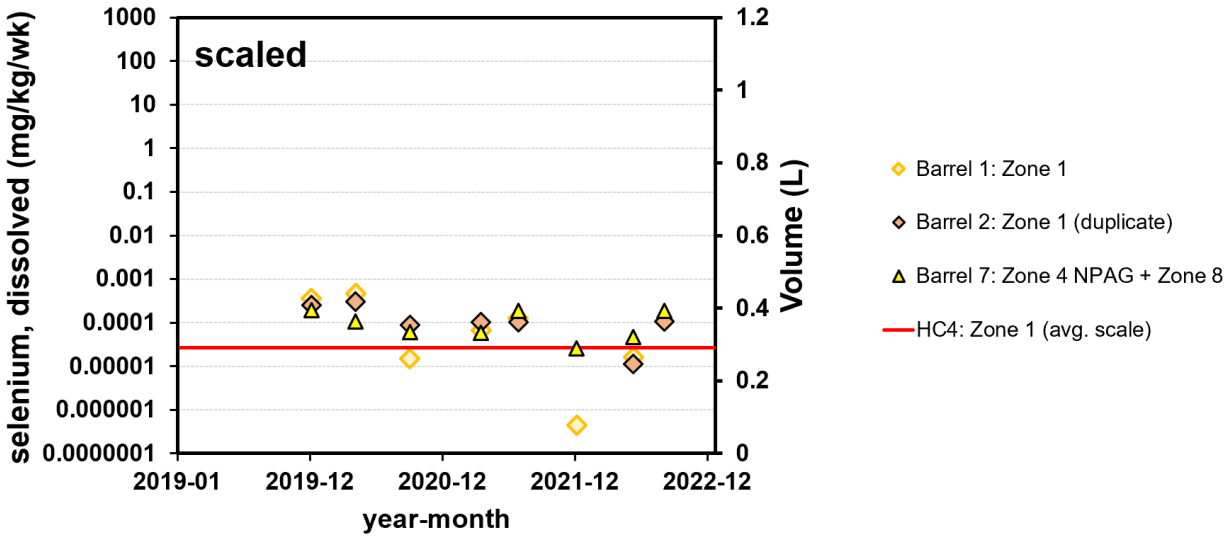
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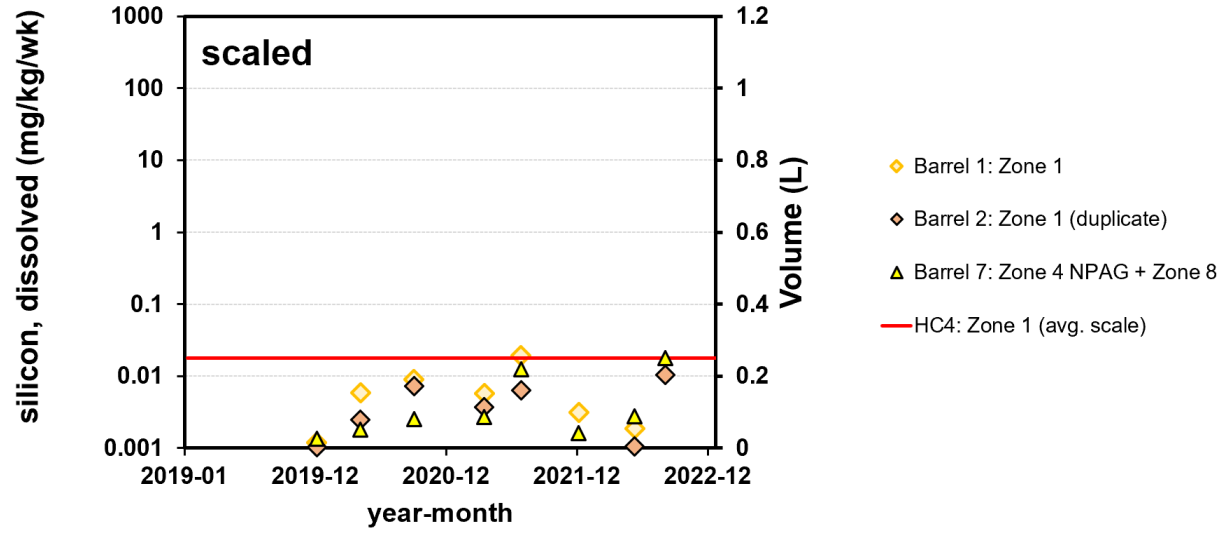
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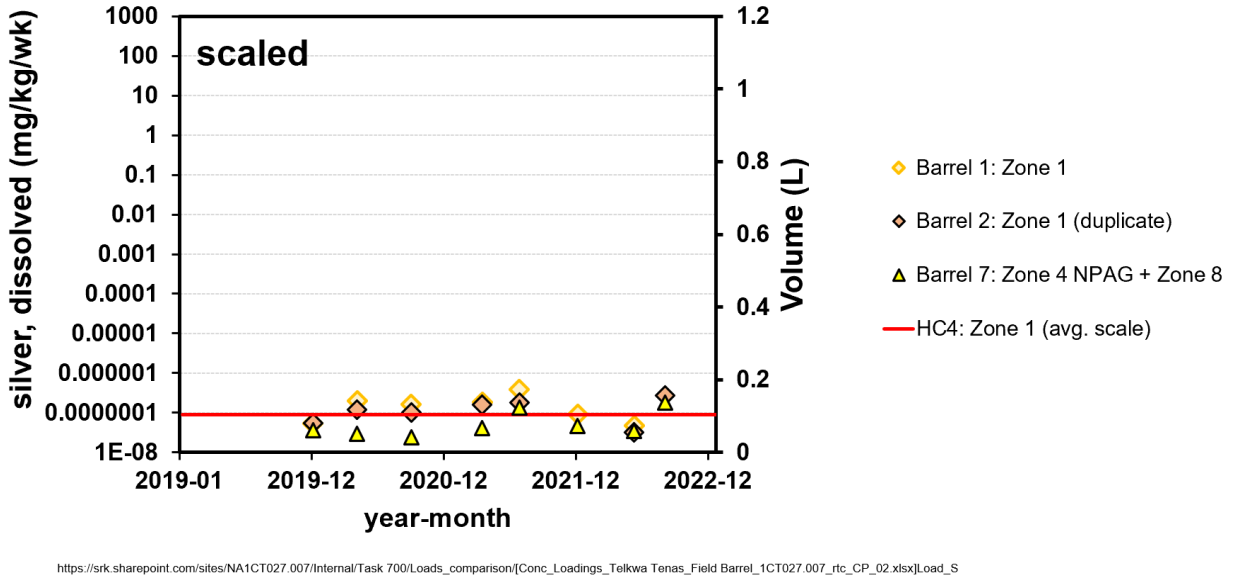
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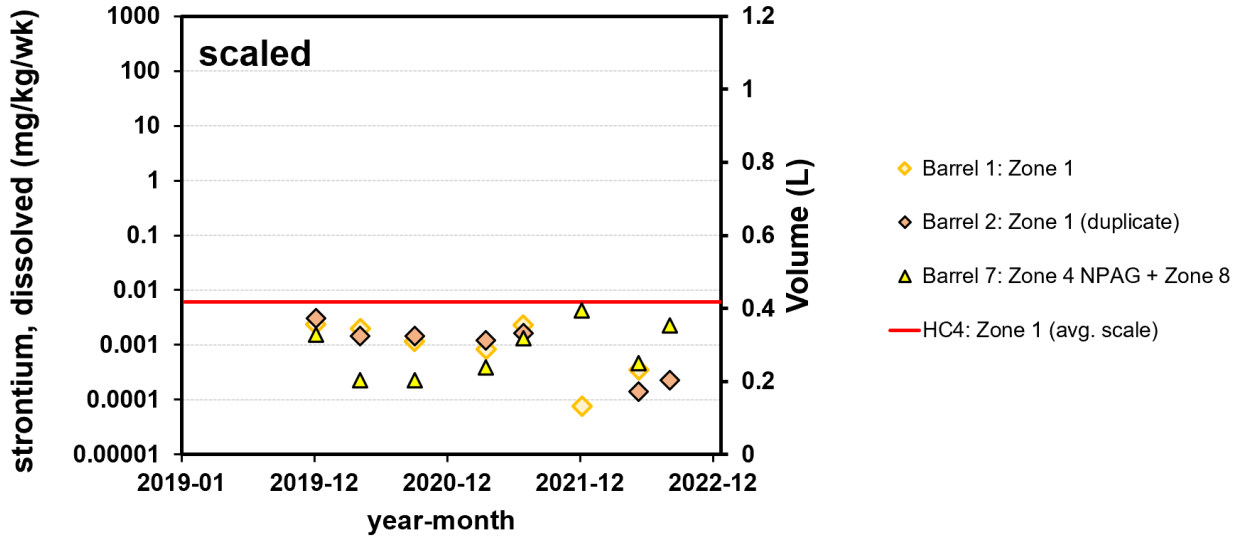
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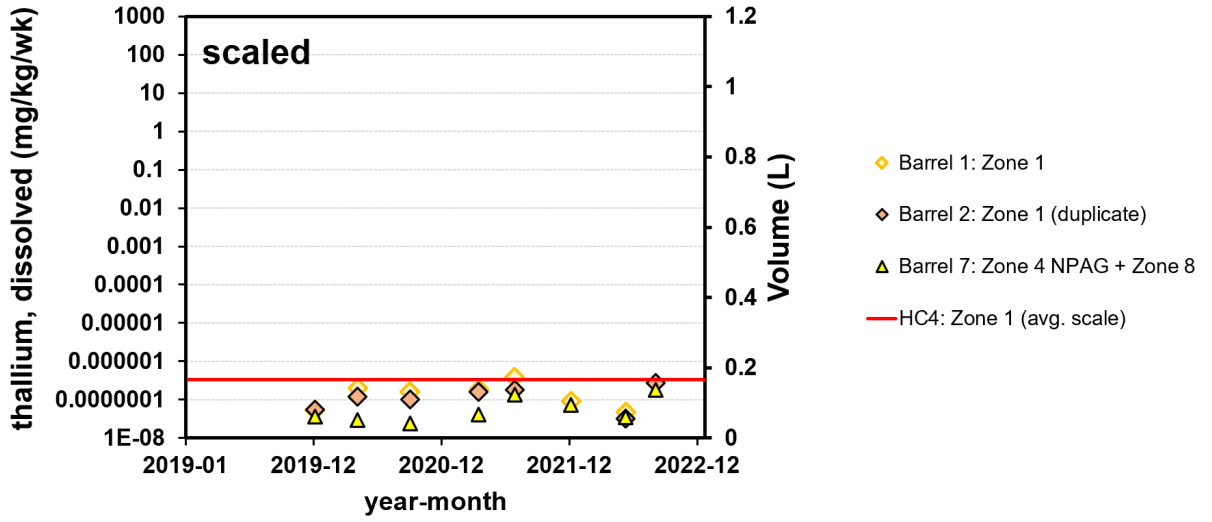
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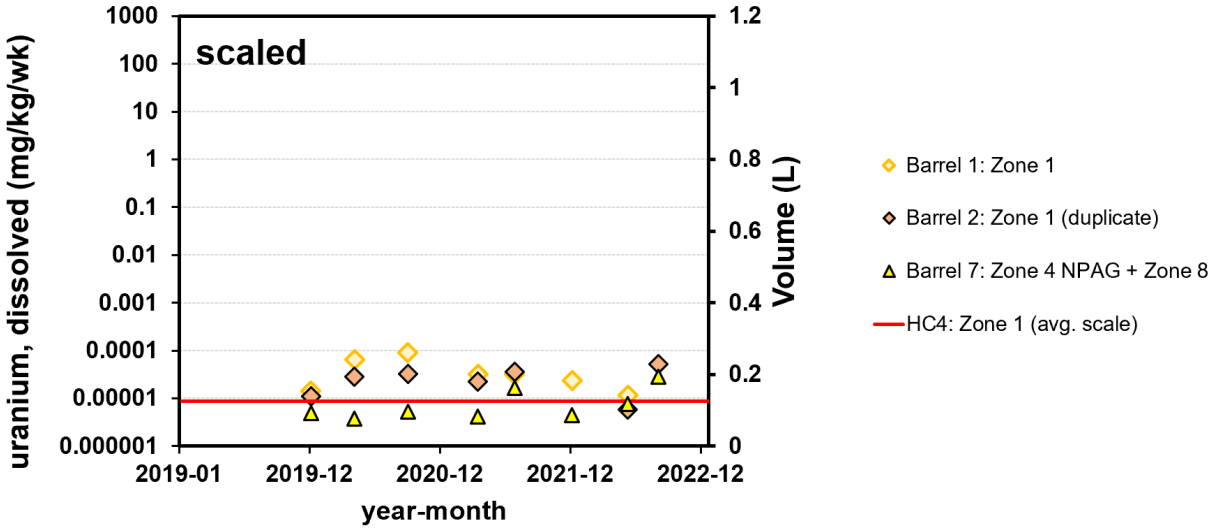
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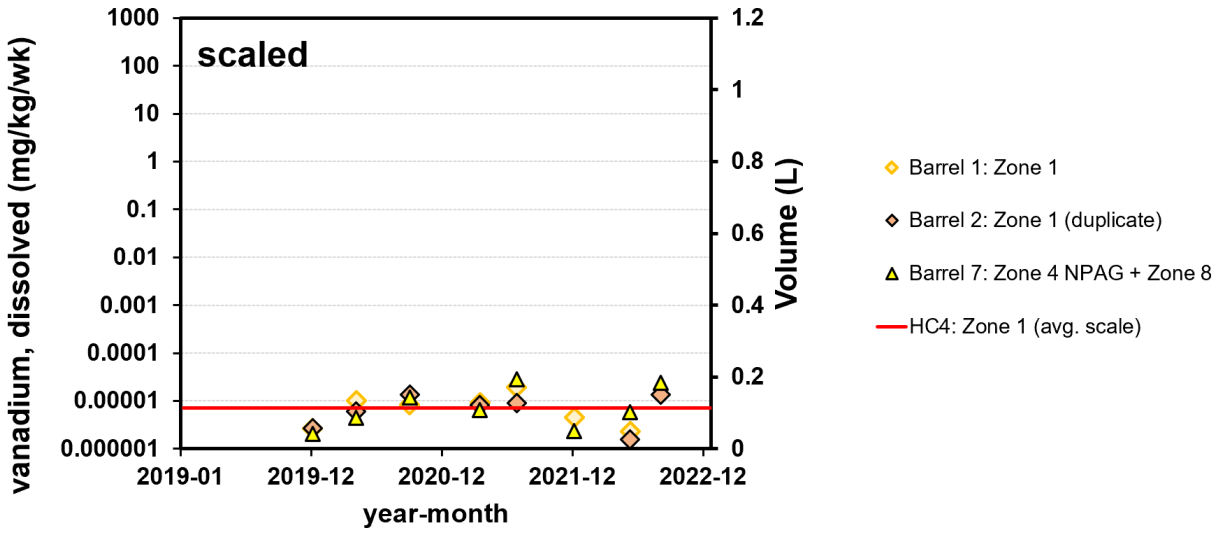
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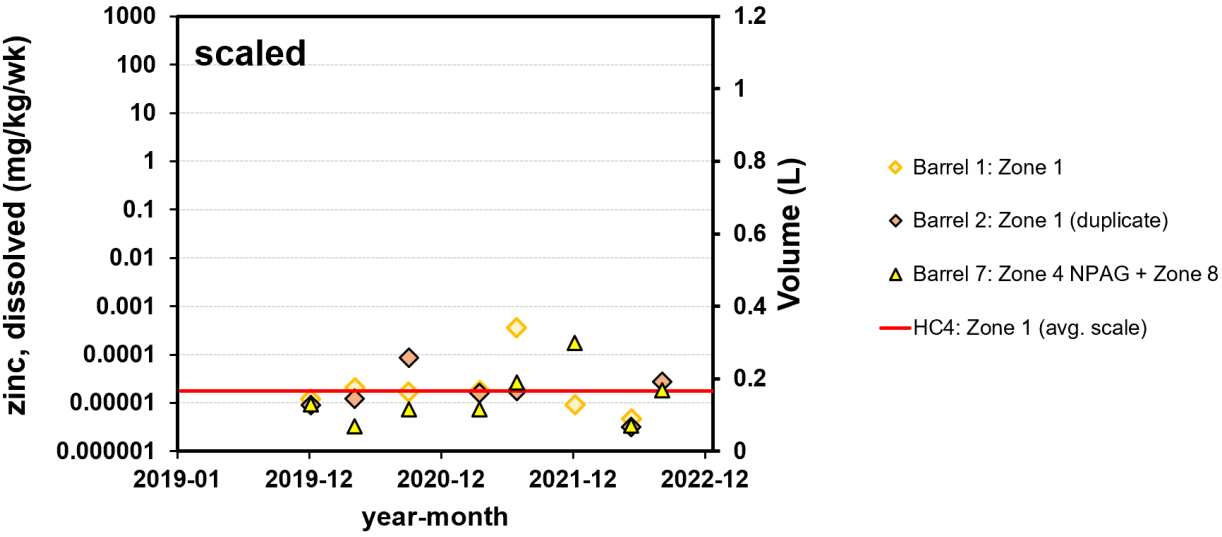
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APPENDIX 4: UPDATED WATER QUALITY MODEL SOURCE TERMS, SRK

FINAL

Updated Water Quality Model Source Terms

Tenas Project, British Columbia, Canada

Telkwa Mining Ltd.



SRK Consulting (Canada) Inc. ▪ CAPR002933 ▪ June 2024

srk consulting

FINAL

Updated Water Quality Model Source Terms

Tenas Project, British Columbia, Canada

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Useful Definitions

This list contains definitions of symbols, units, abbreviations, and terminology that may be unfamiliar to the reader.

EMA	Environmental Management Act
EMP	East Management Pond
EOM	End of Mining
FS	Feasibility Study
HCT	Humidity cell testing
MA	Mines Act
Non-PAG	Non-potentially acid generating
NMP	North Management Pond
PAG	Potentially acid generating
TML	Telkwa Mining Limited
TSS	Total suspended solids

1 Introduction

Telkwa Mining Ltd (TML) submitted an Environmental Assessment Certificate (EAC), application for the Tenas Project, located at the Telkwa Property, near the town of Telkwa, British Columbia in May of 2022. In support of the EA application, SRK Consulting (Canada) Inc. (SRK) developed geochemical source terms (SRK 2022a) that formed the basis for evaluating changes to water quality in downstream receptors. The source terms were based on humidity cell testing (HCT) results. In parallel to the geochemical characterization testing program that was used to support the EAC application, TML initiated a field barrel testing program in late 2019. Release rates from the barrel testing program were compared to the scaled results that formed the basis of the source terms that were developed to support the EAC application. The outcomes indicated that the scaled HCT release rates were underestimated for some constituents while overestimated for others. Updated source terms were developed using the barrel release rates to reflect release rates more accurately under field conditions.

This report describes the conceptual models, methods and assumptions used to derive the site water quality model source term inputs based on the field barrel testing results. The site wide water quality model development and results are described in SRK (2024a).

2 Project Background

2.1 Geological Setting

2.1.1 Bedrock Geology

The Tenas Project is located within the northeast/southwest trending Skeena Arch, which separates Jurassic-age sedimentary rocks of the Bowser Basin in the north from the Jurassic to Cretaceous-age sedimentary rocks of the Nechako Basin to the south. The coal-bearing sedimentary rock sequence of the Project is associated with the Lower Cretaceous age Skeena Group, and unconformably overlies the Jurassic-age Hazelton volcanic group, which will be below the proposed pit limit. A simplified stratigraphic column of the Project's deposit is presented in Figure 2-1.

Jurassic Hazelton Volcanic Group

The volcanic rocks include andesite, trachyte, and basalt with associated tuffs and breccias.

Lower Cretaceous Skeena Group

The Lower Cretaceous Skeena Group includes marine and continental sediments interbedded with coal seams, often correlated over long lateral distances. It is subdivided into four units (Units I through IV) and a unit of undivided sediments overlying the four units (Figure 2-1).

The economic coal seams in the Tenas area are located within Coal Zone 1 of Unit I and include two seams: C seam and 1 seam (upper and lower). Coal Zones 2 through 10, located in Unit III (Figure 2-1), are absent from the Tenas area. Units I through IV are summarized below.

- The Unit I consists of more than 100 m of fine to coarse-grained cross-bedded sandstone, conglomerate, siltstone, mudstone, and coal (coal zone 1). Overall, Unit I fines upward, from primarily conglomerate and sandstone to almost entirely carbonaceous mudstone, seatearth and coal (1A to 1G). The conglomerate and sandstone were deposited in braided channels and bars, and mudstone accumulated in floodplains. Thin coal seams formed in poorly drained, peat-forming backswamps, and seatearths formed under leaching conditions in less submerged areas. With denudation of the volcanic source area, braid plains were abandoned and extensive low-energy, peat-forming swamps were established, resulting in the formation of thick coal seams in the upper part of the Unit.
- The Unit II separates coal zone 1 and coal zone 2. It consists of up to 140 m of primarily monotonous silty mudstone, occasionally interbedded with beds of chert-rich, micaceous, bioturbated or cross-bedded sandstone. The sediments were deposited in a deltaic/shallow marine environment following a regional marine transgression. The mudstone accumulated in bays, and the sandstones in distributary channels and mouthbars. Locally, thin discontinuous peat beds formed in salt marshes.
- Unit III comprises about 90 m of chert-rich, micaceous sandstone, siltstone, and mudstone, and up to nine coal zones (coal zones 2 through 10). The sandstone and mudstone were deposited and biogenically reworked in a tidal flat environment; siltstone accumulated in a restricted, nearshore marine environment. Peat accumulated in freshwater coastal marshes which periodically prograded over tidal flats.

- Unit IV consists of approximately 150 m of a laterally extensive, bright green, chert-rich, chloritic sandstone or siltstone bed at the base, overlain by massive grey silty mudstone like that of Unit II. The basal sandstone is a transgressive lag deposit, and silty mudstone, the predominant lithofacies, was deposited in a quiet, nearshore, shallow marine environment.

Intrusions

Tertiary and Cretaceous-age porphyritic dykes and sills commonly intrude this sequence, the most notable of which includes a Tertiary granodiorite intrusion located on the north side of the Telkwa River. These intrusions are not present in the Tenas area.

Geological Structures

The sedimentary sequence in the Tenas area is folded into a syncline in which the gently (typically 10 to 20°) northeast-dipping western limb of the syncline subcrops on the western side of the pit area, while the moderately (40 to 45°) southwest-dipping eastern limb subcrops on the eastern side of the pit. Faulting is generally near-vertical, and can be subdivided into two main groups, one which strikes approximately northwest/southeast and the other which strikes approximately northeast/southwest. A few east/west striking faults have also been interpreted.

The Goathorn area is located within an outlier of the Lower Cretaceous Skeena Group. The structural geology is somewhat more complex than the Tenas area and is characterized by a complex series of sub-parallel north-south trending reverse faults, and to a lesser extent east-west, trending normal faults.

Northeast striking faults are related to emplacement of the Bulkley intrusions in the Late Cretaceous.

2.1.2 Surficial Geology

The surficial geology in the Project area consists primarily of two types of deposits, glacial clay- or silt-rich till, and sand and glaciofluvial sand and gravel outwash. At upper elevations and south of the proposed pit, the terrain is mapped as having bedrock outcrops to a limited extent or thin mantles of clay- and silt-rich tills deposits, between 3 m and 10 m thick. North of the proposed pit and towards Tenas Creek and Goathorn Creek, drillholes report thin mantles of clay- and silt-rich tills deposits, between 3 m and 10 m thick underlain by a thick sand and gravel outwash deposit that can exceed 100 m.

Other types of deposits are present locally. Patches of glaciolacustrine deposits are scattered throughout the morainal landscape in low ridges and in depressions; the sediments comprise bedded and laminated mud, and minor sand and gravel (Clague 1984). Recent fluvial deposits form the narrow floodplains of Goathorn Creek and Tenas Creek, which are 40 m to 80 m deep incised into the subdued morainal landscape, and the wide floodplains of the Telkwa and Bulkley Rivers. The fluvial deposits range from extremely coarse, poorly sorted gravel on steep alluvial fans to moderately to well-sorted sand and mud on low-gradient floodplains (Clague 1984).

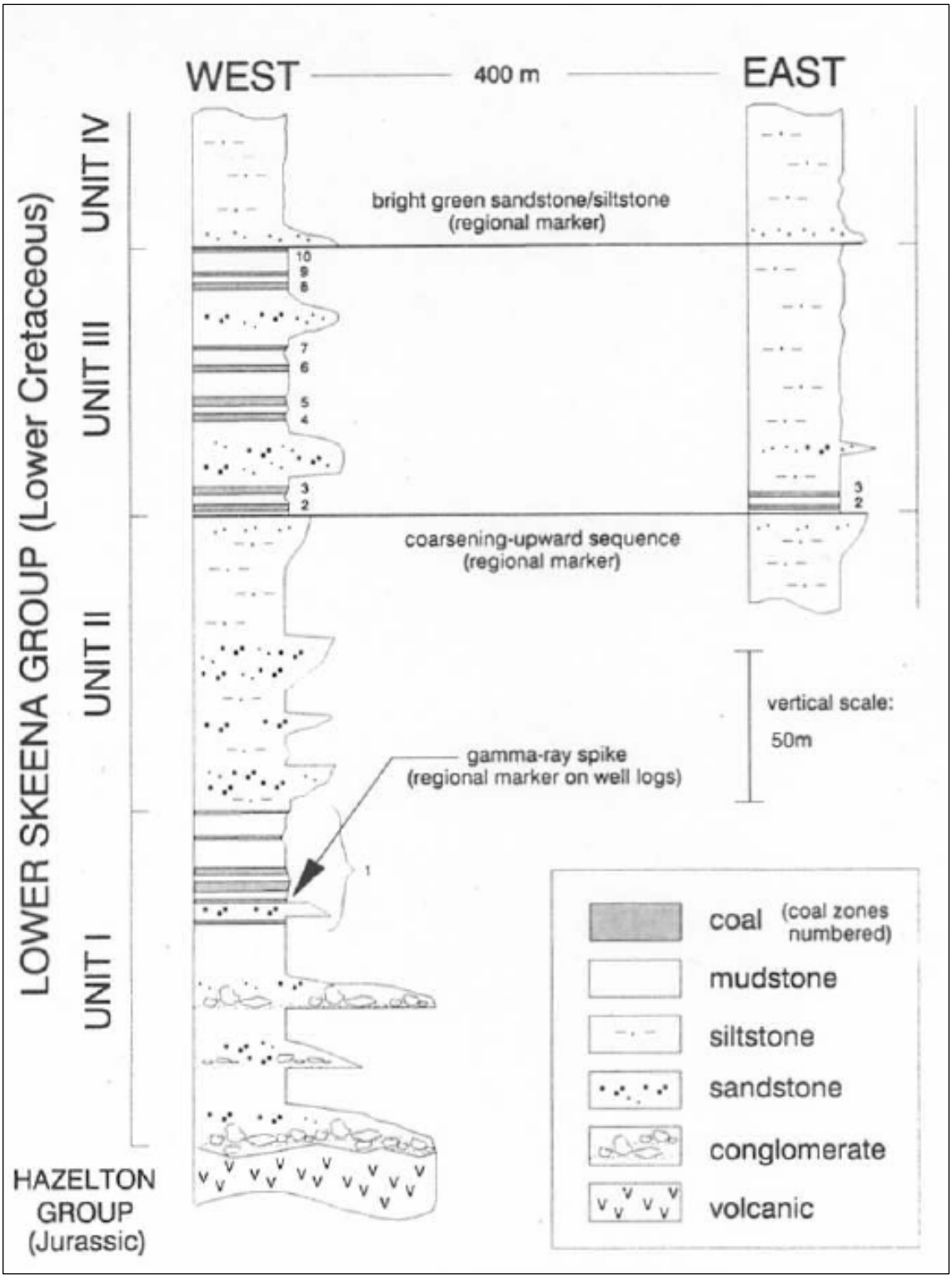


Figure 2-1. Stratigraphic Sequence of Lower Cretaceous Skeena Group Sediments.

Source: Telkwa Coal Ltd.

2.1.3 Material Zone Designations

Geochemical properties are stratigraphically constrained in coal deposits versus lithologically constrained. For example, the deposition environment of the Tenas Deposit includes marine and deltaic sedimentary sequences and rocks formed in these two different environments will be compositionally different. The deposit was demarcated into stratigraphic zones of sedimentary sequences between the mineable coal seams. The stratigraphic zones were further divided into additional zones if they had different distinct geochemical properties (e.g., Zone 1 and Zone 1a) or grouped if geochemical properties were similar between zones identified between coal seams (e.g., Zone 2 and Zone 3). The stratigraphic zones and classification of PAG and non-PAG based on an NPR of 2.0 identified for the Project are presented in Figure 2-2.

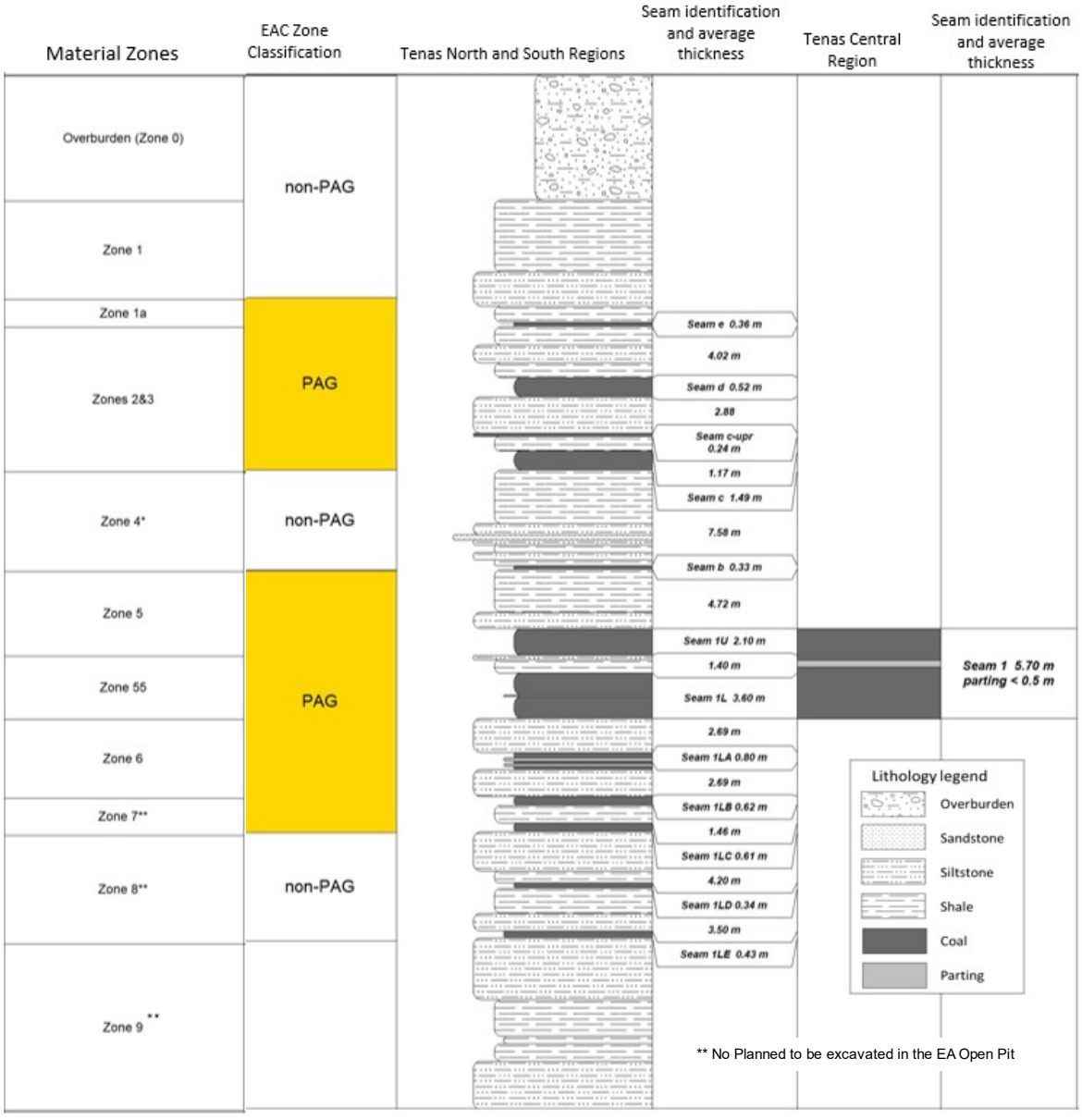


Figure 2-2. Tenas Deposit Stratigraphic Zones

2.2 Geochemical Characterization Study

Two geochemical studies have been completed to characterize the acid generating and metal leaching potential of the Tenas deposit:

- Norecol Dames and Moore (1999). Draft Report. Assessment of ARD Potential and Water Quality Predictions. Telkwa Coal Project.
- SRK (2022b). Telkwa Coal – Tenas Project Supplemental Geochemical Characterization.

The Norecol Dames and Moore (1999) study included the collection and analysis of over 700 samples. An additional 173 samples were collected as part of the supplemental geochemical characterization study (SRK 2022b). The supplemental samples were used to confirm the results of the 1999 study and correlate the test results to more up-to-date testing methods. For example, samples collected as part of the Norecol Dames and Moore (1999) study were analyzed for total sulfur only and neutralization potential was determined using the Sobek-NP (1978) method. Results from both studies were combined to form a robust geochemical characterization that is reported in SRK (2022b). The reader is referred to SRK (2022b) for additional detail on the geochemical characterization program including sample selection, collection, testing and results.

The outcomes of these studies indicated that a large volume of the rock to be mined from the Tenas deposit is potentially acid generating (PAG) and that acid generating potential is stratigraphically constrained in zones generally separated by coal seams. The geochemical properties of the deposit were therefore described based on mineable stratigraphical zones. The geochemical testing results indicate that all zones contain some PAG rock; however, there are units that are predominantly PAG versus non-PAG. Based on the site-specific neutralization potential ratio of 2.0 (NPR) and the average bulk geochemical properties, the following zones were characterized as PAG and non-PAG:

- Non-PAG: Zone 1, 4 and 8;
- PAG: Zones 1a 2/3, 5, 55, 6 and 7.

The geochemical characterization results also indicate that coarse and fine processed rock are PAG and overburden samples tested are non-PAG, including construction materials.

2.3 Summary of Mine Material Management Plan

Mining of the Tenas deposit will produce mine rock and processed rock materials. Previous geochemical testing (Norecol Dames & Moore 1999) indicates that the coarse and fine processed rock and a component of the mine rock will be PAG, and management will be required. Management of mine rock and coarse and fine processed rock are summarized in the following sections.

2.3.1 Management of PAG Rock

In advance of, and during mining, TML proposes to progressively construct Management Ponds with a combination of excavation and embankments with buttresses (Figure 2-3). The purpose of the management ponds is to store PAG and processed rock in saturated conditions preventing sulfide oxidation, limiting acidic drainage from occurring. Three management ponds will be constructed including the North, West and East Management Ponds. The North Management pond will be constructed first and is located north of the West Management Pond and is external to the open pit. The East Management is constructed next and is south of the NMP and external of the open pit. The last management pond, which is the West Management Pond which is constructed from a combination of excavation for the open pit for the North Phase and construction of an embankment external to the open pit.

PAG rock will first be placed in North Management Pond. PAG rock will be progressively placed in lifts and flooded as each lift is completed so that exposure of rock to atmospheric oxygen is minimized. TCL is proposing to place PAG rock including processed rock underwater before it becomes acid generating.

Once the storage capacity of the pond has been reached, storage will begin in the East Management pond and then the West Management Pond. The three management ponds will be independent of one another allowing different water levels and PAG material levels in each of the ponds as conditions require. The Management Ponds will be maintained with at least a two-metre water cover once PAG material disposition has been completed.

2.3.2 Management of non-PAG Rock and Overburden

Non-PAG rock will be used to progressively backfill the open pit during operations and for constructing portions of the embankments and buttresses for the Management Ponds and Control Ponds. Some non-PAG rock will also be used to cap PAG material in the management ponds once the PAG material has reached its design elevation. Non-PAG rock will be placed in lifts into water, keeping the water level at least 1 metre above PAG rock and at or below the non-PAG placement platform. A 1.5 metre thickness was selected for non-PAG as this is below the expected change in water levels during the Post-closure phase so that this material is never above water.

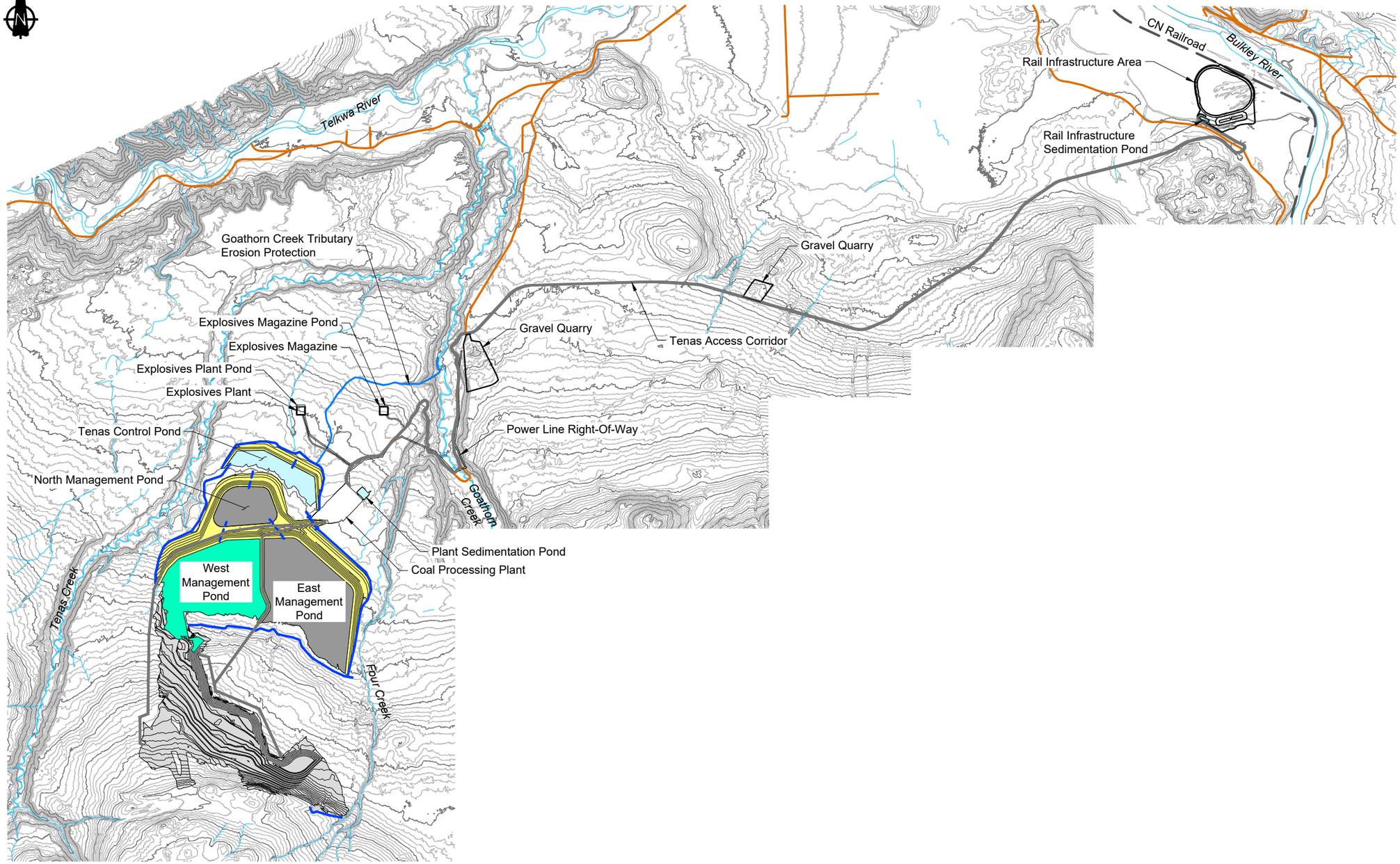
Overburden will be stored in the buttresses during operation and used as a cover material over non-PAG rock placed in the management ponds.

2.3.3 Management of Processed Rock

Coarse and fine processed rock materials are expected to be PAG and will also be placed in the Management Ponds with the PAG rock (Figure 2-3).

2.3.4 Open Pit Walls

Most of the open pit will be backfilled during the Operation phase. However, a small portion of the hanging wall will exist at post-closure. Meteoric water contacting the open pit walls will report to the end pit lakes, with one of them draining northwards by gravity and mix with Management Pond water prior to discharging into the surrounding environment while the other one discharges to Four Creek once its water quality meets regulatory requirements. Until this time, this end pit lake also drains toward the north.



LEGEND

- Water Management Feature
- Spillway
- Existing Watercourse
- Existing Road
- Proposed Road
- Dams and Buttresses
- Sedimentation Pond
- Active Management Pond
- Backfill / NAG Pile
- Covered Inactive Management Pond

NOTES

1. Contours shown at 5.0m intervals.
2. All dimensions shown in meters unless otherwise stated.
3. Pile designs by SRK Consulting Ltd.

REFERENCE

NAD83 UTM Zone 9.

0m 500 1000 1500 2000

srk consulting

TELKWA MINING LIMITED

SRK JOB NO.:	CAPR002933
FILE NAME:	1CT027.003 Overview.dwg

Tenas Project

Geochemical Source Terms

Mine Site Facilities

DATE:	APPROVED:	FIGURE:
2024/05/1	MH	2-3

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3 Conceptual Model

3.1 Unsaturated Mine Rock & Processed Rock

Pyrite (FeS_2) is the main sulfide mineral in PAG rock and processed rock at the Project (SRK 2022b). Under natural conditions, pyrite is stable in bedrock where it is isolated from atmospheric oxygen. However, following blasting and excavation of the bedrock, pyrite in the rock mined will be exposed to atmospheric oxygen prior to being placed in the management ponds and will begin to oxidize producing sulfate, ferrous iron, and acidity (Rxn1).

$$FeS_{2\,(s)} + \frac{7}{2}O_{2\,(g)} + H_2O_{\,(l)} \leftrightarrow Fe^{2+}{}_{(aq)} + 2SO_4{}^{2-}{}_{(aq)} + 2H^+{}_{(aq)} \text{ (Rxn 1)}$$

Under oxidizing conditions, ferrous iron liberated during sulfide oxidation will subsequently oxidize to ferric iron in neutral pH producing additional acidity according to the following reaction:

$$Fe^{2+}{}_{(aq)} + \frac{1}{4}O_{2\,(g)} + 2\frac{1}{2}H_2O_{\,(l)} \leftrightarrow Fe(OH)_{3\,(s)} + 2H^+{}_{(aq)} \text{ (Rxn 2)}$$

Although oxidation of mine rock and processed rock for the Project will release acidity, acidic conditions are not predicted to occur immediately since these materials also contain carbonate minerals that will neutralize the acid according to the following reactions:

$$CaCO_{3(s)} + H^+{}_{(aq)} \leftrightarrow HCO_3{}^-{}_{(aq)} + Ca^{2+}{}_{(aq)} \text{ (Rxn 3)}$$

$$CaCO_{3(s)} + 2H^+{}_{(aq)} \leftrightarrow H_2CO_{3(aq)} + Ca^{2+}{}_{(aq)} \text{ (Rxn 4)}$$

Depletion calculations (SRK 2022b) indicate that the lag times to acid generation are on the order of years (>5 years based on the average bulk rock properties). The lag time to acid generation prediction based on HCTs was confirmed by the barrel testing results. Barrel 6, which is a composite sample of rock from Zones 6 and 7, became acid generating in October 2023, four years after the barrel program was initiated. SRK (2022b) indicated that these zones were non-PAG based on their average bulk geochemical properties. However, the weighted barrel 6's NPR (0.5) was more closely aligned with the minimum and P5 NPR observed for these zones (see Table 4 in SRK (2022b)). The lag times to the onset of acid generation based on the Zone 6 and 7 minimum NPRs ranged from 3 to 5 years.

TML proposes to place PAG rock identified by verification testing and processed rock in the management ponds under saturated conditions within an average of six months after blasting but no more than 12 months. Theoretically, this will limit sulfide oxidation (i.e., oxygen becomes a limited reactant in reaction 1 limiting oxidation of the PAG rock and coarse and fine processed rock precluding acidic conditions at the Project. However, any oxidation products that are produced prior to placement of PAG rock and processed rock underwater will be flushed and dissolve in water stored in the management ponds.

At closure TML will cap saturated PAG rock and coarse and fine processed rock in the management ponds with non-PAG rock. The non-PAG rock will be below the active water level in the management ponds and will be saturated. Any oxidation products that have accumulated on non-PAG rock surfaces will also be flushed when the rock is placed in the management pond.

3.2 Unsaturated Non-PAG Rock

Non-PAG rock that is not used in the management pond cover will be used to backfill the open pit and used in portions of the embankments and buttresses with approximately 50% remaining unsaturated in

post-closure. Under these conditions, the rock will continually oxidize according to Reaction 1 (see Section 3.1) producing oxidation products that will be dissolved in meteoric water contacting the rock. However, non-PAG rock contains more neutralization potential than acid generating potential and the sulfide is predicted to be consumed prior to the neutralization potential (SRK 2022b) and acidic drainage from exposed non-PAG rock will not occur. The non-PAG rock will provide a continuous source of element load under neutral conditions.

3.3 Overburden

Overburden that is stripped during mining will be mixed with unsaturated waste rock for use in the buttresses and open pit backfill. Overburden has been characterized as having low sulfur content (SRK 2022b) and is classified as non-PAG. The small amount of sulfide in the overburden will oxidize according to Reaction 1 producing oxidation products that will be solubilized by incident precipitation. Like unsaturated waste rock, the overburden will provide a continuous source of element load that is soluble under neutral conditions.

3.4 Open Pit Wall Rock Runoff

Mining of the Tenas Project will result in open pit walls that are exposed to atmospheric oxygen until they are progressively covered with non-PAG rock and/or overburden during the Operation phase with any remaining uncovered open pit walls being covered in the Decommissioning and Reclamation phase. Sulfides that are present in the open pit wall rock will oxidize according to reaction 1 (Section 3.1) producing sulfate, acidity, ferrous iron, and release of trace chalcophile elements. Soluble oxidation products will be flushed from exposed open pit wall surfaces in meteoric water contacting the wall rock.

The open pit will be progressively backfilled with non-PAG rock and/or overburden during operations reducing the exposure of open pit wall to atmospheric oxygen. Oxidation of open pit wall rock that is covered with backfill will be reduced by limiting oxygen ingress.

At closure, two end pit lakes will form in the backfilled open pit. A footwall will exist above the end pit lakes composed mainly of Zone 6 sedimentary rock. Based on the site-specific NPR criterion (2.0), this unit PAG; however, as discussed in Section 2.3.4, the majority of the exposed pit walls will be covered. The end pit lake will be a mixture of wall rock runoff, direct precipitation and runoff from non-PAG backfill.

The pit lake will drain by gravity and mix with the Management Pond before being discharged during closure.

3.5 Processed Coal Stockpile Runoff

Processed coal will be temporarily stored at the Rail Infrastructure area in two stockpiles prior to being transported from the site to Ridley terminals. While the processed coal is stored, it will oxidize but long-term oxidation is not a concern since processed coal will only be stored for short durations prior to being loaded into rail cars. Soluble load from the processed coal stockpiles will be collected in the Rail Infrastructure Sedimentation Pond to allow suspended solids to settle.

4 Source Term Derivation Methods

Consistent with SRK (2022b), source terms using the barrel testing results were developed in two ways: concentrations and load flushing rates. Unsaturated mine rock, overburden and wall rock runoff source terms were expressed as concentrations. Concentrations were estimated by scaling barrel testing results and mixing estimated annual loads in predicted annual volumes of water and evaluating if the predicted concentrations would be limited by secondary mineral precipitation. PAG rock, coarse and fine processed rock and some non-PAG rock will be stored permanently underwater in the management ponds. Solute produced through oxidative weathering once these materials have been exposed will be flushed from rock surfaces when they are placed in the management ponds. The source term for these materials is therefore represented by a flushing term in milligrams per bank cubic metre (mg/bcm) of rock, also estimated using scaled barrel testing results.

Processed rock (e.g., coal and rejects) barrels were not constructed since there was insufficient material available. Source terms for coal and rejects have therefore not been updated. The reader is referred to SRK (2022a) for the coal and reject source terms. The particulate concentrations source term has also not been updated since it is independent of kinetic testing release rates (i.e., it was derived based solid-phase static testing results) and is not included in this report. The reader is referred to SRK (2022a) for details on the derivation methods and results of these source terms.

The following subsections provide the inputs and assumptions for each of the source terms based on the barrel testing results.

4.1 Mine Rock Solute Release Rates

A key input into the source term calculations is the mine rock solute release rates. Barrels were constructed from rock representative of each rock zone and the barrel release rates were used to represent the release rates from individual rock zones. Composite samples for each barrel were prepared from excess sample stored at Bureau Veritas Laboratories in Burnaby, British Columbia. Sample, varying in mass from one to 110 kg were selected for use in the barrels until a minimum mass of 200 kg was achieved. Zones with insufficient sample mass to achieve 200 kg (e.g., Zone 4 PAG and Zone 4 non-PAG) were supplemented with sample from other zones with similar geochemical properties (SRK 2024b).

Leachate sampling from the barrels has been conducted intermittently since October 2019 until present. The source terms only consider samples collected until November 2023. Seven to nine samples have been collected from each barrel during this period. The monitoring results from these sampling events was used to estimate barrel release rates according to the following formula:

$$L_j = C_j * \frac{V}{m} / t \qquad \text{(EQ 1)}$$

Where:

L_j is the load of parameter j expressed in mg/kg/week

C_j is the concentration of parameter j in the leachate sample in mg/L

V is the volume of the sample in L

m is the total mass in the barrel in kg

t is the time between sample events in weeks

The average release rate calculated from each sampling event was used in the source term calculations. As noted in Section 3.1, Barrel 6 began to produce acidic leachate in October 2023. Release rates from this sampling event were not included in the average barrel release rate calculations since the conceptual model for the Project is rock will be managed to minimize acid generation and release rates under acidic conditions are not expected to occur.

As noted above, the barrels were constructed of crushed drill core. This results in the barrel samples having a higher reactive surface area in comparison to rock that will be blasted and used in the pit backfill or construction of the buttresses. Scaling factors were applied to the barrel release rates to account for this difference. Details of the scaling factors that were used are discussed in the following subsections.

4.2 Unsaturated Mine Rock and Overburden

4.2.1 Base Case Source Term

Unsaturated non-PAG rock and overburden will be used as backfill in the open pit as well as in construction of the management pond buttresses. The backfill will become partially saturated as the open pit floods at closure. Unsaturated portions of the backfill will continue to oxidize and produce soluble load that will be mobilized in meteoric water interacting with the mine rock.

Annual unsaturated mine rock concentrations were estimated as follows:

$$C_{j=\frac{L_{j,annual}}{Q_{annual}}} \quad \text{(Eq 2)}$$

Where: C_j is the concentration of constituent j

$L_{j,annual}$ is the annual load of constituent j released from exposed mine rock and/or overburden

Q_{annual} is the annual average flow contacting exposed mine rock and overburden

Source term concentrations using Equation 2 were estimated for the following timeframes:

- Pit Backfill
  - End of East Management Pond (EMP)
  - End of Mining (EOM)
- Buttresses
  - End of North Management Pond (NMP)
  - End of EMP
  - End of West Management Pond (WMP)

These periods were selected to evaluate changes to water quality throughout the life of mine (LOM) at key stages of the mine development. In the source term calculations, mine rock and overburden present in the above timeframes was assumed to be unsaturated and produce soluble load. In reality, a portion of the waste rock will become inundated as the pit is progressively backfilled. This assumption results in a conservative estimate of the pit backfill and buttress drainage water quality.

The mine plan indicates that the buttresses will be constructed using overburden and mine rock sourced from Zones 1 and 4. Table 4-1 provides a summary of the cumulative mine rock and overburden volumes and tonnages associated with each of the model timeframes. Mine rock tonnages were estimated using an assumed density of 2.55 grams per bank cubic centimetre (g/bcc) and a density of 2.0 g/bcc was assumed to estimate overburden tonnages (TML 2024, pers. comm.). The respective barrel release rates were prorated in proportions estimated based on the volumes provided in Table 4-1 to estimate the unit solute release rates for the backfill and buttresses at each of the model timeframes. This rate was multiplied by the total mass at each timeframe to estimate the annual load produced.

As noted in Section 4.1, scaling factors were applied to the barrel release rates to account for testing and operational field differences. A generic scaling factor of 0.2, based on SRK's experience at other coal mines in British Columbia, was applied to account for grain size differences between the barrel tests and mine rock that will be produced during operations. Channelization and temperature scaling factors, which were applied to the HCT release rates (SRK 2022b), were not applied to the barrel release rates. Due to the size of the tests, the barrels will have a higher degree of flushing in comparison to rock stored in the backfill and in the buttresses and additional channelization is expected to occur under operational conditions. It is difficult to quantify the degree of flushing in the barrels and a channelization factor was conservatively not included in the barrel release rate estimates.

The barrels only contain 200 kg of material and will therefore be more susceptible to temperature variations in comparison to the rock and overburden used in the backfill and buttresses which will exhibit internal heating from sulfide oxidation. However, the average temperature of the water samples collected from the barrel tests was approximately 10°C. It is assumed a similar internal temperature will occur in the mine rock backfill and buttresses from oxidation of sulfide minerals and carbonaceous rock and release rates were therefore not corrected for temperature differences.

Table 4-1. Summary of Unsaturated Mine Rock & Overburden Quantities

Facility	Cumulative Volume (bcm)			Cumulative Tonnage (Mt)		
	Mine Rock		Overburden	Mine Rock		Overburden
	Zone 1	Zone 2		Zone 1	Zone 2	
Backfill						
End of EMP	279,370	812,529	500,000	0.7	2.7	1.0
EOM	13,194,743	6,667,067	8,727,775	34	17	17
Buttresses						
End of NMP	706,410	---	2,302,531	1.8	---	4.6
End of EMP	2,043,701	---	5,753,394	5.2	---	12
End of WMP	3,621,260	---	10,666,841	9.2	---	21

Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 500 Source Term Updates/01_Source_term_updates/[Telkwa_backfill_buttress_volume_summary_CAPR002933_mkh_r0.xlsx

The annual scaled release rate was divided by the annual average volume of water contacting unsaturated mine rock (SRK 2024a) using Equation 2 to estimate the annual average constituent concentrations in drainage from unsaturated mine rock and overburden. Predicted water qualities were entered into the publicly available speciation and mass transfer code PHREEQC v.3 (Parkhurst and Appelo 1999), developed by the United States Geological Survey (USGS), to evaluate mineral and gas phases that were supersaturated in solution. The mineral and gas phases included in the model are presented in Table 4-2. Supersaturated mineral phases were allowed to precipitate from solution and

sorption to ferrihydrite was also considered using the default values of Dzombak and Morel (1990). Sorption to ferrihydrite will limit parameters that form oxyanions (e.g., arsenic) and other ligands from remaining in solution.

Table 4-2. Model Equilibrium Phases

Mineral	Empirical Formula	Mineral	Empirical Formula	Mineral	Empirical Formula
Carbon Dioxide	CO_2 (g)	Chalcanthite	$CuSO_4 \cdot 5H_2O$	Calcium Molybdenum Oxide	$CaMoO_4$
Gibbsite	$Al(OH)_3$	Ferrihydrite	$Fe(OH)_3$	Nickel Hydroxide	$Ni(OH)_2$
Otavite	$CdCO_3$	Melanterite	$FeSO_4 \cdot 7H_2O$	Zinc Hydroxide	$Zn(OH)_2$
Brochantite	$Cu_4SO_4(OH)_6$	Anglesite	$PbSO_4$	Smithsonite	$ZnCO_3$
Copper Hydroxide	$Cu(OH)_2$	Birnessite	$MnO_2 \cdot nH_2O$	Goslarite	$ZnSO_4 \cdot 7H_2O$
Malachite	$Cu_2(CO_3)(OH)_2$	Manganite	MnO(OH)	Gypsum	$CaSO_4 \cdot 2H_2O$
Azurite	$Cu_3(CO_3)_2(OH)_2$	Lead Molybdenum Oxide	$PbMoO_4$		

4.2.2 High Case Source Term

To account for variability in the source term inputs, a high case source term was developed. The high case source term was estimated by increasing sulfate concentrations to concentrations that are in equilibrium with gypsum (i.e., sulfate concentrations are assumed to be saturated in solution) under the assumed pH and redox conditions. Equilibrium with gypsum was achieved by incrementally adding anhydrite ($CaSO_4$) to the predicted base case solution (Section 4.2.1) until sulfate concentrations reached steady state. Concentrations of other elements were scaled up in the high source term by preserving the metal sulphate ratios (M/SO_4) in the base case source term. A key assumption in this approach is that elements in the solution are chalcophile which could result in an overprediction of non-chalcophile elements. Mineral saturation was evaluated by equilibrating the high case unsaturated mine rock water quality with the same mineral phases (Table 4-2) as the base case solution.

4.3 Saturated Mine Rock

4.3.1 PAG Rock Flushing Source Term

PAG rock produced during mining of the Tenas deposit will be permanently stored in saturated conditions in the management ponds. Placement of PAG rock in the management ponds will result in flushing of oxidation products accumulating on the surfaces of the PAG following exposure during mining. A unit annual flushing rate, in kilograms per tonne of rock (kg/tonne), was estimated by proportioning scaled barrel solute release rates (Section 4.1) in the relative proportion of each zone to be mined in each year (Table 4-3). The same grain size factor used to estimate loadings from unsaturated waste rock (Section 4.2.1) was applied to estimate the mass flushed from PAG rock.

A key input to the PAG rock flushing source term is the exposure time prior to placement in the management ponds. TCL proposes to have PAG rock including processed rock placed in the management ponds within an average of six months which was used when developing the PAG rock flushing source term. Like the unsaturated mine rock source term, a high case was also developed where PAG mine rock was assumed to be exposed for 12 months.

Table 4-3. Annual PAG Rock Volumes and Relative Proportions

Year	Mine Rock Volume (bcm)								Mine Rock Proportion						
	Zone 1a	Zone 2	Zone 3	Zone 4 (PAG)	Zone 5	Zone 55	Zone 6	Total	Zone 1A	Zone 2	Zone 3	Zone 4 (PAG)	Zone 5	Zone 55	Zone 6
-0.5	---	---	---	77,481	120,526	129,135	---	327,142	---	---	---	0.24	0.37	0.39	---
0	---	101,036	116,673	276,461	270,055	271,264	178,523	1,214,012	---	0.083	0.096	0.23	0.22	0.22	0.15
1	---	179,056	229,804	620,602	320,738	99,933	99,320	1,549,453	---	0.12	0.15	0.4	0.21	0.064	0.064
2	21,889	285,673	321,699	472,335	345,853	151,588	112,489	1,711,526	0.013	0.17	0.19	0.28	0.2	0.089	0.066
3	27,407	155,626	308,582	663,762	353,038	165,727	94,900	1,769,042	0.015	0.088	0.17	0.38	0.2	0.094	0.054
4	130,618	312,373	397,354	613,605	290,367	160,116	75,573	1,980,006	0.066	0.16	0.2	0.31	0.15	0.081	0.038
5	68,844	381,138	593,269	214,295	250,877	182,880	79,710	1,771,013	0.039	0.22	0.33	0.12	0.14	0.1	0.045
6	52,353	327,938	705,510	---	321,128	178,341	175,380	1,760,650	0.03	0.19	0.4	---	0.18	0.1	0.10
7	18,042	198,457	378,872	---	378,932	89,907	66,893	1,131,103	0.016	0.18	0.33	---	0.34	0.079	0.059
8	37,018	388,733	629,396	---	439,200	71,890	151,249	1,717,486	0.022	0.23	0.37	---	0.26	0.042	0.088
9	55,727	316,821	466,150	---	428,117	74,035	97,842	1,438,692	0.039	0.22	0.32	---	0.3	0.051	0.068
10	98,303	381,613	547,361	238,780	386,869	55,623	148,670	1,857,219	0.053	0.21	0.29	0.13	0.21	0.03	0.08
11	76,587	223,829	298,043	569,289	532,297	16,062	116,153	1,832,260	0.042	0.12	0.16	0.31	0.29	0.0088	0.063
12	308,172	257,049	167,938	---	264,424	29,924	119,692	1,147,199	0.27	0.22	0.15	---	0.23	0.026	0.1
13	146,459	198,589	397,430	---	523,609	---	61,069	1,327,156	0.11	0.15	0.3	---	0.39	---	0.046
14	325,128	307,724	365,342	---	495,915	---	95,471	1,589,580	0.2	0.19	0.23	---	0.31	---	0.06
15	201,789	146,756	226,844	---	481,190	---	102,576	1,159,155	0.17	0.13	0.2	---	0.42	---	0.088
16	377,112	302,140	282,975	---	186,028	36,948	55,034	1,240,237	0.3	0.24	0.23	---	0.15	0.03	0.044
17	162,336	261,355	238,266	419,874	434,193	49,875	136,393	1,702,292	0.095	0.15	0.14	0.25	0.26	0.029	0.08
18	55,193	165,578	202,373	386,347	183,975	143,569	69,979	1,207,014	0.046	0.14	0.17	0.32	0.15	0.12	0.058
19	33,669	271,177	390,325	437,687	185,176	101,005	55,193	1,474,232	0.023	0.18	0.26	0.3	0.13	0.069	0.037
20	---	---	---	495,776	188,053	102,575	135,720	922,124	---	---	---	0.54	0.2	0.11	0.15
Total	2,196,646	5,162,661	7,264,206	5,486,294	7,380,560	2,110,397	2,227,829	31,828,593	0.07	0.16	0.23	0.17	0.23	0.07	0.07

Source: P:\01_SITES\Telkwa Coal\1CT027.007_2021 Geochemistry Support\Task 500 - Source Term Memo\Tenas_source_term_rpt_tables_1ct027.007_MKH_r1.xlsx

4.3.2 Non-PAG Rock Flushing Source Term

As PAG material reaches its designed elevation, non-PAG rock will then be placed in lifts above the saturated PAG. Once this lift is completed, overburden is then placed in a maximum of a 3 metre lift to form dry land reclamation. Surface soils will then be placed in a lift thickness of approximately 30 centimetres. The non-PAG rock will be placed in aqueous conditions and the majority of the overburden will be unsaturated. Oxidation products that have accumulated on the non-PAG mine rock following exposure during mining will be flushed from the surfaces as the rock is placed in the management pond.

TML proposes to use non-PAG rock source from Zone 1 in the management pond cover. A unit flushing rate, in kg/tonne, was estimated by scaling the Zone 1 average barrel release rates results to account for differences between testing and operational field conditions. The same scaling factor used to estimate the PAG rock flushing term was applied (i.e., grain size factor). Flushing rates were estimated for six- and 12-month exposure periods.

4.3.3 Flooded non-PAG Rock Backfill

Approximately 50% of the non-PAG rock in the backfill will become flooded in Post-closure. Mass that accumulates in the backfill will be flushed during flooding. As discussed in Section 4.2.1, unsaturated mine rock is not assumed to have a channelization factor and is assumed to have a high leaching efficiency since there is uncertainty in quantifying the degree of channelization in the barrel tests. This provides a conservative estimate of the drainage quality from unsaturated materials, but no mass accumulation will occur using this approach. Therefore, flushing of submerged mass is not accounted for in the source terms.

The water balance model (SRK 2021) indicates there is no hydraulic connection of water stored in the flooded backfill to the management ponds. However, a small volume of the flooded backfill water will report to the groundwater system. Water balancing modelling indicates that the water losses from the flooded backfill represent less than one percent (i.e., 0.4%) of the total flow to the groundwater system. As noted above, there is a high degree of uncertainty in estimating the residual load that will be flushed from the flooded backfill and since the flow is effectively negligible to other flows, a source term was not developed for the flooded non-PAG rock backfill.

4.4 Wall Rock Runoff

Exposed wall rock surfaces will produce oxidative load that will be flushed by meteoric water. An annual pit wall drainage water quality was estimated using equation 2; however, in this instance $L_{j,annual}$ is the annual load of constituent j released from exposed wall rock surfaces and Q_{annual} is the annual average flow contacting the exposed wall rock. TML proposes to progressively backfill the open pit during operations. This will continually change the areas of rock exposed in the pit walls. To evaluate changes to the wall rock runoff composition, source terms were developed for the following time periods, which correspond to backfilling of different areas and volumes placed in the open pit:

- End of placement of PAG rock in the North Management Pond (NMP)
- End of placement of PAG rock in the East Management Pond (EMP)
- End of the Operation Phase (EOM)

The reactive mass of each stratigraphic zone in the open pit walls was estimated by multiplying the exposed surface area of each of the zones in the open pit walls by an assumed depth of fractured rock for each of the above time periods. Surface areas for each time period are provided in Table 4-4. The fractured rock depth was assumed to be two metres for blasted areas and five centimetres for free dig areas and the floor of the pit. A density of 2.55 g/cc was assumed to estimate the reactive mass exposed in the pit walls.

The average release rates from each barrel were prorated in relative proportions calculated based on the exposed surface areas (Table 4-4) to estimate the unit solute release rates for the backfill. As discussed in Section 4.1, barrels tests are not available for processed rock. The approach described in SRK (2022a) was used to represent loadings from exposed coal seams. This rate was multiplied by the total reactive mass in the open pit walls to estimate the annual load produced. The annual load was scaled to field conditions using the grain size differences. Since HCT release rates were used to represent release rates from exposed coal seams, a temperature factor was applied to coal (SRK 2022a). It was assumed that the entire fractured rock zone in the open pit walls would be flushed, and a channelization factor was not included.

The annual scaled release rate was divided by the annual average volume of water contacting wall rock runoff (SRK 2022) to estimate drainage concentrations using equation 2. The annual volume for each time period is presented in Table 4-5. Mineral solubility was evaluated and phases that were identified to be supersaturated in solution were allowed to precipitate or off-gas (for gas phases). Mineral phases that were considered are provided in Table 4-2. Sorption to ferrihydrite was also included when this mineral phase precipitated.

Like the unsaturated mine rock source term, a high case wall rock source term was estimated by forcing the predicted solutions to gypsum saturation through incremental anhydrite addition in PHREEQC. Element sulfate ratios in the base case source term were assumed when calculating concentrations of other constituents. The scaled-up solution was subsequently equilibrated with the mineral phases presented in Table 4-2 and sorption to ferrihydrite was permitted when this mineral phase precipitated.

During operations it is assumed that the pit backfill will be fully oxygenated. Therefore, the wall rock that is below the backfill will also be reactive. A load from the backfilled pit walls was also estimated using the same assumptions as exposed wall rock. The annual load originating from covered walls at the end of EMP and EOM was added to unsaturated mine rock load (Section 4.2). The load was estimated by prorating the scaled barrel loads (and HCT for exposed coal seams) in proportions calculated based on the backfilled pit wall surface areas (Table 4-6).

Table 4-4. Exposed Open Pit Wall Surface Areas (m^2)

Layer	Type	End of NMP	End of EMP	EOM
Zone 1	Blasted Wall	34,151	92,219	15,722
Zone 1a	Blasted Wall	---	3,711	---
Zone 2	Blasted Wall	6,392	22,123	---
Zone 3	Blasted Wall	5,780	33,356	---
Zone 4	Blasted Wall	10,798	47,774	---
Zone 5	Blasted Wall	8,489	25,854	---
Zone 6	Free Dug Wall	356,326	627,457	---
Overburden	Free Dug Wall	81,128	239,685	27,065
Seam C	Free Dug Wall	554	3,197	---
Seam 1U	Free Dug Wall	841	4,412	---
Zone 55	Free Dug Wall	2,697	11,130	---
Seam 1L	Free Dug Wall	1,200	6,944	---

Note: Areas presented in m^2

Table 4-5. Annual Wall Rock Runoff Volumes

Time Period	Volume (m^3/year)
End of NMP	302,720
End of EMP	514,842
EOM	116,847

Table 4-6. Backfilled Open Pit Wall Surface Areas (m^2)

Layer	Type	End of EMP	EOM
Zone 1	Blasted Wall	---	93,749
Zone 1a	Blasted Wall	---	13,191
Zone 2	Blasted Wall	4	9,111
Zone 3	Blasted Wall	54	8,074
Zone 4	Blasted Wall	967	12,457
Zone 5	Blasted Wall	1,088	4,654
Zone 6	Blasted Wall	---	10,331
Zone 7	Blasted Wall	---	36,728
Zone 6	Free Dug Wall	320,672	1,686,406
Overburden	Free Dug Wall	12,000	164,165
Seam C	Free Dug Wall	93	2,515
Seam 1U	Free Dug Wall	233	1,557
Zone 55	Free Dug Wall	1,041	449
Seam 1L	Free Dug Wall	280	3,201
Seam 1	Free Dug Wall	---	1,426

Note: Areas presented in m^2

5 Source Terms

The following sections present the Tenas Project source terms. The source terms do not represent discharge water quality and how the mine rock flushing source terms influence site drainage water quality cannot be quantified until they are carried forward into the site wide water and load balance. Therefore, limited interpretation of the source terms is included in the following sections. Detailed interpretations of the site wide water and load balance model results using these source terms are included in SRK (2024a).

5.1 Unsaturated Mine Rock & Overburden

5.1.1 Pit Backfill Source Term Water Quality

The base case and high case pit backfill source terms for end of EMP and EOM are provided in Table 5-1. The charge imbalance for the base case and high case solutions were less than 10%. This is considered acceptable for a modelled solution that have average inputs from multiple sampling rounds and charge imbalances were not corrected. The pH of solutions is alkaline (8.2 to 8.5) and all modelled constituent concentrations are higher in the high case in comparison to the base case source terms since gypsum was not predicted to be supersaturated in the base case source term and the scaling method (i.e., preserving element/sulfate ratios; see Section 4.2.2) results in constituent concentrations being higher in the high case solutions. Predicted constituent concentrations are higher at the EOM in comparison to the end of EMP source terms because of increased reactive mass in the pit backfill (Table 4-1).

Table 5-1. Pit Backfill Source Term Water Quality

Parameter	Units	Non-PAG Backfill - End of EMP		Non-PAG Backfill - End of EOM	
		Typical	High	Typical	High
Conventional					
pH	s.u.	8.2	8.4	8.3	8.5
% Error	%	-0.3	-0.3	-0.2	-0.2
Alkalinity	mg $CaCO_3$/L	1904	3398	2953	4468
Major Ions					
Calcium	mg/L	53	95	79	119
Magnesium	mg/L	32	57	48	72
Potassium	mg/L	13	23	20	31
Sodium	mg/L	1614	2881	2505	3790
Chloride	mg/L	24	43	37	56
Sulfate	mg/L	1803	3218	2772	4193
Dissolved Elements					
Aluminum	mg/L	0.0045	0.0072	0.0064	0.0089
Antimony	mg/L	0.0029	0.0052	0.0045	0.0069
Arsenic	mg/L	0.0043	0.0078	0.0067	0.01
Barium	mg/L	0.045	0.08	0.069	0.1
Boron	mg/L	0.45	0.8	0.7	1.1
Cadmium	mg/L	0.000095	0.00017	0.00014	0.00021
Chromium	mg/L	0.0018	0.0033	0.0029	0.0043
Cobalt	mg/L	0.015	0.026	0.02	0.03
Copper	mg/L	0.016	0.029	0.025	0.037
Iron	mg/L	0.00012	0.0001	0.00011	0.0001
Lead	mg/L	0.0048	0.0085	0.0074	0.011
Lithium	mg/L	0.14	0.24	0.21	0.32
Manganese	mg/L	0.11	0.19	0.12	0.18
Mercury	mg/L	0.00001	0.000018	0.000016	0.000023
Phosphorus	mg/L	0.026	0.046	0.04	0.06
Molybdenum	mg/L	0.17	0.3	0.26	0.39
Nickel	mg/L	0.029	0.051	0.04	0.061
Selenium	mg/L	0.089	0.16	0.14	0.21
Silica	mg/L	4.6	8.3	7.1	11
Silver	mg/L	0.000074	0.00013	0.00011	0.00017
Strontium	mg/L	0.83	1.5	1.3	1.9
Tin	mg/L	0.00078	0.0014	0.0012	0.0018
Thallium	mg/L	0.000078	0.00014	0.00012	0.00018
Uranium	mg/L	0.019	0.034	0.029	0.044
Vanadium	mg/L	0.004	0.0072	0.0062	0.0095
Zinc	mg/L	0.032	0.058	0.046	0.07

Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 500 Source Term Updates/01_Source_term_updates/02_Input_files/[TelkwaSourceTerms_Barrel_Loads_Sc2_CAPR002933_mkh_r4.xlsx

5.1.2 Dam/Buttress Source Term Water Quality

The base case and high case dam/buttress source term water quality for end of NMP, end of EMP and end of WMP are provided in Table 5-2. The charge imbalance for the base case and high case solutions were less than 10%. This is considered acceptable for a modelled solution mixing average inputs from multiple HCTs and charge imbalances were not corrected. The pH of solutions is alkaline ranging from 7.6 to 8.3.

The trends in predicted concentrations are like the pit backfill water quality. For example, the modelled constituent concentrations are higher in the high case in comparison to the base case source terms since gypsum was not predicted to be supersaturated in the base case scenario. Constituent concentrations are predicted to increase throughout the LOM because of the reactive mass increasing (Table 4-1).

Table 5-2. Dam/Buttress Source Term Water Quality

Parameter	Units	Dam/Buttress Infiltration - End of NMP		Dam/Buttress Infiltration - End of EMP		Dam/Buttress Infiltration - End of WMP	
		Typical	High	Typical	High	Typical	High
Conventional							
pH	s.u.	7.6	8.2	7.8	8.2	8.0	8.3
% Error	%	-1.5	-1.5	-1.3	-1.4	-1.4	-1.4
Alkalinity	mg $CaCO_3$/L	448	1848	761	2167	1074	2458
Major Ions							
Calcium	mg/L	33	134	50	141	71	163
Magnesium	mg/L	17	69	26	73	37	84
Potassium	mg/L	3.6	15	5.9	17	8.3	19
Sodium	mg/L	334	1380	577	1643	812	1859
Chloride	mg/L	6.5	27	11	31	15	35
Sulfate	mg/L	432	1784	725	2065	1026	2348
Dissolved Elements							
Aluminum	mg/L	0.0017	0.0044	0.0023	0.005	0.0029	0.0055
Antimony	mg/L	0.00064	0.0026	0.0011	0.0031	0.0015	0.0035
Arsenic	mg/L	0.00092	0.0038	0.0015	0.0043	0.0021	0.0049
Barium	mg/L	0.017	0.072	0.028	0.079	0.039	0.09
Boron	mg/L	0.099	0.41	0.17	0.48	0.24	0.55
Cadmium	mg/L	0.000021	0.000089	0.000036	0.0001	0.000051	0.00012
Chromium	mg/L	0.00045	0.0019	0.00076	0.0022	0.0011	0.0025
Cobalt	mg/L	0.0025	0.01	0.0043	0.012	0.0061	0.014
Copper	mg/L	0.01	0.043	0.016	0.046	0.023	0.053
Iron	mg/L	0.00032	0.00012	0.00021	0.00012	0.00017	0.00011
Lead	mg/L	0.001	0.0043	0.0018	0.0051	0.0025	0.0058
Lithium	mg/L	0.028	0.11	0.048	0.14	0.067	0.15
Manganese	mg/L	0.034	0.14	0.052	0.15	0.074	0.17
Mercury	mg/L	0.0000031	0.000013	0.000005	0.000014	0.0000071	0.000016
Phosphorus	mg/L	0.014	0.056	0.021	0.059	0.03	0.069
Molybdenum	mg/L	0.034	0.14	0.058	0.16	0.082	0.19
Nickel	mg/L	0.0055	0.023	0.0093	0.027	0.013	0.03
Selenium	mg/L	0.028	0.12	0.045	0.13	0.065	0.15
Silica	mg/L	2.3	9.6	3.6	10	5.2	12
Silver	mg/L	0.000018	0.000073	0.00003	0.000085	0.000042	0.000096
Strontium	mg/L	0.27	1.1	0.43	1.2	0.61	1.4
Tin	mg/L	0.00019	0.00077	0.00032	0.0009	0.00045	0.001
Thallium	mg/L	0.000018	0.000073	0.00003	0.000085	0.000042	0.000096
Uranium	mg/L	0.0049	0.02	0.0082	0.023	0.012	0.026
Vanadium	mg/L	0.00088	0.0036	0.0015	0.0042	0.0021	0.0048
Zinc	mg/L	0.009	0.037	0.015	0.042	0.021	0.047

Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 500 Source Term Updates/01_Source_term_updates/02_Input_files/[TelkwaSourceTerms_Barrel_Loads_Sc2_CAPR002933_mkh_r4.xlsx

5.2 Saturated Mine Rock

Saturated rock flushing terms are presented in kg/tonne. The influence of flushing of rock as it is placed in the management ponds cannot be quantified until it is carried forward into the water and load balance. Annual PAG rock flushing rates for the six- and 12-month exposure periods are provided in Table 5-3 and Table 5-4, respectively. The non-PAG rock flushing source terms are provided in Table 5-5, respectively.

Table 5-3. PAG Rock Annual Flushing Source Term – Six Month Average Exposure

Parameter	Units	-0.5	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Conventional																							
Alkalinity	kg CaCO3/tonne	0.005	0.005	0.008	0.006	0.008	0.006	0.003	0.001	0.001	0.001	0.001	0.003	0.006	0.001	0.001	0.001	0.001	0.001	0.005	0.007	0.006	0.011
Major Ions																							
Calcium	kg/tonne	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Magnesium	kg/tonne	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0009	0.001	0.00
Potassium	kg/tonne	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Sodium	kg/tonne	0.009	0.0087	0.01	0.009	0.01	0.011	0.008	0.007	0.007	0.007	0.007	0.009	0.011	0.015	0.01	0.013	0.012	0.015	0.0116	0.01082	0.01	0.012
Chloride	kg/tonne	0.00012	0.00012	0.00014	0.00013	0.00014	0.00014	0.00011	0.0001	0.0001	0.0001	0.0001	0.00012	0.00014	0.00014	0.00011	0.00013	0.00012	0.00014	0.00014	0.00014	0.00013	0.00016
Sulfate	kg/tonne	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.03	0.03	0.03	0.04	0.02	0.021	0.02	0.02
Elements																							
Aluminum	kg/tonne	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.00000	0.00000	0.0000	0.00000	0.00000	0.00000	0.000001	0.00000	0.00000	0.00000	0.0000001	0.00000	0.0000008	0.000001	0.000001	0.000002
Antimony	kg/tonne	9.9E-09	0.00000001	1.3E-08	1.1E-08	1.3E-08	1.2E-08	0.00000001	0.0000000	0.0000000	3.7E-09	4.1E-09	7.4E-09	1.2E-08	7.6E-09	5.3E-09	6.7E-09	6.3E-09	8.1E-09	1.1E-08	0.00000001	1.1E-08	1.7E-08
Arsenic	kg/tonne	1.0E-08	0.00000001	0.00000001	1.1E-08	1.3E-08	1.2E-08	0.00000001	0.0000000	0.0000000	3.9E-09	4.2E-09	7.5E-09	1.2E-08	7.7E-09	5.4E-09	6.8E-09	6.5E-09	8.2E-09	1.1E-08	1.2E-08	0.00000001	0.00000002
Barium	kg/tonne	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.000000	0.00000	0.00000	0.0000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.0000001	0.00000	0.0000001	0.00000
Boron	kg/tonne	0.000002	0.000001	0.000002	0.000002	0.000002	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000002	0.000002	0.000002	0.000003
Cadmium	kg/tonne	4.3E-10	8.9E-10	7.0E-10	0.0000000	0.0000000	6.2E-10	5.3E-10	0.0000000	5.0E-10	5.9E-10	0.0000000	6.5E-10	0.0000000	0.0000000	0.0000000	6.3E-10	0.0000000	0.0000000	7.4E-10	6.7E-10	5.8E-10	0.0000000
Chromium	kg/tonne	8.8E-09	8.5E-09	1.1E-08	9.2E-09	1.0E-08	0.00000001	0.00000001	0.00000001	0.00000001	5.9E-09	6.2E-09	8.0E-09	1.0E-08	9.8E-09	7.4E-09	8.8E-09	8.4E-09	1.0E-08	1.0E-08	1.0E-08	9.6E-09	1.2E-08
Cobalt	kg/tonne	0.00000	0.0000005	0.00000	0.00000	0.00000	0.00000	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.00000	0.000001	0.000001	0.000001	0.000001	0.00000	0.0000005	0.0000004	0.00000	0.00000
Copper	kg/tonne	0.00000003	0.00000002	0.00000004	0.00000003	0.00000004	0.00000003	0.00000002	0.00000001	0.00000001	0.00000001	0.00000001	0.00000002	0.00000003	0.00000002	0.00000001	0.00000001	0.00000001	0.00000002	2.9E-08	0.00000003	0.00000003	0.00000005
Iron	kg/tonne	0.000001	0.000001	0.000002	0.000002	0.000002	0.000002	0.000001	0.00000	0.00000	0.00000	0.00000	0.000001	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000002	0.0000019	0.000002	0.000003
Lead	kg/tonne	1.3E-08	1.3E-08	2.1E-08	1.5E-08	2.0E-08	1.7E-08	8.0E-09	2.1E-09	2.1E-09	2.1E-09	2.2E-09	8.4E-09	1.7E-08	4.0E-09	2.8E-09	3.5E-09	3.3E-09	4.3E-09	1.4E-08	1.8E-08	1.6E-08	2.8E-08
Lithium	kg/tonne	0.0000011	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.0000011	0.000001	0.000001	0.000001
Manganese	kg/tonne	0.0000	0.00001	0.000	0.000	0.000	0.000	0.000	0.000	0.00001	0.000	0.000	0.00001	0.000	0.000	0.000	0.00001	0.000	0.000	0.00001	0.00000518	0.000	0.000
Mercury	kg/tonne	4.2E-11	3.8E-11	4.5E-11	3.9E-11	4.4E-11	4.0E-11	3.0E-11	2.4E-11	2.5E-11	2.4E-11	2.5E-11	3.0E-11	4.1E-11	2.6E-11	2.6E-11	2.6E-11	2.7E-11	2.5E-11	3.8E-11	4.1E-11	3.8E-11	5.3E-11
Phosphorus	kg/tonne	0.000000	0.000000	0.0000001	0.000000	0.0000001	0.0000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0000001	0.0000001	0.000000	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001
Molybdenum	kg/tonne	0.00000043	0.0000004	0.00000067	0.00000047	0.00000063	0.00000055	0.00000023	0.00000004	0.00000004	0.00000003	0.00000004	0.00000025	0.00000054	0.00000013	0.00000007	0.00000011	9.9E-08	1.4E-07	4.6E-07	0.0000006	0.00000051	0.00000089
Nickel	kg/tonne	0.00000	0.000001	0.000001	0.0000	0.0000	0.0000	0.0000	0.0000	0.000001	0.0000	0.0000	0.000001	0.0000	0.0000	0.0000	0.000001	0.0000	0.0000	0.000001	0.00000054	0.000001	0.0000
Selenium	kg/tonne	0.00000046	0.0000004	0.00000044	0.00000043	0.00000049	0.00000066	0.00000044	0.00000035	0.00000032	0.00000032	0.00000041	0.00000051	0.00000057	0.00000138	0.00000073	0.00000112	0.00000101	0.00000151	0.00000077	0.0000006	0.00000046	0.00000053
Silica	kg/tonne	0.00001	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002
Silver	kg/tonne	4.9E-10	4.4E-10	5.0E-10	4.7E-10	5.1E-10	5.6E-10	4.4E-10	3.8E-10	3.8E-10	3.7E-10	4.0E-10	4.7E-10	5.3E-10	7.6E-10	5.2E-10	6.6E-10	6.3E-10	8.1E-10	5.9E-10	5.4E-10	4.8E-10	5.6E-10
Strontium	kg/tonne	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001	0.00001	0.00001
Tin	kg/tonne	0.0000000	0.0000000	0.00000001	0.0000000	0.00000001	0.00000001	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.0000000	0.00000001
Thallium	kg/tonne	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Uranium	kg/tonne	0.00000006	0.00000005	0.00000008	6.5E-08	8.3E-08	0.00000008	0.00000004	0.00000002	0.00000002	0.00000002	0.00000002	4.8E-08	7.7E-08	7.1E-08	4.0E-08	5.9E-08	5.3E-08	7.9E-08	7.7E-08	0.00000008	7.0E-08	0.00000011
Vanadium	kg/tonne	0.00000002	0.00000002	0.00000002	0.00000002	0.00000003	0.00000003	0.00000002	0.00000002	0.00000002	0.00000002	0.00000002	0.00000002	0.00000003	0.00000004	0.00000003	0.00000003	0.00000003	0.00000004	2.9E-08	0.00000003	2.4E-08	0.00000003
Zinc	kg/tonne	0.00000	0.0000007	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.0000006	0.000001	0.000001

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Table 5-4. PAG Rock Annual Flushing Source Term – 12 Month Average Exposure

Parameter	Units	-0.5	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Conventional																							
Alkalinity	kg $CaCO_3$/tonne	0.011	0.01	0.016	0.012	0.015	0.013	0.006	0.001	0.001	0.001	0.001	0.006	0.013	0.002	0.002	0.002	0.002	0.002	0.011	0.013	0.012	0.021
Major Ions																							
Calcium	kg/tonne	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Magnesium	kg/tonne	0.001	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.003	0.003	0.003	0.002	0.003	0.002	0.0018	0.002	0.001
Potassium	kg/tonne	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Sodium	kg/tonne	0.019	0.0174	0.02	0.019	0.021	0.023	0.017	0.014	0.013	0.013	0.015	0.018	0.021	0.029	0.019	0.025	0.024	0.031	0.0233	0.02164	0.019	0.024
Chloride	kg/tonne	0.00024	0.00024	0.00029	0.00026	0.00029	0.00029	0.00023	0.0002	0.00019	0.00019	0.0002	0.00024	0.00028	0.00027	0.00022	0.00025	0.00024	0.00028	0.00028	0.00028	0.00027	0.00032
Sulfate	kg/tonne	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.07	0.05	0.06	0.06	0.07	0.05	0.042	0.04	0.04
Elements																							
Aluminum	kg/tonne	0.000002	0.000002	0.000003	0.000002	0.000002	0.000002	0.000001	0.00000	0.0000	0.00000	0.00000	0.000001	0.000002	0.00000	0.00000	0.00000	0.0000001	0.00000	0.0000017	0.000002	0.000002	0.000004
Antimony	kg/tonne	2.0E-08	0.00000002	2.7E-08	2.1E-08	2.6E-08	2.4E-08	0.00000001	0.00000001	0.00000001	7.5E-09	8.1E-09	1.5E-08	2.4E-08	1.5E-08	1.1E-08	1.3E-08	1.3E-08	1.6E-08	2.2E-08	0.00000002	2.2E-08	3.4E-08
Arsenic	kg/tonne	2.0E-08	0.00000002	0.00000003	2.1E-08	2.6E-08	2.4E-08	0.00000001	0.00000001	0.00000001	7.7E-09	8.4E-09	1.5E-08	2.4E-08	1.5E-08	1.1E-08	1.4E-08	1.3E-08	1.6E-08	2.2E-08	2.4E-08	0.00000002	0.00000003
Barium	kg/tonne	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000001	0.00000	0.00000	0.0000003	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000002	0.00000	0.0000002	0.00000
Boron	kg/tonne	0.000003	0.000003	0.000004	0.000003	0.000004	0.000004	0.000002	0.000001	0.000001	0.000001	0.000001	0.000002	0.000004	0.000002	0.000002	0.000002	0.000002	0.000002	0.000003	0.000004	0.000003	0.000005
Cadmium	kg/tonne	8.7E-10	1.8E-09	1.4E-09	0.0000000	0.0000000	1.2E-09	1.1E-09	0.0000000	1.0E-09	1.2E-09	0.0000000	1.3E-09	0.0000000	0.0000000	0.0000000	1.3E-09	0.0000000	0.0000000	1.5E-09	1.3E-09	1.2E-09	0.0000000
Chromium	kg/tonne	1.8E-08	1.7E-08	2.1E-08	1.8E-08	2.1E-08	0.00000002	0.00000002	0.00000001	0.00000001	1.2E-08	1.2E-08	1.6E-08	2.0E-08	2.0E-08	1.5E-08	1.8E-08	1.7E-08	2.1E-08	2.0E-08	2.1E-08	1.9E-08	2.5E-08
Cobalt	kg/tonne	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.0000009	0.0000009	0.000001	0.000001
Copper	kg/tonne	0.00000005	0.00000005	0.00000007	0.00000006	0.00000007	0.00000006	0.00000004	0.00000002	0.00000002	0.00000002	0.00000002	0.00000004	0.00000006	0.00000003	0.00000002	0.00000003	0.00000003	0.00000003	5.7E-08	0.00000006	0.00000006	0.00000009
Iron	kg/tonne	0.000003	0.000003	0.000004	0.000003	0.000004	0.000004	0.000002	0.000001	0.000001	0.000001	0.000001	0.000002	0.000004	0.000002	0.000001	0.000001	0.000001	0.000002	0.000003	0.0000037	0.000003	0.000006
Lead	kg/tonne	2.7E-08	2.6E-08	4.2E-08	3.0E-08	4.0E-08	3.4E-08	1.6E-08	4.2E-09	4.1E-09	4.1E-09	4.4E-09	1.7E-08	3.4E-08	8.1E-09	5.6E-09	7.1E-09	6.7E-09	8.6E-09	2.9E-08	3.5E-08	3.2E-08	5.5E-08
Lithium	kg/tonne	0.0000022	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.0000023	0.000002	0.000002	0.000002
Manganese	kg/tonne	0.00001	0.00001	0.000	0.000	0.000	0.000	0.000	0.000	0.00001	0.000	0.000	0.00001	0.000	0.000	0.000	0.00001	0.000	0.000	0.00001	0.00001037	0.000	0.000
Mercury	kg/tonne	8.4E-11	7.7E-11	9.0E-11	7.7E-11	8.8E-11	8.0E-11	6.0E-11	4.8E-11	5.0E-11	4.8E-11	4.9E-11	6.1E-11	8.2E-11	5.3E-11	5.2E-11	5.2E-11	5.4E-11	5.1E-11	7.6E-11	8.2E-11	7.7E-11	1.1E-10
Phosphorus	kg/tonne	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000001	0.0000002	0.0000001	0.0000001	0.0000001	0.0000002	0.0000001	0.0000001	0.0000001	0.0000001
Molybdenum	kg/tonne	0.00000086	0.0000008	0.00000134	0.00000095	0.00000127	0.00000109	0.00000047	0.00000007	0.00000008	0.00000007	0.00000009	0.0000005	0.00000108	0.00000026	0.00000015	0.00000021	2.0E-07	2.8E-07	9.2E-07	0.0000011	0.00000101	0.00000178
Nickel	kg/tonne	0.000001	0.000001	0.000001	0.0000	0.0000	0.0000	0.0000	0.0000	0.000001	0.0000	0.0000	0.000001	0.0000	0.0000	0.0000	0.000001	0.0000	0.0000	0.000001	0.00000109	0.000001	0.0000
Selenium	kg/tonne	0.00000092	0.0000008	0.00000087	0.00000086	0.00000099	0.00000132	0.00000089	0.00000071	0.00000064	0.00000064	0.00000081	0.00000102	0.00000115	0.00000277	0.00000145	0.00000223	0.00000202	0.00000303	0.00000154	0.0000012	0.00000091	0.00000106
Silica	kg/tonne	0.00002	0.00002	0.00003	0.00002	0.00003	0.00003	0.00002	0.00001	0.00001	0.00001	0.00001	0.00002	0.00003	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00003	0.00003	0.00004
Silver	kg/tonne	9.7E-10	8.9E-10	9.9E-10	9.4E-10	1.0E-09	1.1E-09	8.9E-10	7.7E-10	7.5E-10	7.4E-10	8.1E-10	9.3E-10	1.1E-09	1.5E-09	1.0E-09	1.3E-09	1.3E-09	1.6E-09	1.2E-09	1.1E-09	9.7E-10	1.1E-09
Strontium	kg/tonne	0.00003	0.00003	0.00002	0.00002	0.00002	0.00002	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00002	0.00004	0.00003	0.00004	0.00004	0.00004	0.00003	0.00002	0.00002	0.00002
Tin	kg/tonne	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000001	0.00000002	0.00000001	0.00000001	0.00000001	0.00000002	0.00000001	0.00000001	0.00000001	0.00000001
Thallium	kg/tonne	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Uranium	kg/tonne	0.00000012	0.00000011	0.00000017	1.3E-07	1.7E-07	0.00000016	0.00000009	0.00000004	0.00000004	0.00000004	0.00000005	9.6E-08	1.5E-07	1.4E-07	7.9E-08	1.2E-07	1.1E-07	1.6E-07	1.5E-07	0.00000016	1.4E-07	0.00000021
Vanadium	kg/tonne	0.00000005	0.00000004	0.00000005	0.00000005	0.00000005	0.00000006	0.00000004	0.00000004	0.00000004	0.00000004	0.00000004	0.00000005	0.00000005	0.00000008	0.00000005	0.00000007	0.00000006	0.00000008	5.9E-08	0.00000005	4.8E-08	0.00000006
Zinc	kg/tonne	0.000001	0.0000014	0.000001	0.000001	0.000001	0.000001	0.000001	0.000002	0.000001	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.0000011	0.000001	0.000001

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Table 5-5. Non-PAG Rock Flushing Source Term

Parameter	Units	Six Month Exposure	Twelve Month Exposure
Conventional			
Alkalinity	kg $CaCO_3$/tonne	0.019	0.0381
Major Ions			
Calcium	kg/tonne	0.00	0.00
Magnesium	kg/tonne	0.0001	0.00
Potassium	kg/tonne	0.00012	0.00024
Sodium	kg/tonne	0.01607	0.03214
Chloride	kg/tonne	0.00022	0.00044
Sulfate	kg/tonne	0.016	0.03
Elements			
Aluminum	kg/tonne	0.0000032	0.000006
Antimony	kg/tonne	2.8E-08	5.6E-08
Arsenic	kg/tonne	2.8E-08	5.6E-08
Barium	kg/tonne	0.0000003	0.000001
Boron	kg/tonne	0.0000044	0.000009
Cadmium	kg/tonne	7.9E-10	1.6E-09
Chromium	kg/tonne	1.8E-08	3.6E-08
Cobalt	kg/tonne	0.00000011	0.00000022
Copper	kg/tonne	7.8E-08	0.00000016
Iron	kg/tonne	0.0000048	0.00001
Lead	kg/tonne	4.9E-08	9.9E-08
Lithium	kg/tonne	0.0000013	0.0000026
Manganese	kg/tonne	0.00000	0.000001
Mercury	kg/tonne	7.3E-11	1.5E-10
Phosphorus	kg/tonne	0.00000011	0.0000002
Molybdenum	kg/tonne	1.6E-06	0.00000324
Nickel	kg/tonne	0.00000024	0.0000005
Selenium	kg/tonne	0.00000069	0.0000014
Silica	kg/tonne	0.000029	0.00006
Silver	kg/tonne	7.1E-10	1.4E-09
Strontium	kg/tonne	0.000006	0.00001
Tin	kg/tonne	0.00000001	0.00000001
Thallium	kg/tonne	0.0000000	0.0000000
Uranium	kg/tonne	1.8E-07	3.7E-07
Vanadium	kg/tonne	3.6E-08	7.1E-08
Zinc	kg/tonne	0.00000024	0.0000005

Source: https://srk.sharepoint.com/sites/NACAPR002933/Internal/Task 500 Source Term Updates/01_Source_term_updates/02_Input_files/[TelkwaSourceTerms_Barrel_Loads_Sc2_CAPR002933_mkh_r4.xlsx

5.3 Open Pit Wall Rock Runoff

The base case and high case open pit wall rock runoff source terms for the End of NMP, End of EMP and EOM are provided in Table 5-6. The charge balance in of the wall rock source terms is less than 10%, which is considered reasonable for solutions based on averaging several release rates in the field barrel tests. The pH of solutions was alkaline (7.4 to 8.1) and maximum pit wall runoff concentrations occurred at the end of the EMP since this timeframe represents the maximum exposure of pit wall and has the highest reactive mass (Table 4-6).

Most of the constituents were higher in the high case source term in comparison to the base case. Concentrations of iron were lower in the high case source terms. Iron concentrations are low in both scenarios since it is solubility constrained through ferrihydrite ($Fe(OH)_3$) precipitation. Lower iron concentrations occur in the high case source term since these solutions are more alkaline reducing the ferrihydrite solubility (i.e., more ferrihydrite is predicted to precipitate in the high case scenario).

Table 5-6. Open Pit Wall Rock Runoff Source Terms

Parameter	Units	Open Pit Wall Runoff - End of NMP		Open Pit Wall Runoff - End of EMP		Open Pit Wall Runoff - EOM	
		Typical	High	Typical	High	Typical	High
Conventional							
pH	s.u.	7.4	7.8	7.6	7.8	7.4	8.1
% Error	%	-0.3	-0.3	0.5	0.5	-0.3	-0.3
Alkalinity	mg $CaCO_3$/L	24	837	40	718	27	1662
Major Ions							
Calcium	mg/L	2	58	4	65	0	15
Magnesium	mg/L	2	53	3	61	0	13
Potassium	mg/L	0	7	0	7	0	11
Sodium	mg/L	26.3	906.0	47	856	23	1404
Chloride	mg/L	0.4	12.7	0.7	11.8	0.3	19.2
Sulfate	mg/L	42	1442	81	1469	23	1432
Dissolved Elements							
Aluminum	mg/L	0.0013	0.0024	0.0016	0.0022	0.0014	0.0041
Antimony	mg/L	0.00004	0.00136	0.00007	0.00122	0.00004	0.00246
Arsenic	mg/L	0.00005	0.00167	0.0001	0.002	0.00	0.002
Barium	mg/L	0.0006	0.0193	0.0011	0.0198	0.0005	0.03
Boron	mg/L	0.01	0.21	0.01	0.19	0.01	0.39
Cadmium	mg/L	0.0000	0.00013	0.00001	0.00015	0.0000	0.00007
Chromium	mg/L	0.00003	0.00097	0.00005	0.00089	0.00003	0.00156
Cobalt	mg/L	0.001	0.034	0.0017	0.0306	0.0002	0.0098
Copper	mg/L	0.0001	0.0038	0.0002	0.0035	0.0001	0.0068
Iron	mg/L	0.00047	0.00021	0.00031	0.00024	0.00042	0.00013
Lead	mg/L	0.00006	0.00219	0.0001	0.0019	0.00007	0.00432
Lithium	mg/L	0.003	0.09	0.005	0.09	0.0019	0.12
Manganese	mg/L	0.01	0.43	0.022	0.4	0.0005	0.03
Mercury	mg/L	0.00000	0.000005	0.00000	0.000006	0.00000	0.000006
Phosphorus	mg/L	0.0002	0.007	0.0004	0.0074	0.0002	0.0096
Molybdenum	mg/L	0.0021	0.0725	0.0035	0.0636	0.0023	0.1413
Nickel	mg/L	0.001	0.047	0.0023	0.041	0.0003	0.021
Selenium	mg/L	0.001	0.04	0.002	0.042	0.001	0.06
Silica	mg/L	0.05	1.6	0.1	1.5	0.04	2.5
Silver	mg/L	0.0000012	0.0000425	0.0000023	0.0000411	0.000001	0.000062
Strontium	mg/L	0.02	0.79	0.05	0.82	0.01	0.52
Tin	mg/L	0.00002	0.00062	0.00004	0.00074	0.00001	0.00065
Thallium	mg/L	0.000003	0.000108	0.000008	0.000152	0.000001	0.000062
Uranium	mg/L	0.00024	0.00829	0.0004	0.0075	0.0003	0.0161
Vanadium	mg/L	0.0001	0.0022	0.0001	0.0022	0.0001	0.0031
Zinc	mg/L	0.001	0.049	0.0025	0.0448	0.0003	0.0211

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6 Summary

SRK (2022a) developed geochemical source terms by scaling HCT testing results to field conditions. A comparison to the scaled HCT and barrel testing results indicated that the release rates of some constituents are higher in the barrels in comparison to the HCT. The geochemical source terms were updated using the barrel release rates. The barrel release rates are considered more appropriate for estimating site drainage water quality because they are more representative of solute release rates under field conditions.

Barrels were constructed using mine rock sample rejects and overburden. Insufficient processed rock (e.g., coal, coarse rejects, etc.) sample precluded barrels being constructed for these materials. Base The following source terms were updated using the barrel testing results:

- Unsaturated non-PAG & overburden
  - Pits backfill
  - Dams/buttresses
- Saturated non-PAG rock
- Saturated PAG rock
- Open pit wall rock runoff

The following source terms were not updated and the SRK (2022a) source terms remain current:

- Processed rock
- Processed coal stockpile runoff
- Particulate concentrations

The above source terms will be carried forward into the site wide water and load balance to evaluate the mixed project discharge water quality. To evaluate uncertainty in the model, both the base case and high case scenarios should be evaluated.

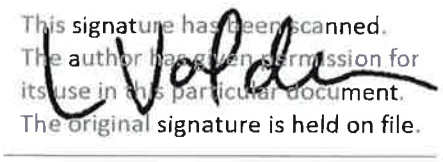
Closure

This report, Updated Water Quality Model Source Terms, was prepared by



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EGBC Permit to Practice Reg. No.: EGBC 1003655

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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APPENDIX 5: TENAS PROJECT - SUBOXIC EVALUATION OF NON-ACID GENERATING MINE ROCK, OKANE

Tenas Project - Suboxic Evaluation of Non-Acid Generating Mine Rock

August 2, 2024



TELKWA MINING LIMITED

okane

Integrated Mine Closure and Relinquishment Solutions

Tenas Project - Suboxic Evaluation of Non-Acid Generating Mine Rock

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EXECUTIVE SUMMARY

Okane Consultants (Okane) are providing support to evaluate the development of suboxic conditions for the backfill of non-potentially acid generation (NAG) mine rock into the Open Pit for Telkwa Mining Limited (Telkwa) at their proposed Tenas Project in northwest British Columbia. The current scope focuses on placement of NAG mine rock. The objective of the scope was to develop geochemical source terms for the backfilled mine rock that reflect the construction and reclamation schedule, and the resulting hydrological and oxygen conditions of the backfill.

The source terms were developed using a two-dimensional oxygen model to evaluate the size, location, and timing of suboxic (low oxygen concentration) conditions within the NAG backfill. The formation of suboxic conditions limits oxidation rates of sulfide minerals and decreases the loads of constituents of interest released from sulfide oxidation to the receiving environment. The source terms will be used as inputs for the site-wide water quality model that integrates seepage and chemical loads from all mine domains to understand the overarching water quality effects of the Project on the receiving environment. All years presented herein refer to mine plan years.

Three scenarios were chosen to evaluate the development of suboxic conditions. The three scenarios were:

- Scenario #1: Poorly graded till and sandstone mine rock;
- Scenario #2: Well graded till and mine rock mix (60% siltstone, 35% mudstone, and 5% sandstone);
- Scenario #3: Well graded till and mine rock mix (60% siltstone, 35% mudstone, and 5% sandstone) with no internal cover layers.

During the covered time period for all modelled scenarios, two sequential cover surface conditions (grass cover followed by the establishment of mature forest) were used to simulate the maturing of vegetation on the cover system. These surface conditions affected how oxygen and water move into the cover material and underlying NAG backfill. For a five-year period directly after cover placement the simulation used a grass surface; following this five-year period, a forest surface was used for the remainder of the model timeframe.

GoldSim seepage modelling for the NAG backfill demonstrated a significant reduction in stabilized seepage rates between the modelled scenarios. Stabilized seepage rates for Scenarios #2 and #3 were approximately half of the stabilized rates for Scenario #1. The modelling also demonstrated that the NAG backfill will be wetted up after approximately 40 years in Scenario #1 and approximately 80 years in Scenarios #2 and #3 due to differences in material texture in the cover system. Modelling demonstrated that suboxic conditions within Scenario #1 took approximately 15 years to develop and approximately 13 years in Scenarios #2 and #3 once the cover system was placed. Depths to suboxic conditions varied between the scenarios due to differences in oxygen ingress and net percolation. Scenario #1 had a

long-term depth to suboxia of approximately 15 m while Scenarios #2 and #3 had a long-term depth to suboxia of approximately 3 m.

Estimated stored water volumes increase as mine rock is placed during construction and stabilize after approximately 15 years when construction has ended. Similar to seepage results, the stored water volumes stabilize after approximately 40 years for Scenario #1 and 70-80 years for Scenarios #2 and #3. Stored water volumes in the NAG backfill are predicted to be lower in Scenarios #2 and #3 relative to Scenario #1.

Source terms were developed for Scenarios #1, #2, and #3 using a reactive transport modelling approach. Reactive transport modelling was used to simulate the weathering of sulfide and carbonate minerals and resulting concentrations of related dissolved constituents using mechanistic kinetic weathering rates controlled by the geochemical setting of the NAG backfill. For constituents not directly controlled by sulfide oxidation and carbonate dissolution, a constant loading rate scale-up model was used to develop source terms. The geochemical models were calibrated to on-site kinetic barrel tests containing NAG mine rock and subsequently applied to the full-scale NAG backfill geometry.

The geochemical model incorporated changing cover system surface conditions by changing net percolation into the model for each time period (bare mine rock, grass coverage, and forest coverage). The effects of suboxic zones were simulated by limiting pyrite oxidation to depths where oxygen models simulated oxic conditions.

In general, concentrations for modelled parameters were similar between all scenarios. Although it was evident that less pyrite oxidation was occurring in the Scenario #2 and #3 models due to the larger suboxic zones, which resulted in lower mass release of oxidation products, decreased infiltrating water volumes (i.e., less dilution) in these scenarios resulted in similar concentrations as seen in Scenario #1. The primary benefit of the well-graded cover system scenarios is the overall decrease of released load of oxidation products (e.g., selenium and sulfate) from the NAG backfill. Scenarios #2 and #3 consistently had lower chemical loading relative to Scenario #1 resulting in approximately half the mass of oxidation products released from the NAG backfill on an annual basis. Scenarios #2 and #3 had similar chemical loading due to similar lag-times to suboxic zone development and depth to suboxic conditions. Additionally, geochemical source terms of the NAG backfill from the current model were comparable, although generally slightly lower, than source terms initially developed for the backfill (SRK, 2022a). The NAG backfill source terms from this modelling work will be integrated into the site wide load balance model to quantify the effects of the backfill on water quality around the Tenas project.

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1 INTRODUCTION

1.1 Project Description

Telkwa Mining Limited (Telkwa) are proposing to develop the Tenas Project (Project), located approximately 25 km southwest of the town of Smithers in northwest British Columbia (BC) within the Telkwa and Bulkley River watersheds. The Project consists of an open pit, backfill, external stockpiles, water management ponds, control ponds, coal processing plant, and rail infrastructure. Elevation of the Project ranges from 750 to 1,050 meters above sea level (masl), with a median elevation of 800 masl. The Project is within the Ministry of Environment and Climate Change Strategy (MECCS) Zone 8 – Nechako Plateau, close to the border with Zone 9 – Southern Hazelton Mountains (Ahmed and Jackson, 2013). The MECCS hydrological zones are areas of homogeneous hydrologic and geomorphic characteristics.

1.2 Project Objectives and Scope

Okane Consultants (Okane) is providing support to develop source terms for three scenarios of backfill NAG mine rock in lifts using bottom-up construction methodology with overburden covers within the Open Pit provided by Telkwa. The objective of the backfilled design is to limit oxygen and water ingress to minimize the release of potential contaminants of concern such as selenium and sulfate to the receiving environment.

A geochemical model that incorporated both a mechanistic reactive transport model and geochemical scale-up model was developed to simulate long-term water quality of mine rock backfilled into the Open Pit. Seepage water quality results from the geochemical model were developed as source terms to be used in the Tenas site-wide water quality model developed by SRK Consulting (SRK).

1.3 Report Organization

For convenient reference, this report has been subdivided into the following sections:

- Section 2 – Provides pertinent background information for this study;
- Section 3 – Description of modelling processes;
- Section 4 – Modelling results and discussion; and
- Section 5 – Conclusions of the modelling work.

2 BACKGROUND

Source control of contaminants of interest (COIs) is a cutting-edge practice. It demonstrates a significant commitment to minimizing water quality impacts in the region to both regulators and stakeholders. Okane has extensive experience in implementing closure strategies to mine storage facilities, ultimately limiting oxygen ingress and net percolation into the underlying waste material. This working experience has led to development of fully integrated models that link hydrology, oxygen conditions, material properties, mine rock structure and climate to develop source terms for site-wide water quality models.

Okane's experience has shown that there are solutions available to improve source control and water quality, therefore, providing the opportunity to relinquish the site at the end of the mine life versus treating water from the mine rock into perpetuity. Such solutions can include progressive reclamation and the application of oxygen-limiting cover systems which can lead to the development of suboxia within the NAG mine rock storage facilities (MRSFs) to help improve long-term seepage quality by inhibiting the oxidation of sulfide minerals within the SOZ, decreasing the release and production of metal leaching in the lower zones of the MRSF.

Currently for the Project, suboxia is defined as pore gas oxygen concentrations less than 1 vol.%, which results in a dissolved oxygen concentration in pore water of less than 1 mg/L. The NAG mine rock is a large porous mass, which during placement will have oxygen concentration in pore spaces reflecting ambient conditions, or near to ambient conditions. Oxygen within NAG mine rock pore spaces will be depleted because of sulfide (pyrite) oxidation.

2.1 Net Percolation and Oxygen Ingress Classifications

The term 'net percolation' (NP) is used throughout this memo and is defined as presented in Figure 2.1. Precipitation (PPT) that reaches the cover system surface will either be intercepted by vegetation, run off (RO), or infiltrate into the cover system. A portion of the water that infiltrates will be stored in an active zone (ΔS) where water is actively cycled within the soil profile and into the atmosphere. Water stored in the active zone can be evaporated (AE) into the overlying atmosphere or can be removed by plant transpiration (AT); the combination of evaporation and transpiration is referred to as actual evapotranspiration (AET). Water in the cover system can also potentially move laterally as interflow. Water that moves below the active zone and is no longer available to be removed from the system via AET or laterally is defined as NP. NP is infiltrating water expressed as a percentage of average annual precipitation (PPT) that will migrate beyond the active zone because of gravity overcoming the influence of evapotranspiration, resulting in flow of water into the underlying NAG mine rock and overburden cover.

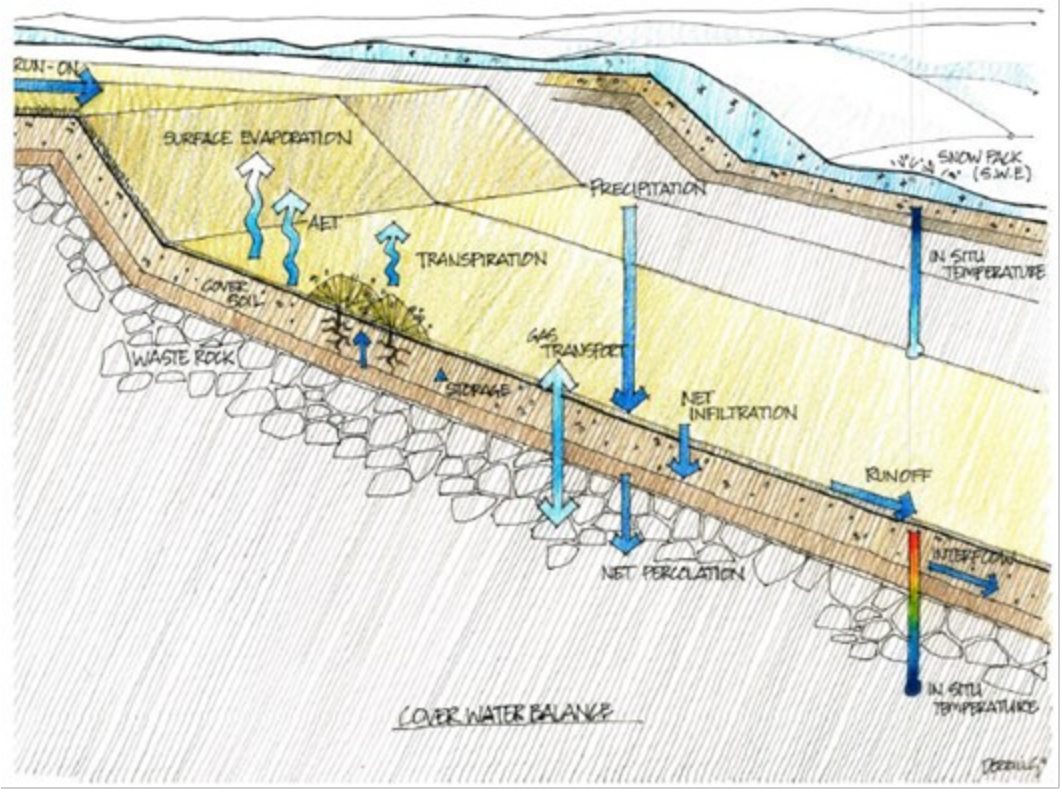


Figure 2.1: Schematic of hydraulic processes that influence performance of a cover system (from INAP, 2017)

As shown by the Project climate data described later in this report, the Project is classified as subarctic (Dfc) using the Köppen-Geiger climate classification (Peel *et al.,* 2007). Based on this classification, the range of cover system performance for the Tenas Project is presented conceptually, as defined in the Global Cover System Design Technical Guidance Document (INAP, 2017), as follows:

- "Very High" NP is greater than 50% PPT;
- "High" NP is between 25% PPT and 50% PPT;
- "Moderate" NP is between 15% PPT and 25% PPT;
- "Low" NP is between 5% PPT and 15% PPT; and
- "Very Low" NP is less than 5% PPT.

Within a single climatic regime, the same range of NP rates may be a result of the influence of differing abilities of a cover system to evapotranspirate water, and to promote runoff and interflow (i.e., lateral flow within the cover system) from the landform. Net percolation rates will also vary from year to year. For example, a high rainfall year (or, more specifically, several successive wetter than average climate

years) may result in a moderate net percolation rate for the year, even for a cover system scenario classified, on average, as having a low net percolation rate.

Cover performance with respect to oxygen (O_2) ingress can also be classified using the Global Cover System Design Technical Guidance Document (INAP, 2017) as follows:

- "Very High" O_2 ingress is greater than 100 mol/m^2/year;
- "High" O_2 ingress is between 50 and 100 mol/m^2/year;
- "Moderate" O_2 ingress is between 10 and 50 mol/m^2/year;
- "Low" O_2 ingress is between 1 and 10 mol/m^2/year; and
- "Very Low" O_2 ingress is less than 1 mol/m^2/year.

Limiting oxygen ingress is often achieved by limiting diffusion or restricting air flow by reducing pressure and/or thermal gradients. Usually, the most effective way to limit oxygen ingress is to create and sustain saturated conditions in a layer within the cover system. O_2 ingress is less challenging to limit in wetter environments where a tension-saturated layer is more easily maintained, and finer-textured material together with the tension saturated conditions will lead to reduced air permeability and therefore, advective gas transport. A similar range of performance exists for O_2 ingress as for NP where rates will vary from year to year. For example, a low rainfall year or several successive drier than average years will reduce the degree of saturation maintained within the cover system and may increase the predicted oxygen ingress rate for the year.

Limiting NP and O_2 ingress are not necessarily mutually beneficial and achieving reductions in either or both is site specific. Depending on available materials for cover system construction, limiting NP may result in less water available to maintain a saturated layer, whereas limiting O_2 ingress may require promoting additional NP. Hence, a technical assessment is required to make decisions on how best to optimize these two aspects to best take advantage of how each facet enhances performance for a particular project.

2.2 Site Specific Attributes

Assessment of the NAG backfill and cover system performance requires analysis of site attributes that constrain design alternatives to achieve the desired performance (INAP, 2017). The following site-specific attributes will be used to define performance of the NAG backfill design at Tenas:

- Climate;
- Hydrogeological setting;

- Materials;
- Vegetation; and,
- Geochemistry.

These key site attributes are described in the following sections based on background data provided by Telkwa.

2.3 Climate

The regional climate is a subarctic climate where winters are cold, averaging around -5°C during the period of November through February with temperatures potentially dropping to -30°C or colder, and summers are warm, with average temperatures greater than 20°C and highs of greater than 30°C are possible. Precipitation occurs as rain during the warmer months, accounting for 60-65% of annual precipitation. Snow accounts for 35-40% of annual precipitation with maximum accumulation of snow occurring in February-March.

The Project falls near the intersection of Dfc (subarctic climate) and Dsc (Mediterranean-influenced subarctic climate) of the Köppen-Geiger climate classification system (Peel *et al.*, 2007) where:

- D – 'continental' where average temperature of the coolest month is < -3 °C, and average temperature of the warmest month is > 10 °C;
- f – 'without dry season' where precipitation is evenly distributed throughout the year;
- s – 'dry summer' where precipitation of the driest month in summer is less than 40 mm and is also less than a third of the precipitation of the wettest month in winter; and
- c – 'cold summer' where one to three months average temperature reach >10 °C but < 22 °C.

2.4 Hydrogeological Setting

The results of historical hydrogeological investigations and *in-situ* testing are presented in Table 2.1. Surficial material is primarily sandy till to silty clay (Piteau, 1997), which is underlain by fractured sedimentary bedrock consisting of mudstones, siltstones, and sandstones (Klohn, 1985; Piteau, 1997; SRK 2018; 2019). *In-situ* hydraulic conductivity of the bedrock ranged from 6.0×10^{-6} m/s to 1.0×10^{-10} m/s.

Using the British Columbia Groundwater Wells Database, a search was completed, and 11 water wells were found in the vicinity of the mining operations. Nine domestic drinking water wells and two commercial water wells were found to be in the area N-NE of the mine site. Four of the wells are just south of the Telkwa River and west of Tenas Creek while the remaining seven (7) wells are east of Goathorn Creek. The range in finished depth of the water wells is 12 to 43 m below ground level (mbgl),

with a range of static head of 5.5 to 39 m below top of casing (btc), and an estimated yield range from 15 to 114 L/min.

Table 2.1 Record of hydrogeological investigations and *in-situ* testing.

Location and Geology	Hydrogeological Instrumentation	Groundwater Flow and Piezometric Surface	*In-Situ* Hydraulic Conductivity (K) and Linear Flow Velocity (V)
Telka Site (Klohn, 1985) Variable thicknesses of glacial till and gravel overlying sequences of sandstones, siltstones, mudstones, and coal. Bedrock dips 15-20 degrees to the east and is structurally dominated by several N-S trending reverse faults and normal faults which trend N-S and EW. Bedrock is of low permeability and contains no stratigraphically definable aquifers. The groundwater table is at or close to ground surface for much of the eastern part of the site. Breccia filled fault zones are expected to be significant conductors of groundwater.	16 piezometers installed (*none of the piezometers are still functional)	23 rural households within 3 km of the mine area obtain their domestic water supplies from groundwater, either by dug wells (2 to 6 m depth) or by drilled wells (less than 50 m depth) Domestic well records indicate that groundwater in the area is at about 12.5 m depth within a gravel layer.	Coefficient of permeability, Coal: 5×10^{-7} to 5×10^{-9} m/s Siltstone, Mudstone Sandstone: 2×10^{-7} to 1×10^{-10} m/s Recharge was estimated as 3% of annual precipitation based on the estimated groundwater flux and a value for hydraulic conductivity derived from the packer tests.
Tenas Pit (Piteau, 1997) Telkwa coal lease is underlain by coal-bearing sedimentary sequence comprising siltstone, sandstone, mudstone, and shale strata of the Lower Cretaceous age Skeena Group (Units 1-4). Economic coal seams in Unit 1 – 120 mm thick sequence of interbedded coal and sedimentary rocks. Faulting is near vertical, one group strikes ~NW/SE and other group strikes ~NE/SW. Few E/W striking faults. Surficial deposits are primarily till ranging from sandy silt to silty clay with minor gravel with range in thickness from less than 3 m to more than 10 m.	4 piezometers within coal seam #1 in 1995 5 piezometers in the major coal seams at three new locations in 1996	NE direction with horizontal hydraulic gradient of ~0.1. Flowing artesian conditions exist in all but 3 piezometers completed in coal seam #1.	K range of 2.1×10^{-8} to 6.0×10^{-6} m/s Average V is 115 m/year but does not consider local fault or fracture zones. V in the range of 10 to 250 m/year may be expected.

Location and Geology	Hydrogeological Instrumentation	Groundwater Flow and Piezometric Surface	*In-Situ* Hydraulic Conductivity (K) and Linear Flow Velocity (V)
Waste Dumps (Piteau, 1997) Waste dump sites underlain by till from 3.75 - 13.5 m thick. Thinnest till blanket is deposited directly on the bedrock surface and thickest till deposit overlies outwash sediments. East side of Tenas pit, thin 6.0 m till overlies permeable sands and gravels. Where overburden is more than 10 m thick, bedrock is overlain by high permeability sand and gravel outwash deposits. The thickest of which (106 m) is in the NW corner of the Tenas waste dump sites where a buried channel (clays, sands, and gravels) exists where the depth to bedrock exceeds 117 m. Bedrock from 4.6 - 117 m consists of either volcanic ash or interbedded sequences of siltstone and mudstone with occasional sandstone.	11 holes drilled at 9 locations	Interpreted to follow topography within surficial sediments between 0.5 - 2.0 m. Depending on location, shallow groundwater flow will either be in a northwesterly or northeasterly direction towards Tenas Creek or Four Creek. At one piezometer nest, strong downward vertical gradients indicative of groundwater recharge conditions exist between upper and lower water-bearing deposits. Due to upland topography of the waste dump sites, groundwater recharge conditions are expected to prevail.	Three single well response tests indicated K of the upper water-bearing till deposit to be in the range of 2.8×10^{-9} to 7.2×10^{-7} m/s. These values are low and thus vertical infiltration rates through this deposit would similarly be expected to be low.
Pit 3 (Piteau, 1997) Bedrock: alternating sequence of siltstone, mudstone, sandstone, and coal with sporadic volcanic tuffs throughout the sequence. Complex series of sub-parallel, N-S trending reverse faults and N-S, and to a lesser extend E-W, trending normal faults. Bedrock overlain by ~10 - 15 m of silty clay till with minor coarse fragments and sand.	5 piezometers installed at 3 locations in Pit 3. At each location, a piezometer was completed across coal seam #2 A second piezometer was installed across coal seam #4 at two locations.	Within coal units, groundwater flow is interpreted to be in a north to northwesterly direction. Horizontal hydraulic gradient of ~0.04. Depth to water ranged from 7.55 - 36.73 mbgs.	From one single well response test, K of coal seam #2 estimated at 4.3×10^{-10} m/s. From two single well response tests, K of coal seam #4 estimated at 8.5×10^{-7} m/s and 3.7×10^{-6} m/s. Average V in coal seams estimated range 20-100 m/year.
Mine rock dumps and sediment ponds (SRK, 2018)	13 sonic drillholes to depths between 9.0 m and 30.8 m upon reaching bedrock or sufficiently high soil density.	Two sonic piezometers were dry, one had water up to ground level and the last had a depth to water of ~14 m.	-

Location and Geology	Hydrogeological Instrumentation	Groundwater Flow and Piezometric Surface	*In-Situ* Hydraulic Conductivity (K) and Linear Flow Velocity (V)
	4 standpipe piezometers were installed for groundwater monitoring in 2017. 8 diamond drillholes with lengths from 70 m to 213.7 m were drilled. 3 of these drillholes had piezometers installed in them.		
Management ponds, sediment ponds, external soil/rock piles and infrastructure pad (SRK, 2019)	12 sonic drillholes were terminated at depths between 10.7 m and 67.1 m upon reaching bedrock. 12 standpipe piezometers were installed for groundwater monitoring in 2018.	The shallowest groundwater levels were approximately 14 mbgs but the piezometric table was located between 20 m and 40 m within the overburden soils.	-

2.5 Materials

Site-specific material characterization and availability are the two main elements for cover system design. Material selection and strategic placement is a key control on cover system performance and is used to provide a means for functions such as vegetation establishment, erosion control, and drainage where required in the cover system design (MEND, 2004).

Surficial deposits (overburden) within the Project Area are primarily till ranging from sandy silt to silty clay with minor gravel (and less than 5% cobbles and boulders) with a range in thickness over the Tenas Project Area from 4 m to 100 m (SRK, 2018). Recent drilling investigations (SRK, 2018; 2019) of the overburden material are in agreement with historical investigations (Klohn, 1985; Piteau, 1997) except for no sand and gravel outwash deposits in the northwest of the project site reported in Piteau (1997) being encountered in current drill holes (SRK, 2018; 2019). The till surface deposits will be excavated in the mining process and stockpiled for later use in the cover systems or direct placed from mining.

The bedrock in the Tenas Open Pit is of the early Cretaceous-aged Skeena Group and consists of alternating sequences of siltstone, mudstone, sandstone, and conglomerates with inter-bedded, bituminous coal seams (SRK, 2018). In Unit 1 a sedimentary sequence from 50 m to 120 m in thickness is interbedded with Coal Seam 1 (Seamas 1A-1F) with individual thicknesses of 1 m to 3 m (SRK, 2018). To access the inter-bedded coal layers, the bedrock will be excavated becoming mine rock to be placed in lifts and covered with the till material.

Particle size distribution (PSD) data was only available for the overburden till material and no information was available for the mine rock. The overburden material can be grouped into two categories based on the PSD data, a poorly-graded till and a well-graded till. Figure 2.2 shows the range of PSDs for each group based on the testing completed by SRK in 2019 (SRK, 2019). Following completion of sample compaction tests, four till samples were assessed for permeability, the results ranged from 1.04×10^{-7} m/s to 1.18×10^{-10} m/s (SRK, 2018).

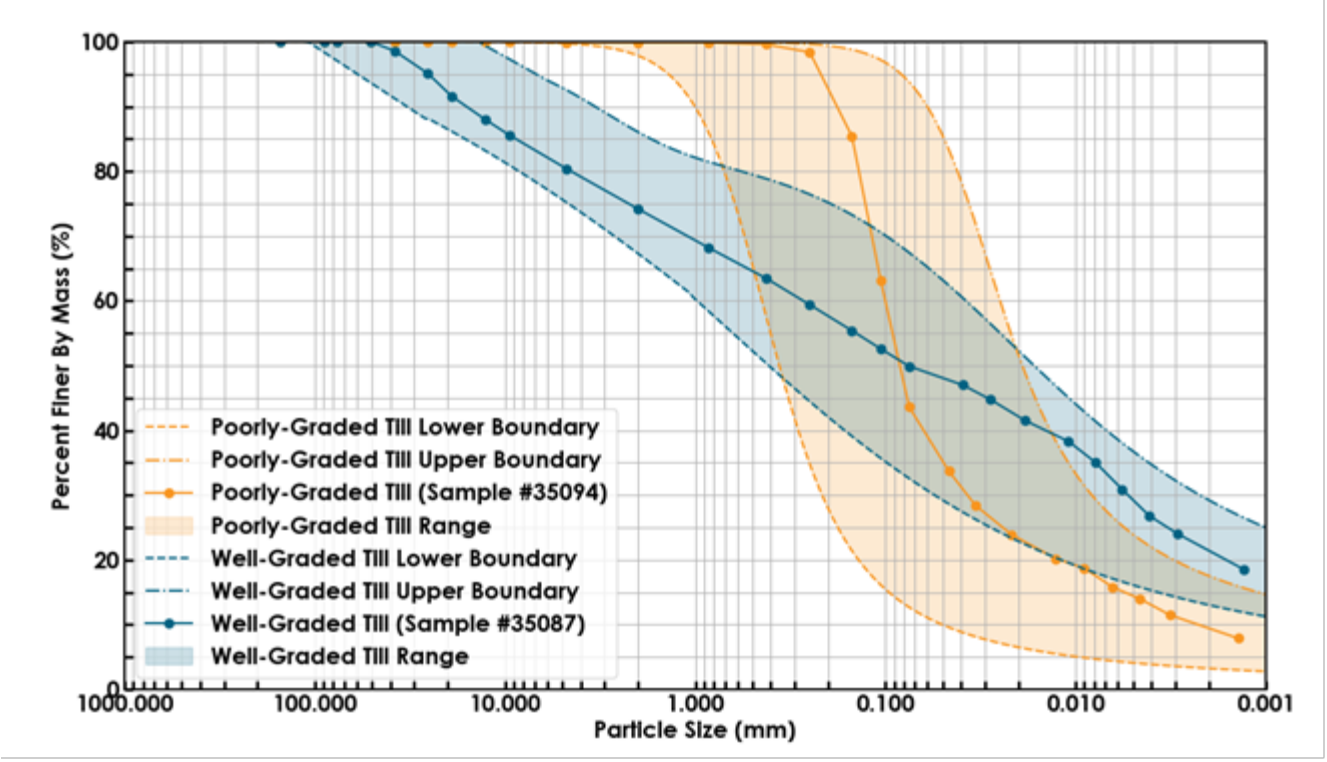


Figure 2.2: Range of PSDs for Poorly-Graded and Well-Graded Till based on SRK (2019).

(adapted from SRK, 2019)

2.6 Vegetation

The Project is located within the Sub-Boreal Spruce (SBS) zone of the biogeoclimatic zones of British Columbia. The dominant coniferous tree species in this zone include hybrid white spruce (hybrid of Engelmann spruce and white spruce), sub-alpine fir, lodgepole pine, and occasionally, black spruce and Douglas-fir (BC Ministry of Forests, 1998). Deciduous species include trembling aspen and paper birch.

2.7 Geochemistry

Non-potentially acid generating mine rock will be used as backfill into the Open Pit. Although sulfide minerals are present (and sulfide oxidation is expected), these materials contain an excess of neutralization potential (at least 2x) relative to the acid potential (AP) and are not expected to generate acidic drainage (Price, 2009). However, sulfide oxidation products will still be generated and transported through the mine rock by contact water. Concentrations of select dissolved trace metals and sulfate will be constrained by secondary mineral precipitation (e.g., gypsum and metal hydroxide phases) and adsorption to iron hydroxides that typically precipitate in circum-neutral mine waters. However, even with these solubility controls, metal loads from pyrite oxidation could still pose a risk to downstream

receptors. A conceptual model of geochemical reactions occurring along a typical flow path within the Tenas NAG mine rock is shown in Figure 2.3.

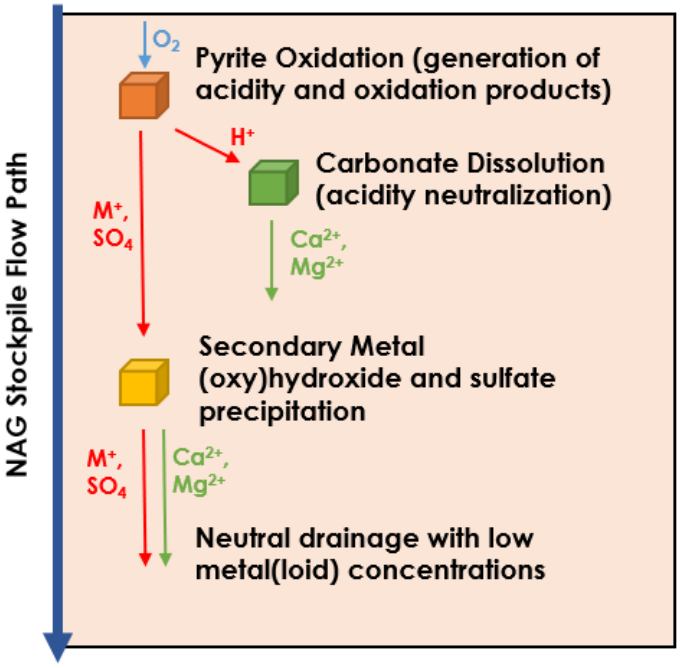


Figure 2.3: Geochemical conceptual model for Tenas NAG mine rock flow path.

Parameters that were elevated above typical crustal concentrations within the Project Area were: arsenic, phosphorus, sulfur, and selenium. Although elevated solid-phase concentrations do not necessarily imply that these species will be mobilized and result in elevated concentrations in contact water, solid-phase metals analysis was completed to flag potential contaminants of concern to evaluate in further geochemical testing.

Current geochemical characterization recommended the use of a neutralization potential ratio (NPR) > 1.60 to classify mine rock as NAG (where, NPR = neutralization potential / acid potential) during verification testing completed during the Operations phase of the Project. For planning and the EAC submission, an NPR cutoff of 2.0 was used to classify mine rock as NAG or PAG, with values > 2.0 considered NAG. This is based on a strong correlation between NP_{XRD} and modified NP following correction for iron carbonates and was developed using calcium and magnesium molar ratios in humidity cell tests (HCTs; SRK, 2022b).

Dolomite-ankerite and calcite are the most abundant carbonate minerals with lesser amounts of siderite in NAG mine rock while PAG mine rock has a higher siderite content. Dolomite-ankerite content ranged from 0.3 to 23.8 wt.% (median = 14.0 wt.%), while calcite ranged from below detection (BD) to 4.4 wt.% (median = 1.4 wt.%). Siderite content ranged from 0.2 to 12.6 wt.% (median = 2.0 wt.%). It is worth noting that siderite does not provide net neutralization to acidity generated from sulfide oxidation. This is because Fe(II) released from siderite dissolution typically oxidizes to Fe(III) which precipitates Fe(III)

hydroxide phases, releasing acidity. Therefore, the bulk of acidity neutralization in the NAG mine rock will come from the dissolution of calcite and dolomite. The primary sulfide mineral in the PAG mine rock is pyrite, which ranges from 0.3 to 2.5 wt.% (median = 0.8 wt.%).

3 DESCRIPTION OF MODELLING PROCESSES

To estimate seepage quantity and quality for the backfilled NAG mine rock in the Open Pit, Okane used the following numerical models and modelling process.

1) ***One-Dimensional (1D) Soil-Plant-Atmosphere (SPA) Models*** using components of the GeoStudio FLOW (Bentley Systems, 2022) modelling suite (namely, SEEP/W and TEMP/W) to simulate the NP rate.

2) ***Two-Dimensional (2D) Oxidation Model*** using the GeoStudio FLOW suite, including SEEP/W, TEMP/W, CTRAW/W, AIR/W, and the Gas Consumption and Exothermic Reactions Add-In Module to evaluate the size and development of suboxic conditions.

3) ***Three-Dimensional (3D) GoldSim Oxidation, Wetting-Up and Draindown Model*** to determine a range for potential seepage and oxygen consumption based on hundreds of realizations of the model, using the GoldSim Monte-Carlo formulation (GoldSim, 2021).

4) The ***Geochemical Model*** using a combination of both a *mechanistic reactive transport model* and a *scale-up geochemical model* to evaluate the evolution of water quality moving through the overburden cover and into the backfilled NAG mine rock.

The source terms from the geochemical model will be provided to SRK to be used in the site-wide water quality model to evaluate the potential effects of key mine facilities on the receiving environment. The following sections describe the numerical models in more detail.

3.1 1D Soil-Plant-Atmosphere Model with GeoStudio SEEP/W and TEMP/W

In combination, SEEP/W and TEMP/W are a 2D finite element model (which can also perform 1D simulations) that predict suction in the material profile in response to climatic forcing (such as evaporation) and lower boundary conditions (such as a water table). A key feature of the software is the ability of the model to predict actual evapotranspiration (AET) based on potential evaporation (PE) and predicted suction, as opposed to the user being required to input these surface flux boundary conditions. The AET rate from the surface material is below the potential rate during prolonged dry periods because the suction, or negative pore water pressure, in the material profile increases as the surface desiccates. In addition, SEEP/W and TEMP/W together form a fully coupled (through the vapour pressure term) heat and mass transfer model, which can predict water vapour movement and the influence of freeze/thaw on hydraulic conditions through reductions in the hydraulic conductivity. The 1D SPA models provide runoff and NP estimates, which are used as inputs in the 2D Oxidation and 3D GoldSim Oxidation, Wetting-Up, and Draindown models.

3.2 2D Oxidation Models

The 2D oxidation modelling was completed using the GeoStudio FLOW suite (SEEP/W, TEMP/W, CTRAN/W, and AIR/W) and the Gas Consumption and Exothermic Reaction Add-In to evaluate the size and development of suboxic zones within the NAG backfill. The models will account for annual material placement and provide estimates of the timing and depth to the suboxic zones, which are used in the 3D GoldSim model, as well as an estimate of cumulative oxygen (O_2) consumption with time, which is used to calibrate and validate the 3D GoldSim results.

3.3 3D GoldSim Oxidation, Wetting-Up and Draindown Model

The 3D model is a wetting-up and drain-down model developed by Okane in GoldSim to simulate the water movement in mine rock based on climate data and material properties. In the model, gravity-driven water flow depends on the NP rate and hydraulic conductivity. The hydraulic conductivity of each layer of mine rock is calculated based on the following formula with measured material properties:

$$k(h) = k_s S_e^l \left[1 - \left(S_e^{\frac{1}{m}}\right)^m\right]^2 \quad (1)$$

where S_e is the effective saturation, k_s is the saturated hydraulic conductivity (LT^{-1}), n and m are van Genuchten's equation parameters, and l is the pore-connectivity parameter. The effective saturation, S_e, within the layer is defined as:

$$S_e = \frac{\theta_w - \theta_{wr}}{\theta_s - \theta_{wr}} \quad (2)$$

where θ_w is the volumetric water content of the layer, θ_{wr} is the residual volumetric water content (L^3/L^3), and θ_s is the saturated volumetric water content (L^3/L^3). The van Genuchten equation parameter m is defined as a function of n as:

$$m = 1 - \frac{1}{n} \quad (3)$$

In the modelling process, hydraulic conductivity is calculated based on the water content of each layer of mine rock. This parameter is then used to calculate the flow rate of water between layers of mine rock. The change in water content due to the placement of new mine rock can also be simulated as part of the hydrogeology model. The Monte-Carlo formulation is used to vary the material properties for each lift of material within an anticipated range to produce a more realistic estimate of overall backfill performance.

The 3D models were extended an additional 50 years to 2150 using stochastic net percolation inputs based on the 1D water balance to ensure that steady state seepage was reached.

3.4 Geochemical Model

The evolution of water quality in the backfilled NAG mine rock was evaluated using a combination of both a mechanistic reactive transport model and a scale-up geochemical model.

The ***Mechanistic Reactive Transport Model*** was constructed with PHREEQC v.3 (Parkhurst and Appelo, 2013) and accounts for geochemical characteristics such as mineralogy, reaction kinetics, transport time, and oxygen conditions of the mine rock. This model incorporates key reactive minerals including sulfides and carbonates, chronology of the NAG mine rock placement, and cover system placement and source control implementation leading to suboxic zone development.

The ***Scale-up Geochemical Model*** was completed to estimate parameters that were not modelled using the Mechanistic Geochemical Model, and generally consist of parameters not directly influenced by sulfide oxidation or carbonate mineral dissolution. Parameter concentrations were calculated based on field barrel leachate quality and scaled-up based on the physicochemical differences between the smaller scale test conditions and expected field conditions of the NAG backfill.

3.5 Model Inputs

3.5.1 Base Case Geometry

The in-pit NAG backfill will be constructed as 120 m wide by 36 m high cells, with a 3 m cover of compacted overburden on the slope of the cell and 1 m of compacted overburden on the plateau of each cell. The cells will be built starting with the face of the slope as a 4 m by 50 m lift / road (1 in Figure 3.1). The overburden and NAG mine rock will be end dumped and compacted in 1.33 m lifts. The second lift will be a 4 m by 39 m lift (2 in Figure 3.1) on top of the first lift, followed by a third lift of 4 m by 28 m (3 in Figure 3.1). The remaining space within the cell will be end dumped as a 12 m high standard dump (4 in Figure 3.1). This process is planned to occur three times per cell, resulting in a 35 m high cell. The last step of each cell is the addition of a 1 m compacted overburden layer, completing the 36 m high cell.

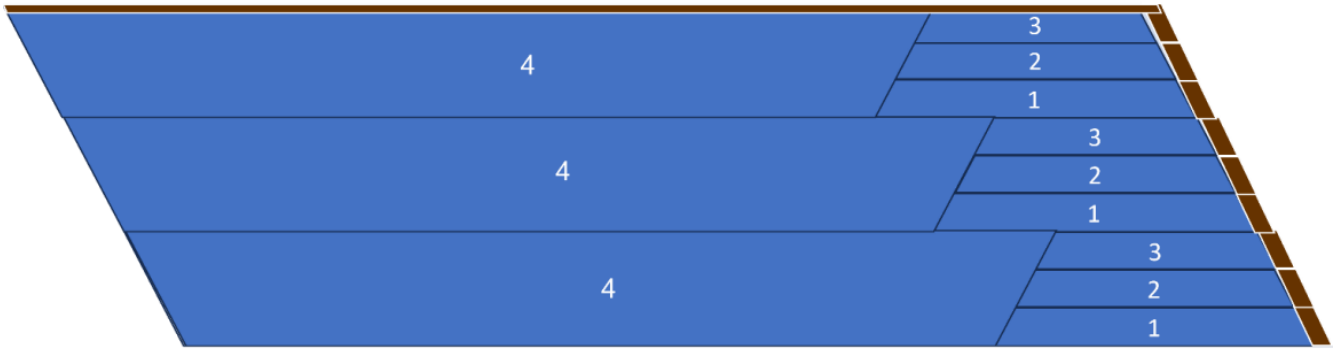


Figure 3.1: Building plan for the cells within the backfilled open pit NAG mine rock landform.

Cells will be stacked and reach an approximate height of three 36 m cells to complete the backfill within the Open Pit, as the bottom and top cells are anticipated to be half height, as shown in Figure 3.2, due to the pit bottom shape and final reclamation goals.

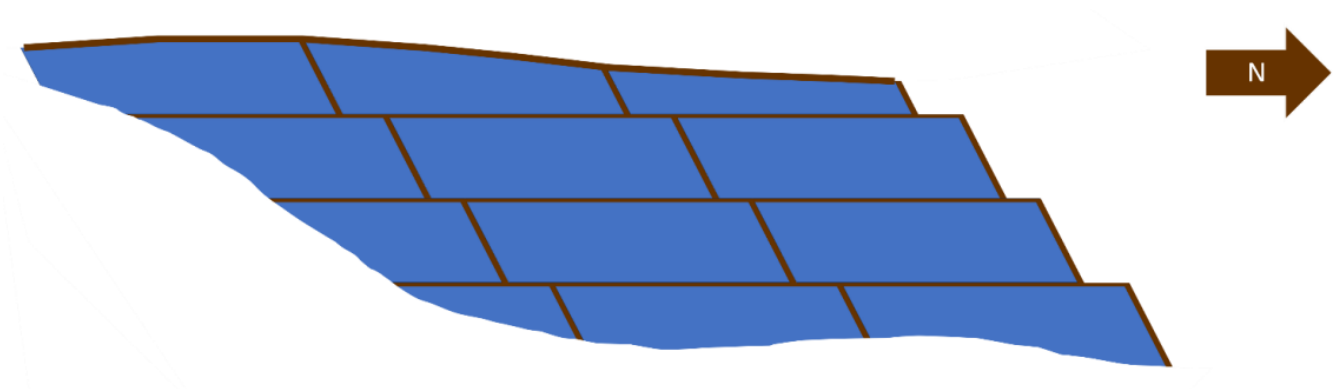


Figure 3.2: Encapsulation plan for NAG in-pit mine rock.

The final cover system on the landform will be 3 m of overburden overlain by approximately 0.3 m of surface soils (topsoil). The 1D models were constructed as 35 m of mine rock with the final cover system at the surface. These models were used to investigate the different material combinations.

A cross-section through the NAG backfill was modelled in 2D to determine the development and extent of the suboxic zone within the backfill. Figure 3.3 shows the approximate location of the cross section while Figure 3.4 shows the 2D geometry that was modelled.

An additional scenario that did not include the internal overburden layers was also modelled. This scenario assumed that the Open Pit would be backfilled following the same procedure as outlined above, but the entire 36 m cell would be composed of mine rock, with only the final cover system being composed of overburden.



Figure 3.3: Plan view of the backfill open pit NAG mine rock showing the strips and approximate location of the projected cross section.

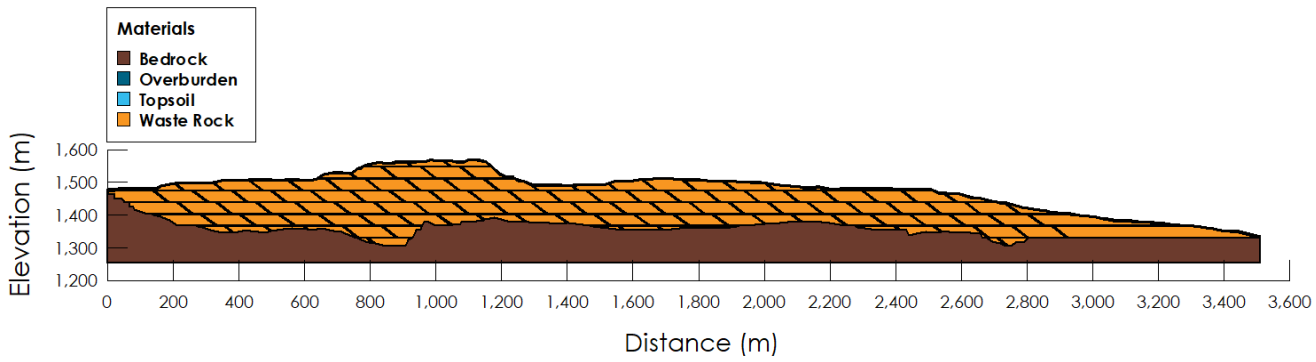


Figure 3.4: Geometry of the project 2D cross section. It should be noted that bedrock refers to bedrock of open pit, waste rock is the NAG mine rock and topsoil includes surface soils.

Within the 3D GoldSim model, the backfilled NAG mine rock was simulated by subdividing its area into 23 main strips, with each strip representing areas with similar timing of cover placement (Figure 3.3). The construction schedule for each strip was assumed based on the filling volumes and timing provided by Telkwa. The following assumptions were made regarding the placement of NAG mine rock for the GoldSim simulations:

- Construction of the NAG backfill is strip dependent, but in general, begins in Year 6 for the main strips and continues until the completion of the Operation phase in Year 21;
- Cover system placement is strip dependent and will be assumed to occur over one year (*e.g.*, cover placement that occurred in Year 8 will be assumed to occur at a uniform rate from January 1 to December 31 of Year 8). Cover system placement is assumed to occur in the year following completion of each strip due to model limitations; and
- Daily NP rate inputs will be derived separately from the 1D GeoStudio model results. In general, daily stochastic inputs will be setup for each day of the year based on the results of the GeoStudio models.

The assumed height of NAG mine rock and overburden in each strip with time, based on the volume of material placed and the surface area of the strip is shown in Figure 3.5. The surface area, total NAG mine rock and overburden volumes, and timing of cover system placement are listed in Table 3.1. For the no internal layers scenario, the internal layer volume was assumed to be NAG mine rock rather than overburden.

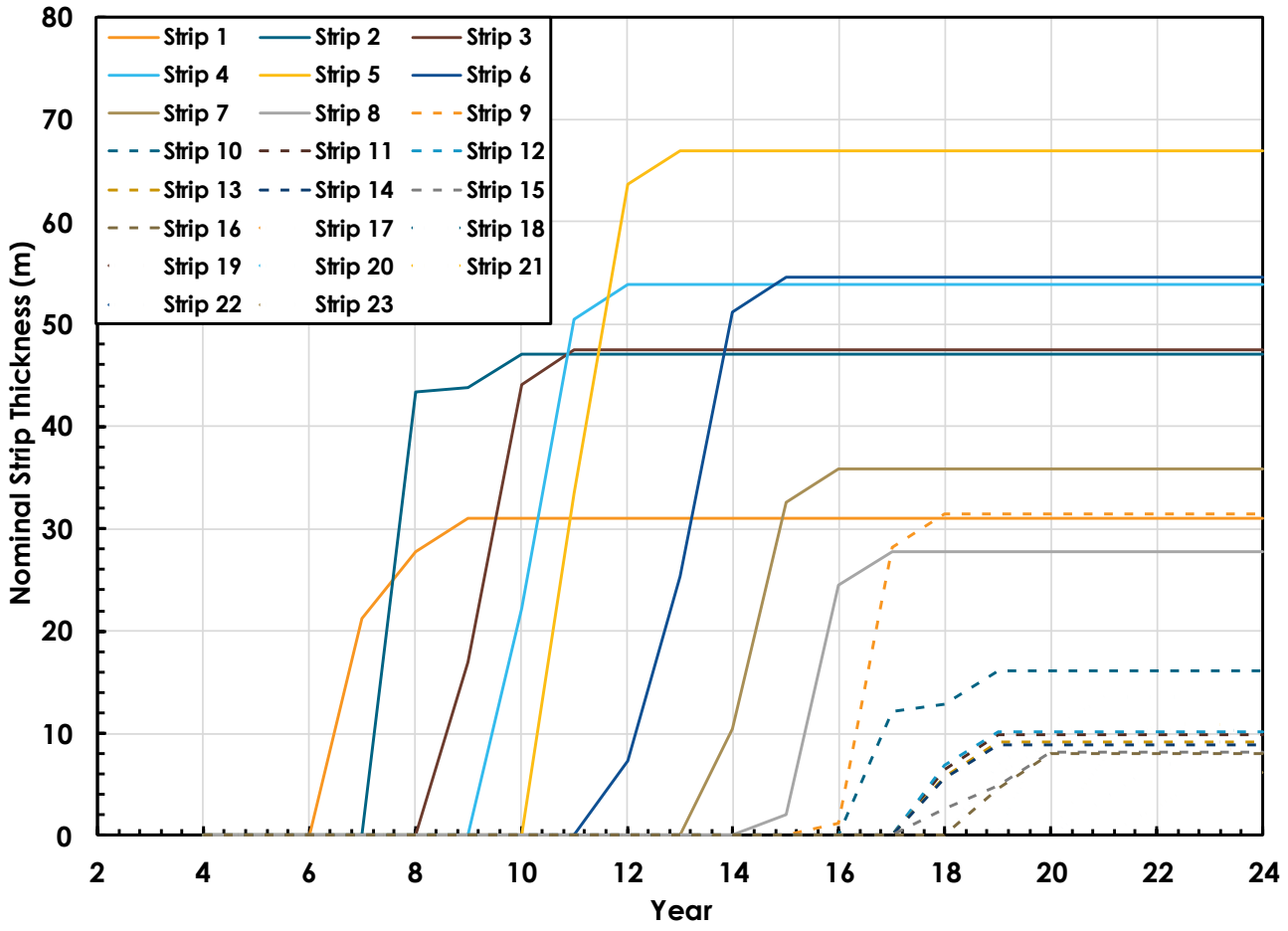


Figure 3.5: Evolution of nominal strip thickness within the GoldSim model for each strip.

Table 3.1: Surface area, volume, and nominal thickness of each strip, along with year of cover system placement.

Strip	Strip Surface Area (m^2)	Mine Rock Volume (m^3)	Internal Layers Overburden Volume (m^3)	Cover System Overburden Volume (m^3)	Total Strip Volume[1] (m^3)	Nominal Thickness (m)	Year of Cover Placement
1	41,897	1,065,383	95,548	71,661	1,232,593	31	Year 8
2	49,774	2,035,361	143,168	107,376	2,285,907	47	Year 9
3	61,199	2,529,237	171,692	128,769	2,829,695	47	Year 10
4	71,013	3,336,530	250,260	150,156	3,736,944	54	Year 11
5	78,079	4,660,016	305,995	183,597	5,149,606	67	Year 12
6	95,072	4,580,978	288,455	173,073	5,042,504	55	Year 14
7	95,482	2,895,869	209,244	156,933	3,262,049	36	Year 15
8	92,182	2,102,945	155,400	116,550	2,374,893	28	Year 16
9	61,588	1,611,409	123,760	92,820	1,827,988	31	Year 17
10	93,728	1,077,586	123,928	92,946	1,294,461	16	Year 18

Strip	Strip Surface Area (m^2)	Mine Rock Volume (m^3)	Internal Layers Overburden Volume (m^3)	Cover System Overburden Volume (m^3)	Total Strip Volume[1] (m^3)	Nominal Thickness (m)	Year of Cover Placement
11	132,059	684,134	173,334	86,667	944,138	10	Year 18
12	100,087	562,842	127,240	95,430	785,515	10	Year 18
13	105,498	486,553	126,556	94,917	708,023	9	Year 18
14	104,842	461,895	126,664	94,998	683,556	9	Year 18
15	105,081	387,746	121,744	91,308	600,798	8	Year 19
16	95,046	343,940	98,832	98,832	541,604	8	Year 19
17	91,078	368,246	96,090	96,090	560,424	8	Year 19
18	87,435	506,810	108,252	81,189	696,251	10	Year 19
19	88,006	412,599	108,160	81,120	601,876	9	Year 19
20	102,696	899,529	155,640	93,384	1,148,551	14	Year 20
21	162,765	1,054,401	184,100	110,460	1,348,963	11	Year 21
22	120,549	336,966	106,156	79,617	522,740	7	Year 21
23	324,682	755,903	157,040	235,560	1,148,505	6	Year 22
Total	*2,359,838*	*33,156,878*	*3,557,258*	*2,613,453*	*39,327,584*	-	-

1 - Includes total NAG mine rock and overburden volumes.

3.5.2 Material Properties

The hydraulic properties or functions required for modelling of overburden and NAG mine rock material are as follows:

- Water retention curve (WRC – volumetric water content versus matric suction): a continuous function relating energy and the state of water, and hence describes the water content of a material as a function of the soil suction, or negative pore-water pressure. It is central to the design of an unsaturated soil system.

- Hydraulic conductivity function (k-function – hydraulic conductivity versus matric suction): a measure of the ability of a soil or rock material to transmit water and is a maximum for saturated soil or rock materials. The saturated hydraulic conductivity (k_{sat}) and unsaturated hydraulic conductivity function are key input parameters to numerical models analyzing hydraulic performance.

For the best results, WRC and k_{sat} should be measured in the laboratory and field for each material of interest. In this case, only particle size distribution (PSD) data was available for the overburden material and no information was available for the NAG mine rock. Two PSDs for the overburden material were used as representative samples for well-graded (sample# 35087) and poorly-graded (sample# 35094) till found in the SRK 2019 field investigations (Figure 2.2).

For the overburden material the WRC (Figure 3.6) and k-function (Figure 3.7) were estimated from the PSD (both well-graded and poorly-graded) using the Fredlund and Xing (1994) pedotransfer functions in SVSOILS™ Software (Plaxis, 2022). The k_{sat} was estimated using Kozeny (1962) with PSD data as the input.

As no lab or field information was available for the NAG mine rock, three proxy materials (mudstone, siltstone, and sandstone) were provided by Okane based on field testing completed at several mine sites. A well-graded mixed material based on core logs consisting of 35% mudstone, 60% siltstone, and 5% sandstone (D. Farmer, 2024, pers. comm.) was also estimated. The WRC and k-functions for the mine rock proxy materials are found in Figure 3.6 and Figure 3.7, respectively.

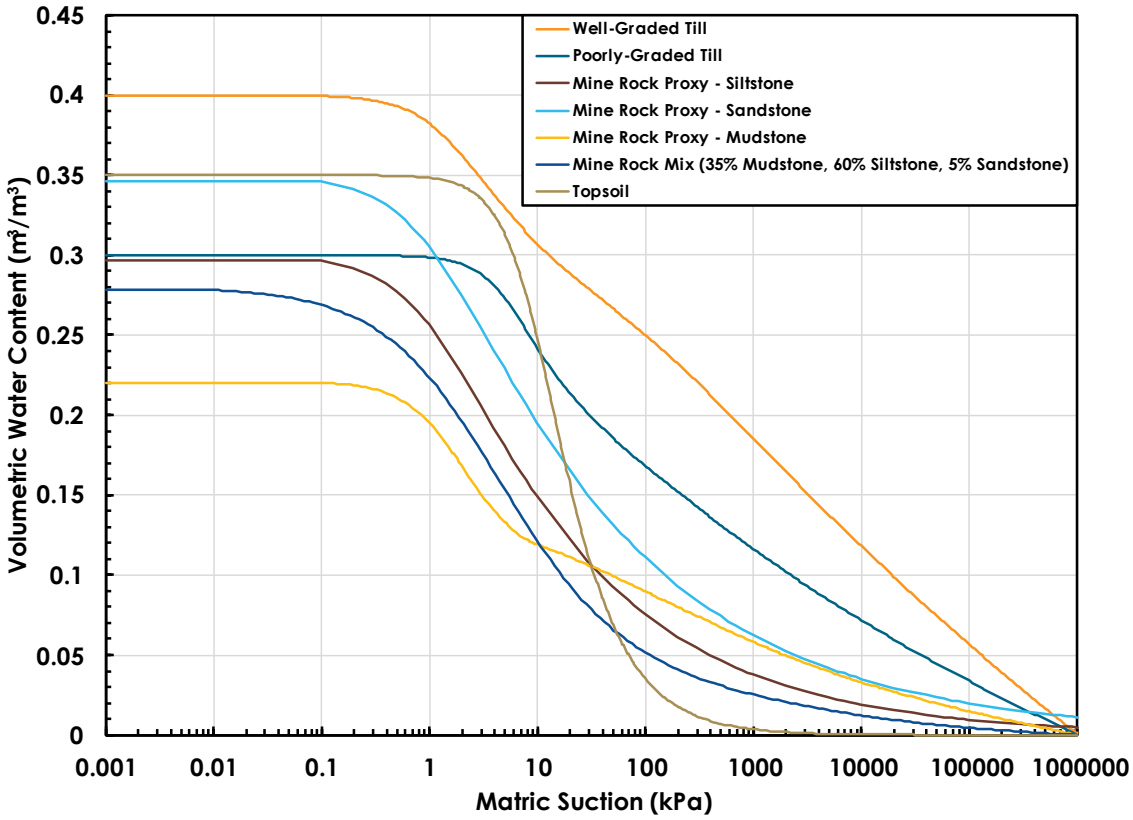


Figure 3.6: Estimated overburden (till) and proxy mine rock water retention curves.

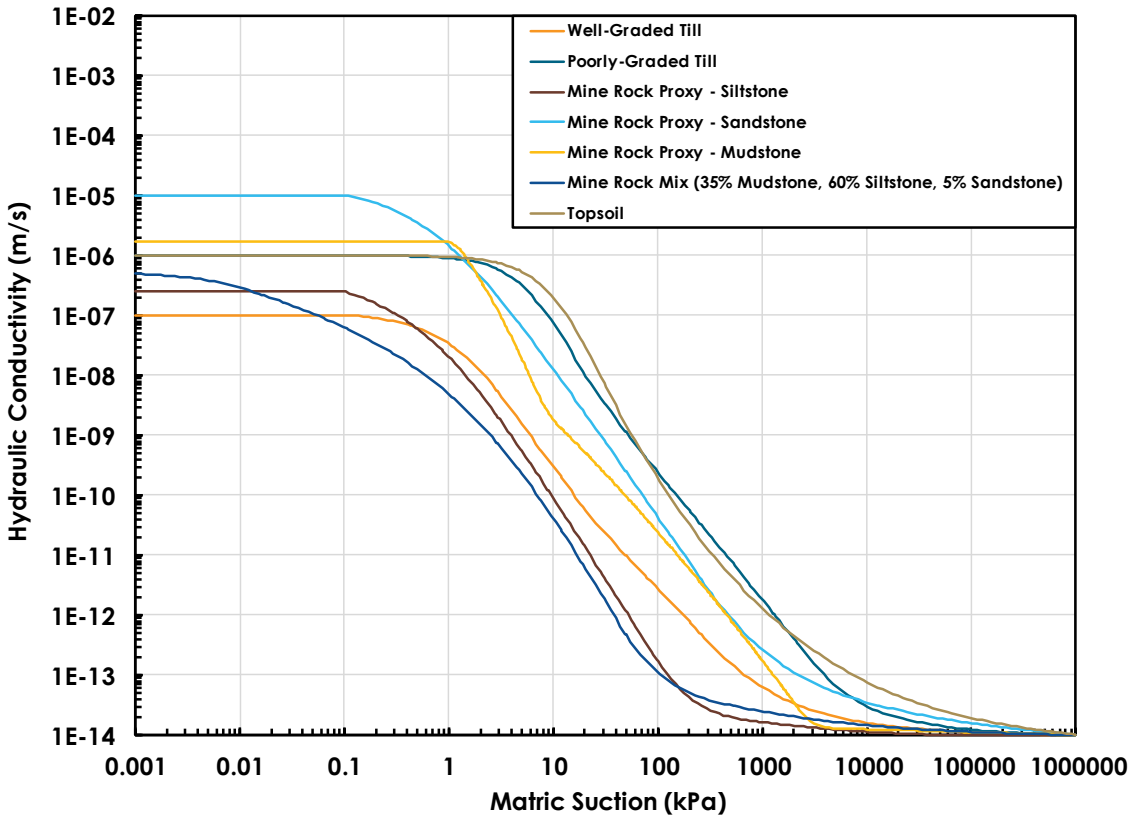


Figure 3.7: Estimated overburden (till) and proxy mine rock k-functions.

3.5.3 Climate Model Inputs

SRK (2022c) developed a project-specific synthetic historical climate database based on transposing regional datasets to the site and adjusting for orographic effects. The historical dataset spans 77 years from 1943 to 2020 and is summarized in Table 3.2.

SRK (2022c) also completed a climate change assessment for the project using the fifth version of the Coupled Model Intercomparison Project (CMIP5) and Representative Concentration Pathway (RCP) 4.5 of the Intergovernmental Panel on Climate Change (IPCC) fifth Assessment Report (AR5) (IPCC, 2014). Monthly rates of changes relative to baseline conditions (1981-2010) were calculated for temperature and precipitation based on the median values of an ensemble of 29 CMIP5 models. Projected climate change effects were evaluated for three consecutive 30-year forecast periods, defined as follows:

- Baseline period from 1981 to 2010 (CMIP5), centred on 1995;
- First forecast period from 2011 to 2040 (CMIP5), centred on 2025;
- Second forecast period from 2041 to 2070 (CMIP5), centred on 2055; and

- Third forecast period from 2071 to 2100 (CMIP5), centred on 2085.

Monthly changes relative to monthly baseline data for RCP4.5 are shown in Table 3.3 for temperature and Table 3.4 for precipitation. A long-term daily dataset (SRK, 2023a) was developed by applying the monthly changes to the average monthly values from the baseline period.

This climate change dataset was used directly as the upper boundary condition in the 1D SPA modelling through the Land-Climate Interaction (LCI) and Surface Energy Balance (SEB) boundary conditions to develop the surface water and energy balance, which was used as the upper boundary conditions in the 2D and 3D models.

Table 3.2 Monthly summary of historical climate database.

Month	Air Temperature (°C)		Precipitation[1] (mm)				Solar Radiation (W/m²)	Relative Humidity (%)	Lake Evaporation (mm)	Wind Speed (m/s)
	Maximum	Minimum	Mean	Rainfall	Snowfall	Total				
January	-5.8	-12.6	-9.2	6.1	53.9	60.0	38	83.6	0	2.0
February	-1.8	-10.4	-6.1	1.0	33.9	34.9	64	79.3	0	1.9
March	2.2	-7.5	-2.7	0.3	26.5	26.8	114	71.2	0	2.0
April	7.4	-3.1	2.1	12.5	19.6	32.2	173	63.3	60	2.2
May	12.9	0.8	6.8	41.5	8.3	49.8	220	61.3	97	2.1
June	16.5	4.7	10.7	68.7	1.2	69.9	224	65.7	108	1.9
July	19.0	6.9	13.0	57.3	0.0	57.3	224	68.8	116	1.7
August	18.6	6.4	12.5	55.2	0.1	55.3	201	72.1	99	1.5
September	13.7	3.1	8.4	63.9	3.5	67.4	134	79.5	50	1.5
October	6.5	-1.4	2.6	42.4	42.0	84.3	73	82.1	0	1.9
November	-0.8	-6.8	-3.8	5.4	67.3	72.7	40	85.9	0	1.9
December	-4.6	-11.2	-7.9	2.1	53.7	55.8	34	85.4	0	2.0
Annual	*7.0*	-2.6	*2.2*	*356.4*	*310.0*	*666.4*	*128*	*74.8*	*529*	*1.9*

(SRK, 2022c)

[1]Total precipitation was updated by SRK (SRK, 2023b) in November 2023 based on analysis against measured data at Tenas Deposit Station. Rainfall and snowfall were calculated by Okane assuming a threshold temperature of 0 °C.

Table 3.3 Monthly average temperature increase from the baseline period for RCP4.5 (in °C).

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2011-2040	1.25	1.23	1.16	1.13	1.35	1.44	1.35	1.21	1.00	0.97	1.02	0.86	1.2
2041-2070	2.89	2.16	2.42	2.30	2.60	2.51	2.45	2.39	2.11	2.07	2.26	2.48	2.4
2071-2100	3.45	2.79	3.01	3.04	3.14	3.13	3.24	2.99	2.72	2.56	2.85	2.97	3.0

Table 3.4 Monthly average precipitation variation from the baseline period for RCP4.5 (in %) (from SRK, 2022c).

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2011-2040	5%	7%	6%	0%	14%	2%	1%	-1%	5%	7%	4%	3%	+5%
2041-2070	12%	8%	14%	14%	34%	33%	-5%	0%	10%	12%	11%	12%	+12%
2071-2100	12%	11%	16%	9%	48%	23%	-23%	2%	14%	18%	16%	18%	+15%

3.5.4 Vegetation Model Inputs

Vegetation model inputs were based on the SBS bio-geoclimatic zone. Prior to reclamation, no vegetation was assumed. Once areas are reclaimed, vegetation was simulated to re-establish and grow.

To simulate the vegetation re-establishment the following assumptions were made:

- The year after cover system placement, grasses and shrubs are assumed to establish and grow.
- Grasses and shrubs are assumed to be the predominant vegetation for the first five years following cover system placement.
- Forest species are assumed to be the predominant vegetation after the grasses.

3.5.4.1 Rooting Depth and Distribution

The rooting depth and distribution was described by the work of Jackson *et al.* (1996) using the equation:

$$Y = 1 - \beta d \qquad (4)$$

where Y is the cumulative root fraction (a proportion between 0 and 1) from the soil surface to depth d (cm), and β is the fitted 'extinction coefficient', which Jackson *et al.* (1996) estimates as 0.943 for both grassland and boreal forest biomes. Hence, the same rooting depth and distribution (Figure 3.8) were used to represent both grasses and forest growth.

The maximum rooting depth is approximately 1.2 m, with 95% in the top 0.5 m of the cover system. This is like the root characteristics described in Klinka *et al.* (2000) for tree species in the region.

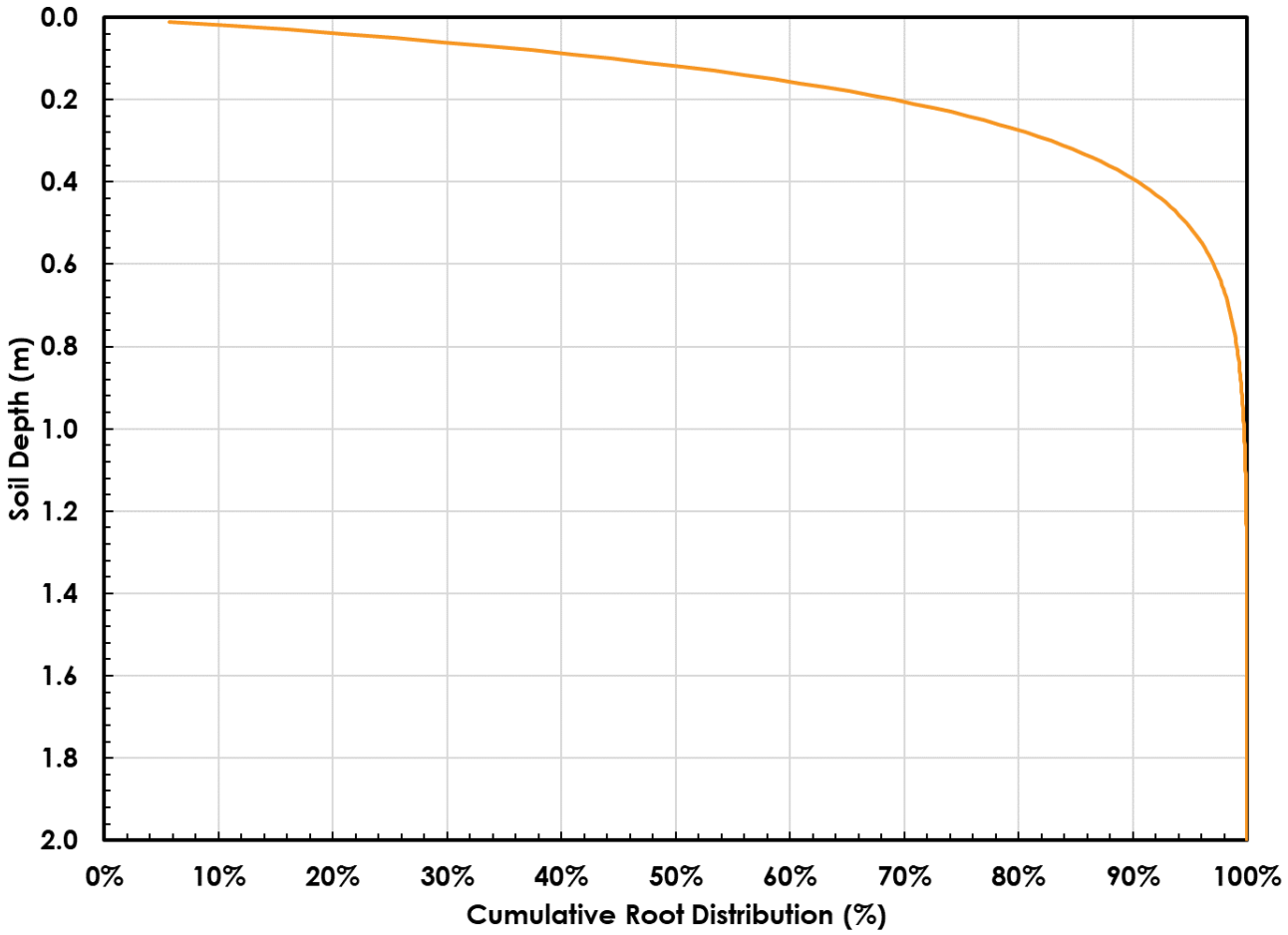


Figure 3.8: Estimated rooting depth and distribution for grasses and forest growth at Tenas Project.

3.5.4.2 Leaf Area Index and Percent Ground Cover

The Leaf Area Index (LAI) for grasses is estimated to be 1.7 with a percent ground cover of 70%. Once forest and understory species establish, LAI is estimated to increase to 2.3 with a percent ground cover of 85%. During the first seven years of vegetation, the LAI was increased annual by 0.3, starting at an LAI of 0.3, to gradually reach the mature forest vegetation LAI of 2.3.

3.5.4.3 Plant Water Limiting Function

Lack of available water and/or high evaporative demands will cause most plants to biologically react by closing stoma, reducing transpiration, and reducing metabolic reactions (Saxton, 1982). Under continued and increasing stress, the plant will reach its permanent wilting point (PWP), at which point transpiration is estimated to cease. The plant water limiting function (PWLF) defines the reduction in transpiration due to increased soil suction conditions. In general, the PWLF is defined to start to reduce at 10 kPa and stop transpiration entirely at a PWP of 1,500 kPa. This function was used to simulate grasses

growing on the cover system. Lopushinsky and Klock (1974) measured the PWLF for conifer species, which produced the PWLF (Figure 3.9). This PWLF was used to simulate forest growth.

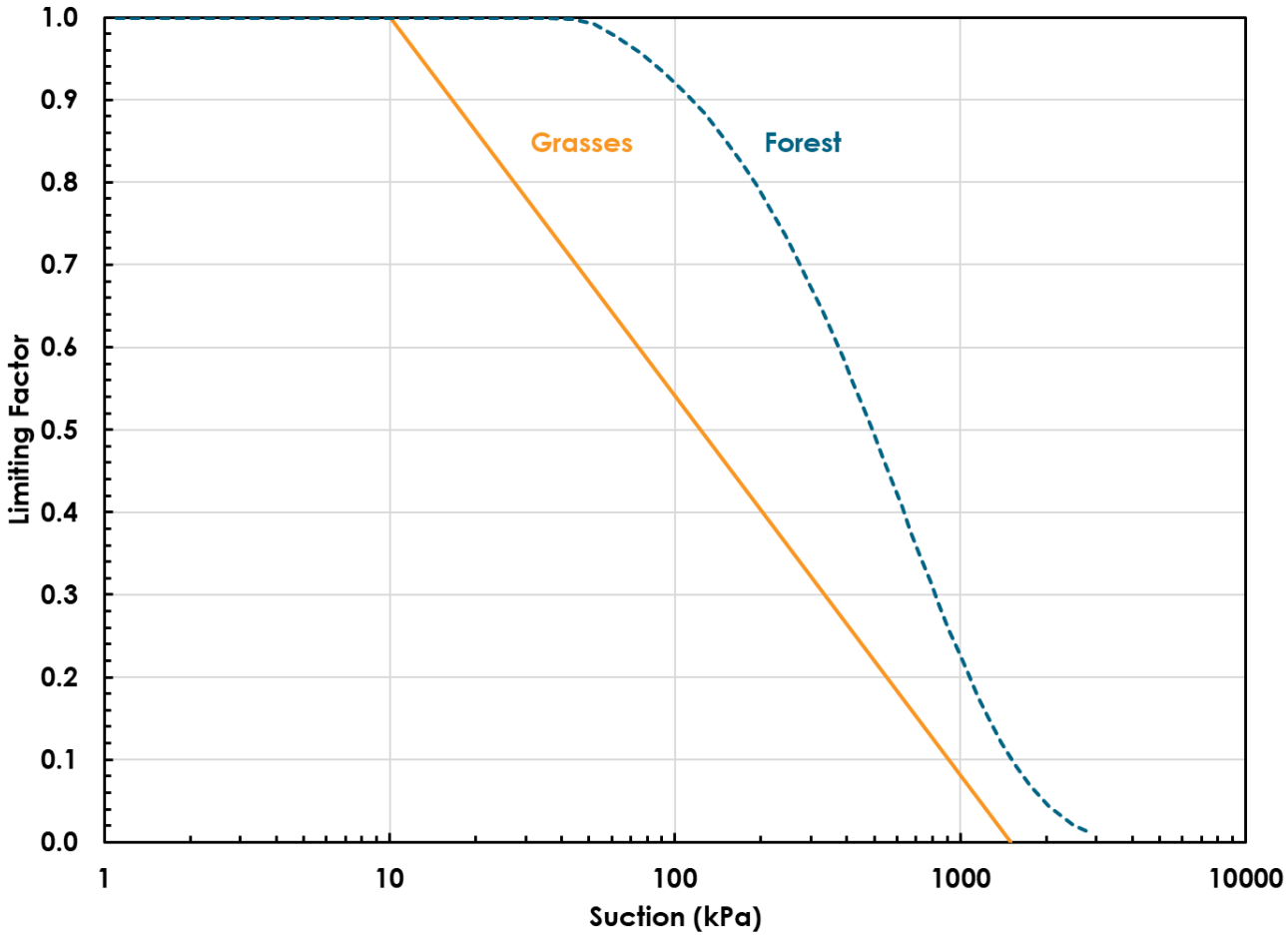


Figure 3.9: PWLFs estimated to simulate grasses and forest growth.

3.5.4.4 Growing Season

To define the growing season, the following assumptions were made:

- The growing season starts once the snowpack is completely melted and mean daily air temperature is above 5°C.
- The growing season ends once the minimum temperature after September 1 drops below 0°C.

3.5.5 Lower Boundary Conditions

The lower boundary condition was assumed to be a unit hydraulic gradient for the 1D simulations. This boundary condition assumes that the movement of water at the depth of the lower boundary is no longer influenced by atmospheric forces and is moving downwards only due to gravity.

3.5.5.1 Initial Conditions

The initial conditions for the 1D SPA model were obtained by running the models twice, using the final conditions of the first simulation as the initial conditions of the second simulation. This is done to remove the subjectivity of the ascribed initial conditions from the model results. The initial conditions of the 2D and 3D models were based on the results of the 1D SPA model.

3.5.6 Geochemical Model

Source terms for the NAG pit backfill were developed using a geochemical model based on the facility specific conceptual model. Source terms were modelled using both mechanistic reactive transport models and geochemical scale-up models. Source terms were developed for three scenarios; two cover system scenarios, a poorly graded till and sandstone mine rock scenario and a well graded till and blended mine rock (60% siltstone, 35% mudstone and 5% sandstone) with internal layers scenario and a third well graded till and blended mine rock (60% siltstone, 35% mudstone and 5% sandstone) without internal layers scenario. Source terms for the NAG pit backfill can be found in Appendix A.

3.5.6.1 Geochemical Model Methodology

Reactive transport models utilized the geochemical code PHREEQC to apply mineralogical kinetics that applicable to NAG mine rock from the Project. The purpose of the reactive transport model was to incorporate mineral kinetics, water flow, and oxygen availability to simulate the evolution of sulfide oxidation rates, metal leaching, and carbonate dissolution simultaneously over a long-term timeframe. Reaction kinetics were calibrated to NAG mine rock barrel tests that are ongoing at the Tenas site (SRK, 2022b). The geochemical scale-up model utilized NAG barrel tests from the Tenas project to calculate loading rates of parameters that are not strongly influenced by sulfide oxidation and carbonate dissolution. Source terms of these parameters were scaled up to conditions representative of the NAG backfill.

Parameters that were modelled via the reactive transport model included pH, alkalinity, SO_4, Al, Ag, As, Ca, Co, Cr, Cd, Cu, Fe, Hg, Mg, Mn, Na, Ni, Pb, Si, Sr, Sn, U, V, Zn, NO_3, NH_3, and NO_2. The mechanistic reactive transport model was developed in two phases:

- ***Phase 1*** – The reactive transport model was developed and calibrated using mineralogical data and barrel test leachate data for representative NAG mine rock.

- ***Phase 2*** – The calibrated reactive transport model for the barrel test was scaled to field conditions by adjusting for the differences in hydrology, temperature, and mass of the reactive particle size fraction (< 6.35 mm in the barrel tests) between the barrel tests and full-scale conditions.

Parameters not incorporated into the reactive transport model were estimated using a geochemical scale-up model. This model was developed by scaling up barrel test production rates by using facility- and site-specific adjustment factors to obtain representative weathering rates. Parameters incorporated in this model included Ba, B, Be, Li, K, P, Si, Sr, Ti, and Zr. Adjustment to full scale conditions was completed by applying scaling factors for reactive particle size, and water contact.

3.5.6.2 Model Development

Reactive transport models were developed for the B1 and B2 barrel tests combined and for the B7 barrel test. The B1 and B2 were combined as these barrels were constructed using the same NAG mine rock samples while the B7 barrel test used different NAG mine rock samples.

Mineralogical analyses for several samples used in the barrel tests reported a single mass for the dolomite-ankerite phase while other samples reported a unique mass for both dolomite and ankerite. Therefore, for modelling purposes it was assumed that if dolomite-ankerite was reported, 50% of this mass was dolomite and the other 50% was ankerite. The reactive mineralogy modelled in the NAG barrel tests is summarized in Table 3.5.

Table 3.5: Summary of reactive minerology in NAG mine rock barrel tests (from SRK, 2022b).

Mineral Name	Unit	B1 and B2	B7	Median NAG Mine Rock
Calcite	wt.%	2.3	0.5	1.4
Siderite	wt.%	7.3	7.8	2.0
Dolomite	wt.%	8.9	8.0	6.9
Ankerite	wt.%	7.9	3.4	0.4
Pyrite	wt.%	4.6	2.0	0.8

Metal leaching was assumed to be predominantly associated with pyrite oxidation. Therefore, metal(loid)s were added to the pyrite mineral phase in PHREEQC based on the molar ratio of respective metals to SO_4 in barrel test leachates (Table 3.6). Divalent cationic metals were assumed to substitute for Fe, while anionic metals were assumed to substitute for S in the pyrite structure. This enabled the release of metals commonly associated with pyrite to be closely coupled to the kinetics of pyrite dissolution in the model.

Table 3.6: Molar composition of pyrite phase used in the reactive transport model.

Parameter	Molar Composition
Fe	0.9999384
Ni	0.0000177
Co	0.0000051
Cu	0.0000044
Pb	0.0000014
Mn	0.000022
Zn	0.0000097
Se	0.000045
As	0.0000013
S	1.99995

Kinetic rate equations were added to the reactive transport model based on published rate law equations and reaction rate coefficients for both the oxidation of sulfide minerals and the dissolution of carbonate phases (Table 3.7). Due to limited kinetic and thermodynamic data associated with ankerite in literature it was assumed that ankerite had the same thermodynamic and kinetic properties as dolomite in the model.

The hydraulic regime of the reactive transport model of the barrel test followed leachate collection events when leachate volumes were measured. Material properties for the reactive particle size fraction (< 6.35 mm) from the water balance modelling were used and assumed a porosity of 0.35 and degree of saturation of 50%, corresponding to a volumetric water content of 0.175 m^3/m^3 in the barrels.

Table 3.7: Kinetic rate equations for minerals included in the reactive transport model.

Mineral	Rate Equation	Rate Constant, k (mol m^{-2} s^{-1})	Effective Rate Constant, k_{eff} (mol m^{-3} s^{-1})	Reference
Pyrite	$Pyrite\ Rate = k\ x \left(\frac{A}{V}\right)\ x\ [H^+]^{-0.11}\ x\ [O_2]^{0.5}\ x \left(\frac{m}{m_0}\right)^{\frac{2}{3}}$	1.1×10^{-10}	-	Williamson and Rimstidt, 1994 Xu et al., 1998
Calcite	$Calcite\ Rate = (k_1\ x\ [H^+] + k_2\ x\ [H_2CO_3])\ x \left(\frac{A}{V}\right)\ x \left(\frac{m}{m_0}\right)^{\frac{2}{3}}$	$k_1 = 10^{-0.05}$ $k_2 = 10^{-0.05}$	-	Chou et al., 1989
Dolomite	$Dolomite\ Rate = k\ x \left(\frac{A}{V}\right)\ x\ [H^+]^{0.5}\ x \left(\frac{m}{m_0}\right)^{\frac{2}{3}}$	$10^{-2.59}$	-	Chou et al., 1989
Ankerite	$Ankerite\ Rate = k\ x \left(\frac{A}{V}\right)\ x\ [H^+]^{0.5}\ x \left(\frac{m}{m_0}\right)^{\frac{2}{3}}$	$10^{-2.59}$	-	*
Siderite	$Siderite\ Rate = k_{eff}\ x \left(\frac{m}{m_0}\right)^{\frac{2}{3}}$	-	$10^{-9.52}$	Dresel, 1989

*Ankerite kinetic characteristics were assumed to be similar to dolomite.

3.5.6.3 Calibration

The reactive transport model was calibrated by adjusting mineral-specific surface areas or effective rate coefficients (Table 3.8) such that modelled barrel test results were comparable to the median leachate concentration of the barrel tests. A separate model was calibrated for the B1 and B2 barrel tests together and another model was calibrated to the B7 barrel test.

Substantial cation exchange between Na, Ca, and Mg was observed in the barrel tests. Carbonate dissolution releases Ca^{2+} and Mg^{2+} that subsequently exchange for Na^{+} from surface sites of the host rock (likely associated with clay minerals). The resulting leachate from the barrel tests is enriched in Na concentrations. In order to calibrate the reaction rate for carbonate dissolution, Ca and Mg concentrations needed to be back calculated from the Na concentrations in the leachate. It was assumed that all Na was sourced from cation exchange with Ca and Mg. The ratio of Ca/Na exchanged compared to Mg/Na exchanged was calculated based on the ratio of ion exchange coefficients of Ca-Na and Mg-Na exchange pairs (Bruggenwert and Kamphorst, 1982).

Table 3.8: Calibrated values of kinetic rate equation parameters.

Mineral	Calibrated Surface Area/Volume (dm^{-1})		Calibrated Effective Rate Coefficient (mol m^{-3} s^{-1})	
	B1 and B2	B7	B1 and B2	B7
Pyrite	-	-	$10^{-8.585}$	$10^{-8.72}$
Calcite	0.01	0.009	-	-
Dolomite	0.02	0.007	-	-
Ankerite	0.01	0.007	-	-
Siderite	-	-	$10^{-9.523}$	$10^{-9.523}$

Following the calibration of the barrel test scale reactive transport model, there was good agreement between modelled parameter concentrations and measured leachate chemistry from the mine rock barrel tests (Figure 3.10). The average of the calibrated factors for the B1/B2 and B7 models were used in the full-scale reactive transport model.

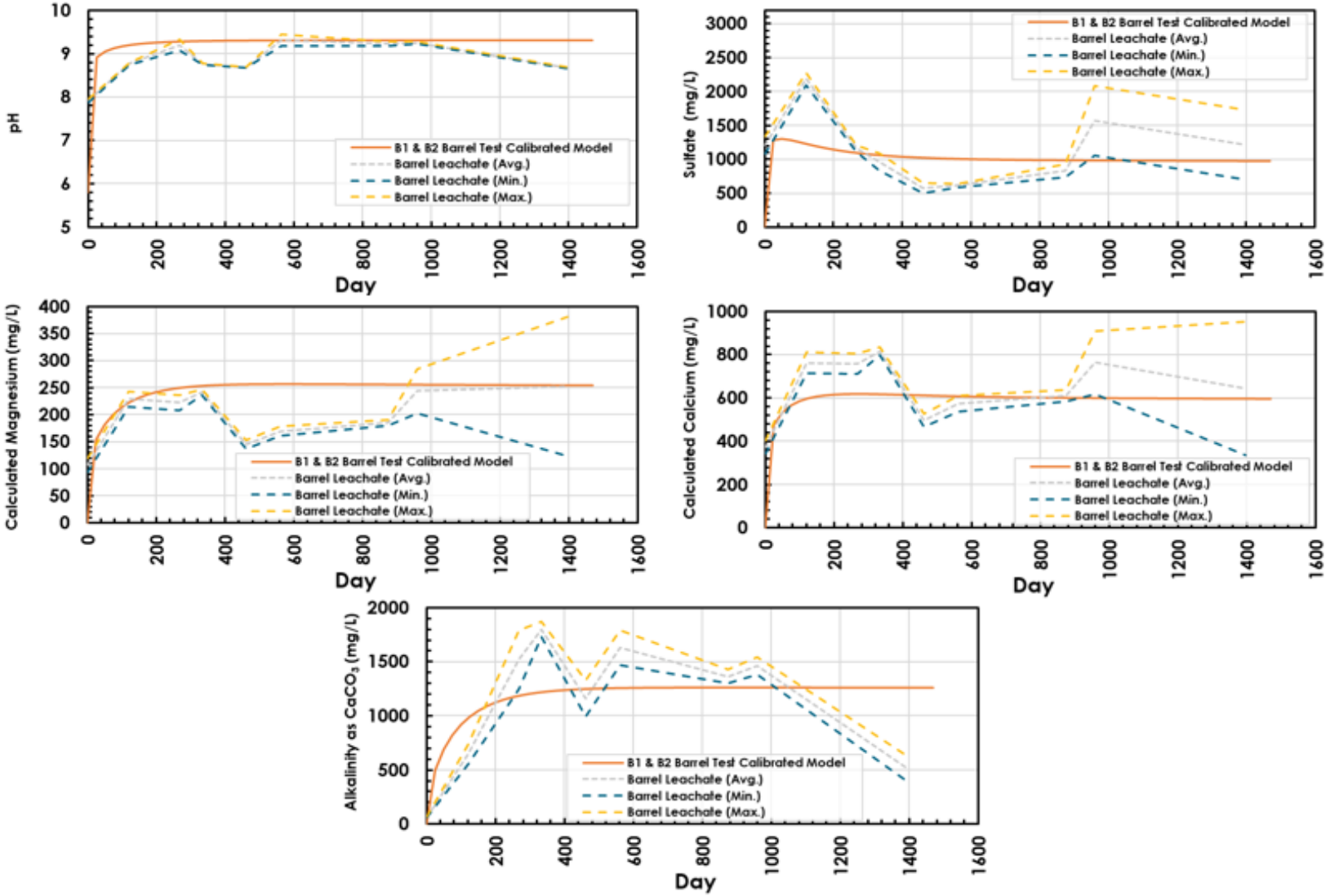


Figure 3.10: Parameter concentrations for the calibrated model versus minimum, maximum, and average B1 and B2 leachate concentrations.

3.5.6.4 Model Scale-Up

Once the geochemical model was calibrated to the field barrel tests, the reactive transport model was scaled up using the nominal height of respective strips (Table 3.1) within the NAG backfill with the final output being stockpile drainage chemistry. GeoStudio oxidation modelling provided stockpile temperature and thickness of both oxic reactive and suboxic non-reactive material. Hydraulic information such as the timing and amount of seepage for the full-scale model was provided by the GoldSim hydrological and seepage models for bare surface and covered conditions.

Temperature Adjustments

The effects of temperature on the literature values for the rate constant of each mineral modelled in the NAG backfill was adjusted using the Arrhenius equation (Equation 4; Gautelier et al., 1999). The temperature adjustment was performed on barrel tests that used an average annual air temperature of 4.9°C. The average internal NAG backfill temperature was estimated to be approximately 3°C based on the GeoStudio oxidation model, and this temperature was used to scale the reaction rates.

$$k_T = k_{25°C}\, x\, A^{\left(\frac{-Ea}{R\Delta T}\right)} \quad (5)$$

Where:

- k_T is the rate constant at temperature, T;
- $k_{25°C}$ is the rate constant at 25°C;
- A is the pre-exponential factor (2.718 s^{-1});
- E_a is the activation energy (kJ);
- R is the molar gas constant (8.314 J K^{-1} mol^{-1}); and
- ΔT is the temperature difference $\left(\frac{1}{T\ (K)} - \frac{1}{298.15\ K}\right)$

The activation energies used for the temperature correction of mineral reaction rates are summarized in Table 3.9. Only pyrite, calcite, and dolomite were adjusted for temperature, while reactivity of siderite was maintained under standard conditions due to a lack of information.

Table 3.9: Activation energies for minerals included in the reactive transport model.

Mineral	Activation Energy (kJ)	Reference
Pyrite	70	Lowson, 1982
Calcite	20.9	Sajwan and Evangelou, 1991
Dolomite	36.1	Herman and White, 1985
Siderite	-	-

3.5.6.5 Reactive Transport Model of the NAG Backfill

Infiltrating Water Chemistry

The chemical signature of the infiltrating water (or net percolation) was assumed to be equal to the water chemistry of a site-specific overburden barrel test because of the use of overburden in the cover system (Table 3.10). Initial NAG backfill porewater was assumed to be similar to the initial water chemistry sampled from the NAG barrel tests. An average from the B1/B2 and B7 tests was used in the full-scale model.

Table 3.10: Reactive transport model infiltrating water and initial NAG backfill porewater composition.

Parameter	Unit	Infiltrating Water Composition	Initial Porewater Composition
pH	-	8.2	7.9
Sulfate (Dissolved)	mg/L	118	1,205
Alkalinity (Total as $CaCO_3$)	mg/L	0.1	106
Chloride (Dissolved)	mg/L	0.25	3.83
Fluoride (Dissolved)	mg/L	0.13	-
Arsenic (Dissolved)	mg/L	0.00078	0.00012
Calcium (Dissolved)	mg/L	45.0	372
Cobalt (Dissolved)	mg/L	0.00016	0.0057
Copper (Dissolved)	mg/L	0.011	0.001
Iron (Dissolved)	mg/L	0.005	0.01
Lead (Dissolved)	mg/L	0.00014	0.0001
Magnesium (Dissolved)	mg/L	26.0	107
Manganese (Dissolved)	mg/L	0.00052	0.034
Nickel (Dissolved)	mg/L	0.00025	0.0074
Potassium (Dissolved)	mg/L	1.6	3.23
Selenium (Dissolved)	mg/L	0.00058	0.11
Sodium (Dissolved)	mg/L	19	512
Zinc (Dissolved)	mg/L	0.0005	0.0043

Parameter	Unit	Infiltrating Water Composition	Initial Porewater Composition
Nitrate (as N)	mg/L	0.44	56.8
Ammonia (Total)	mg/L	0.0088	7.18
Nitrite (as N)	mg/L	0.0039	1.31

Blasting residues from placed mine rock will leach inorganic nitrogen. Initial source terms of N species (NO_3, NO_2, and NH_4) were determined based on the powder factor (0.5 kg/m^3) and proportion of inorganic N produced based on emulsion and ammonium nitrate fuel oil (ANFO) composition (SRK, 2022a). To calculate the mass of residual N in the NAG backfill, the method by Ferguson and Leask (1988) was used and assumed the following:

- 0.9% of N from ANFO and 5.1% of N from the emulsion as available for leaching (Ferguson and Leask, 1988);
- ANFO is 75% ammonium-nitrate and emulsion comprise the remaining 25%; and
- Leachable inorganic N load from explosives will result in:
    - 87% as NO_3-N;
    - 11% as NH_4-N; and
    - 2% as NO_2-N.

Nitrogen species leaching was incorporated into the reactive transport model by using an assumed volumetric water content, the total volume of material placed, and the mass of residual N to calculate an N concentration leaching from the backfill. This methodology was used so that the hydraulic transport time simulated in the reactive transport model could also be applied to N leaching. Nitrogen species concentrations used in the model are shown in Table 3.10.

Mineralogy

The NAG backfill reactive transport models included both reactive primary minerals and secondary minerals. Reactive primary minerals were limited to pyrite, calcite, dolomite, ankerite, and siderite. Additional minerals (e.g., primary silicates) were identified in the geochemical characterization program (SRK, 2022b); however, these minerals were assumed to be kinetically insignificant during the modelled time scale due to the neutral pH of the NAG backfill.

Elevated concentrations of dissolved metals under neutral pH conditions can result in the precipitation of secondary minerals. Secondary mineral precipitation was incorporated into the final reactive transport and geochemical scale-up model results by completing equilibrium modelling on the source terms. Minerals applied in the equilibrium modelling step were generally consistent with those used in the

SRK (2022a) (Table 3.11). Surface adsorption reactions were not included in the model because it was assumed that adsorption was accounted for in the barrel test leachate chemistry, therefore, the pyrite stoichiometric composition used in the model.

Table 3.11: Model equilibrium phases.

Phase	Empirical Formula	Phase	Empirical Formula
Aluminum Hydroxysulfate	$Al_4(OH)_{10}SO_4$	Ferrihydrite	$Fe(OH)_3$
Amorphous Aluminum Hydroxide	$Al(OH)_3$	Goslarite	$ZnSO_4 \cdot 7H_2O$
Azurite	$Cu_3(CO_3)_2(OH)_2$	Gypsum	$CaSO_4 \cdot 2H_2O$
Barite	$BaSO_4$	Lead Molybdenum Oxide	$PbMoO_4$
Birnessite	$MnO_2 \cdot nH_2O$	Malachite	$Cu_2(CO_3)(OH)_2$
Brochantite	$Cu_4SO_4(OH)_6$	Manganite	MnO(OH)
Calcium Molybdenum Oxide	$CaMoO_4$	Melanterite	$FeSO_4 \cdot 7H_2O$
Calcite	$CaCO_3$	Nickel Hydroxide	$Ni(OH)_2$
Chalcanthite	$CuSO_4 \cdot 5H_2O$	Otavite	$CdCO_3$
Carbon Dioxide	$CO_{2(g)}$	Zinc Hydroxide	$Zn(OH)_2$
Copper Hydroxide	$Cu(OH)_2$		

Note: Phases in **BOLD** not included in SRK (2022a).

Flow Transport

Hydrology is an important component of the NAG reactive transport models. The NAG backfill hydrology used results from the GoldSim hydrological and seepage models (Section 3.3). The NAG backfill reactive transport models were split into 23 cells (Figure 3.3), each having different geometries and mine rock storage capacities (Table 3.1).

Material properties of the bulk mine rock in the NAG backfill were included in the full-scale geochemical model but were adjusted to account for only the reactive fraction of the mine rock (assumed to be the -6.35 mm fraction as used in the barrel tests). Flow of water was assumed to be primarily matrix-dominated. Flow calculations for the model assumed the following material properties for the finer fraction:

- Porosity – The porosity of the finer fraction of the NAG backfill was assumed to be 0.4;
- Degree of saturation – The degree of saturation of the finer fraction in NAG backfill at steady-state was 0.61 based on GoldSim modelling; and
- Proportion of reactive mine rock – The -6.35 mm size fraction typically controls the reactivity of mine rock. The NAG backfill was assumed to composed of 20% -6.35 mm particles based on existing material properties.

The adjusted reactive volumetric water content of the facility was calculated to be 0.049 based on these values and was used to determine cell-specific pore volumes in the reactive transport model.

The volume of water entering of the NAG backfill will change once the mine rock is covered. Additionally, this volume will be different based on the cover system scenario modelled. Three hydrological periods were defined in NAG backfill reactive transport models for each of the modelled scenarios, respectively:

1) ***Bare Surface*** – This period represented conditions prior to cover system placement on the cell. During this phase, mine rock is exposed to the atmosphere and infiltration rates are 273 mm/year for the poorly graded till and sandstone scenario (Scenario #1) and 143 mm/year for both the well graded till and mixed mine rock scenario (Scenario #2) and the no internal layers scenario (Scenario #3). The duration of the bare surface period is cell-specific and is dependent on the construction and reclamation schedule.

2) **Covered Grass NP** – This phase represented construction of the closure cover on a cell and occurred for a period of five years as re-vegetation occurs. Once the cover system is placed, both oxygen ingress and NP decrease. Once covered, NP decreases to 197 mm/year in the poorly graded till and sandstone scenario (Scenario #1). Due to differences in runoff between the bare surface and the grass covered surface in the well graded till and mixed mine rock scenarios (Scenarios #2 and #3) NP increased to 148 mm/year.

3) **Covered Forest NP** – This phase represents maturing of vegetation on the constructed cover system and occurred for the remaining model time following the covered grass NP period. As vegetation matures and shifts to forest dominated NP decreases. Covered forest NP was 124 mm/year for the poorly graded till and sandstone scenario (Scenario #1) and 72 mm/year for the well graded till and mixed mine rock scenarios (Scenarios #2 and #3).

Effects of Suboxic Zones

Potential establishment of suboxia within the NAG backfill is a function of limiting re-supply of oxygen from the atmosphere, either laterally across angle of repose slopes of the backfilled mine rock, or vertically across the horizontal surface of the backfilled mine rock. Limiting airflow capacity across the horizontal surfaces can also limit lateral advective gas transport, in the absence of a limitation of the presence of a limitation on airflow capacity on the sloping backfilled surface, depending on the lift height of the backfilled mine rock. Initially, oxygen concentration in the pore-space of the backfilled NAG material will be atmospheric (nominally 20.9% by volume). Sulfide material within the NAG material will consume this oxygen; however, if re-supply of oxygen is limited as discussed previously, then the availability of further sulfide oxidation will be limited, thus creating suboxic conditions within each encapsulated cell. As oxygen decreases, and the geochemical conditions shift from oxic to suboxic, additional biological reactions that are favourable in the absence of oxygen may occur; however, to provide a conservative prediction of the effect of suboxic conditions, these biological reactions were

not included in any modelling. This is a substantively conservative approach given that in suboxic conditions, and provided there is opportunity and hydraulic residence time for denitrification, it is reasonable to postulate that bio-reduction of selenium will also occur (see MEND, 2015). Once suboxic conditions are established, the reactive transport model assumes that pyrite oxidation only occurs in the oxic zone nearer to the surface, while carbonate minerals can still react throughout the entire depth of the cell as their reactivity is not dependent on oxygen availability in the NAG backfill.

Given the geometry of the NAG backfill, and the different cell volumes and placement timing, zones of suboxia will vary based on the location of the cell in the NAG backfill. Cell-specific reactive and suboxic zone thicknesses for all cells were determined from the GeoStudio Oxygen Ingress Model results (Section 4.2). The development of suboxic conditions occurred at depths of roughly 13 m below the cover system in the poorly graded till and sandstone scenario and occurred within the 3.3 m cover system in both the well graded till and mixed mine rock scenarios. In order to remain conservative and capture sulfide oxidation and subsequent reactions occurring in the mine rock mix cover system, a depth to suboxic conditions of 3 m was used in the well graded cover system scenarios. Cell-specific reactive and suboxic zone thicknesses are summarized below in Table 3.12.

Table 3.12: Cell-specific reactive and suboxic zone thicknesses.

Cell	Total Cell Height (m)*	Reactive Zone Thickness (m)		Suboxic Zone Thickness (m)	
		Poorly Graded	Well Graded	Poorly Graded Scenario	Well Graded Scenarios
1	28	13	3	15	25
2	44	13	3	31	41
3	44	13	3	31	41
4	51	13	3	38	48
5	64	13	3	51	61
6	51	13	3	38	48
7	33	13	3	20	30
8	24	13	3	11	21
9	28	13	3	15	25
10	13	13	3	-	10
11	6	6	3	-	3
12	7	7	3	-	4
13	6	6	3	-	3
14	6	6	3	-	3
15	5	5	3	-	2
16	5	5	3	-	2
17	5	5	3	-	2

Cell	Total Cell Height (m)*	Reactive Zone Thickness (m)		Suboxic Zone Thickness (m)	
		Poorly Graded	Well Graded	Poorly Graded Scenario	Well Graded Scenarios
18	7	7	3	-	4
19	6	6	3	-	3
20	10	10	3	-	7
21	8	8	3	-	5
22	4	4	3	-	1
23	3	3	3	-	-

*Not including cover system

Construction Schedule

The construction schedules of the NAG backfill will influence timing of seepage quality. Placement of the cover system will limit oxygen ingress and NP into the NAG backfill as well as the maturing of the cover system vegetation. The construction schedule of both the backfill and cover system was simplified to allow for implementation into the reactive transport model. These simplifications and assumptions were:

- All cells are built instantaneously, and the complete height of the cell was available for reaction once it was placed in the model.
- Cover system placement for the backfill is indicated by the construction schedule provided by Telkwa and detailed in Section 3.5.1.
- Once covered, there will be an instantaneous decrease in NP.
- Once forest vegetation is developed (assumed to be five years after cover construction) there will be an instantaneous decrease in NP.
- Once covered, there will be an approximately 15-year period for suboxic conditions to develop. It was assumed there will be an instantaneous shift to suboxic conditions 15 years after cover construction.

Additional NAG Backfill Reactive Transport Model Assumptions

- Mineralogy was homogeneous throughout the NAG backfill and is defined based on the NAG mine rock barrel tests compositions;
- Mine rock placement in the NAG backfill will include mine rock characterized as the average composition from the mine rock barrel tests;

- Cell-specific annual loads (mg/year) were calculated based on the reactive transport concentration outputs and total annual flow volumes for each cell respectively;
- The timing of seepage from each cell of the reactive transport model was based on wetting-up timing from the GoldSim model. A cell was assumed to be wetted-up when total annual seepage from the GoldSim model was greater or equal to 50% of the steady state total annual seepage for that cell. Prior to a cell being wetted-up, parameter concentrations were set to equal the concentration from Year 0 of the reactive transport model. Seepage rates are negligible during the time the cell is wetting up, and therefore load from the cell is also negligible;
- After an initial wetting-up phase, final concentrations for the NAG backfill were calculated using the total annual loads (mg/year) from each cell divided by the total annual seepage rate (L/year);
- Seasonality was not included in the model. A constant NP based on bare surface, covered grass surface, or covered forest surface was assumed for all cells;
- Cell-specific seepage volumes and concentrations were mixed at the base of the NAG backfill based on the modelled seepage rates from the GoldSim model;
- The performance of the cover system remains constant;
- Parameter concentrations below detection limit were assigned values of the detection limit used in the barrel test leachate chemistry reporting;
- During the bare surface period, seepage and porewater is in equilibrium with the atmosphere ($\log(pO_2) = -0.7$ and $\log(pCO_2) = -3.5$); and
- During the cover period, pore water residing in the suboxic zone is in equilibrium with O_2 concentrations of 0.1% ($\log(pO_2) = -3.0$).

3.5.6.6 Geochemical Scale-Up Model

Parameters that were not included in the reactive transport model were modelled using a geochemical scale-up model. The geochemical scale-up model functioned by:

- Developing average loading rates for parameters not included in the reactive transport models using the leachate data from the B1, B2 and B7 barrel tests; and
- Scaling-up the production rates based on material placement, hydraulic properties, and material properties.

Soluble salts can accumulate before kinetic experiments are initiated and result in rapid flushing of constituents. Potentially due to the age of the weathering experiments or variations in collected water volumes it was not entirely apparent if the B2 and B7 barrel tests had fully flushed stored soluble salts; however, loading rates from the last three samples collected were used.

Similar to the reactive transport model, loading rates derived using the barrel leachate data were scaled up based on differences between the barrel test scale and the full backfill scale. The scale up included two scaling factors: particle size and mine rock contact. Temperature scaling factors were not applied as it was assumed that the average temperature in the barrels will be comparable to the full-scale NAG backfill.

Particle Size Factor

The reactive particle sizes of the NAG backfill were assumed to be limited to the < 6.35 mm portion and assumed to be 20% of the bulk mine rock; therefore, the scaling factor for particle size was set to 0.2. This particle size scaling factor was previously used by SRK (2022a) to scale HCT loading rates to field scale.

Contact Factor

The reactivity of the mine rock will be limited to the < 6.35 mm portion; however, only a portion of the seepage will react with this portion given the likely presence of preferential flow paths. A contact factor of 0.5 was used in previous source term development (SRK, 2022a) and was deemed reasonable for the current model.

Geochemical Scale-Up Model Assumptions

The following assumptions were included in the geochemical scale-up model:

- Cell-specific annual loads (mg/year) were calculated based on the annual mass of mine rock for the cell in the given year and the loading rate of the parameter (mg/kg/year). After an initial wetting-up phase, final concentrations for the NAG backfill were calculated using the total annual loads (mg/year) for all cells divided by the total annual seepage rate (L/year);

- The wetting up period for the backfill was estimated as the period of time prior to total annual seepage volumes equalling roughly 50% of steady state annual seepage volumes (roughly 17 years). Seepage concentrations prior to wetting up were set to concentrations calculated for the first year after wetting up;

- Once a cell was fully constructed and wetted-up, the annual loads were assumed to remain constant and estimated parameter concentrations were only influenced by changes in annual seepage rates;

- The seepage of all cells mixed at the base of the NAG backfill;

- Loading rates remained constant and were not affected by changes in mineralogy or kinetic rates over time; and

- Solubility controls were applied by including the geochemical scale-up modelled parameters in the equilibrium modelling discussed in Section 3.5.6.5.

3.5.7 Nitrogen Sensitivity Scenarios

Two additional model sensitivity scenarios were simulated to assess nitrogen source terms under different blasting loss conditions. A high nitrogen source term scenario was run to simulate a scenario where nitrogen losses from blasting are greater than expected. A low nitrogen source term scenario was run to simulate decreased nitrogen losses from blasting resulting from blast hole liners used as a source mitigation.

Nitrogen source term scenarios were modelled by either increasing or decreasing the residual nitrogen available for leaching as calculated by Ferguson & Leask (1988). This in turn increased or decreased the initial pore-water concentration of nitrogen species applied in PHREEQC for the respective nitrogen scenarios (Table 3.13). All other reactive transport model inputs remained the same as in the Well-Graded with No Internal Layers models. The high nitrogen source term scenario represents an increase of 56.25% residual nitrogen. Blasthole liners are assumed to decrease nitrogen losses by 37.5% in the low nitrogen source term scenario (D. Farmer, personal communication, July 15, 2024).

Table 3.13: Initial nitrogen species concentrations in NAG backfill porewater for nitrogen source term scenarios.

Parameter	Unit	Initial Porewater Composition		
		Well-Graded No Internal Layers Scenario	High Nitrogen Scenario	Low Nitrogen Scenario
Nitrate (as N)	mg/L	65	102	41
Ammonia (Total)	mg/L	8.3	13	5.2
Nitrite (as N)	mg/L	1.5	2.4	0.94

4 MODELLING RESULTS AND DISCUSSION

4.1 Water Balance Results

A landform water balance was completed to develop simplified boundary conditions for the 2D GeoStudio oxidation modelling and the 3D GoldSim modelling. A summary of the 1D water balance for the two material combination scenarios is provided in Table 4.1. The well-graded till and mine rock mix material properties and results were also used for the no internal layers scenario.

Table 4.1: Summary of water balance results for the two material combination scenarios.

Scenario	Total Precipitation (mm)	Rainfall (% of PPT)	Snow (% of PPT)	Actual Evapotranspiration (% of PPT)	Runoff (% of PPT)	Sublimation (% of PPT)	Net Percolation (% of PPT)
PG Till and Sandstone (Bare)	649	61%	39%	32%	2%	24%	42%
PG Till and Sandstone (Grass – 5 years)	616	52%	48%	49%	0%	19%	32%
PG Till and Sandstone (Forest – 73 years)	655	61%	39%	57%	3%	21%	19%
WG Till and Mine Rock Mix (Bare)	649	61%	39%	42%	12%	24%	22%
WG Till and Mine Rock Mix (Grass – 5 years)	616	52%	48%	54%	3%	19%	24%
WG Till and Mine Rock Mix (Forest – 73 years)	655	61%	39%	59%	9%	21%	11%
Mine Rock Mix (Bare)	649	61%	39%	28%	28%	21%	22%*

PG Till – Poorly Graded Till; WG Till – Well Graded Till; PPT – Precipitation

* - Surface net infiltration into the bare Mine Rock Mix

An average year of daily net percolation rates for each time period (bare, grass, and forest) were used as inputs in the 2D GeoStudio models and stochastically in the 3D GoldSim model.

4.2 2D GeoStudio Oxidation Model Results

The predicted development of the suboxic zone within the NAG backfill mine rock within the Open Pit with time for the poorly graded till and sandstone mine rock scenario is shown in Figure 4.1. The suboxic zone development for the well graded till and mine rock mix scenario is shown in Figure 4.2, while the suboxic zone development for the scenario with no internal overburden layers is shown in Figure 4.3. The models indicate that the long-term depths to suboxia are, on average, 13 m for the poorly graded till with sandstone mine rock scenario and 3.3 m for the well graded till with the mine rock mix scenario, as well as the no internal overburden layers scenario. The suboxic zone takes approximately 15 years to form in each strip in the poorly graded till with sandstone mine rock scenario. In both the well graded till with the mine rock mix scenario and the no internal layers scenario (using well graded till and mine rock mx material properties), it took approximately 13 years for the suboxic zone to form in each strip. These results were used to estimate the development of the suboxic zone within the 3D GoldSim model.

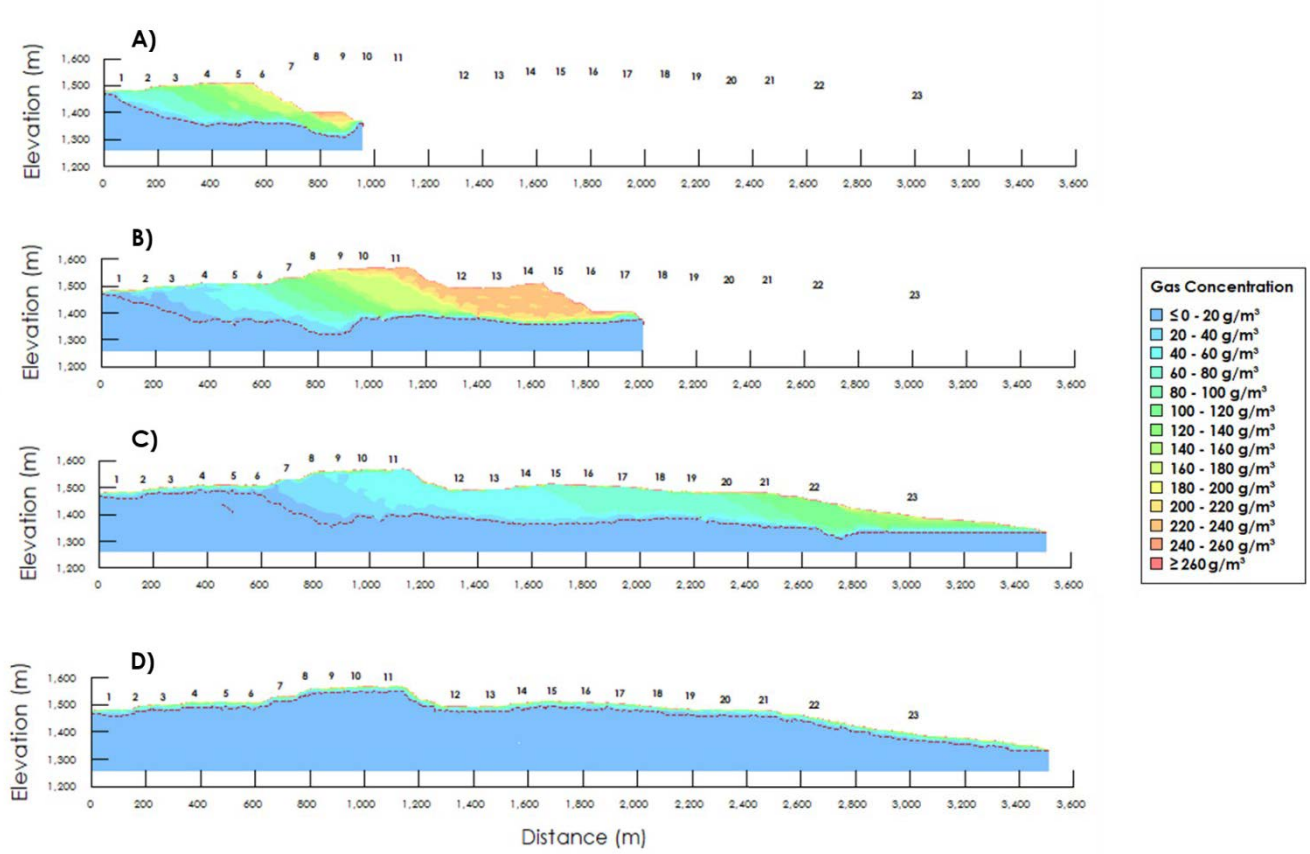


Figure 4.1: Development of suboxic zone for the poorly graded till and sandstone mine rock scenario (outlined by red dashed line in figures, which represents the zone at, or below, an O_2 concentration of 13 g/m³ or 1 vol.%) for the poorly graded till and sandstone mine rock scenario at A) Year 12; B) Year 17; C) Year 23; and d) Year 36/Long Term.

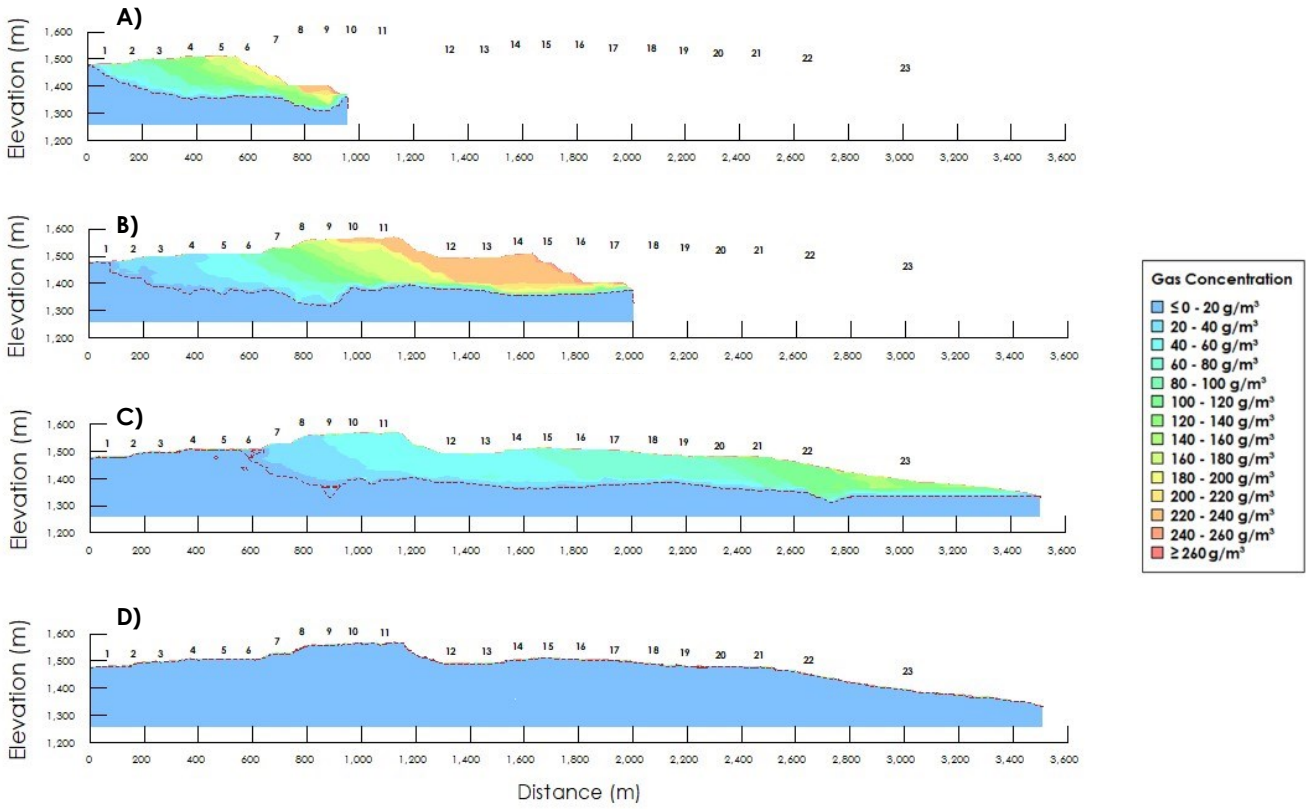


Figure 4.2: Development of suboxic zone (outlined by red dashed line in figures, which represents the zone at, or below, an O_2 concentration of 13 g/m³ or 1 vol.%) for the well graded till and mine rock mix scenario at A) Year 12; B) Year 17; C) Year 23; and d) Year 36/Long Term.

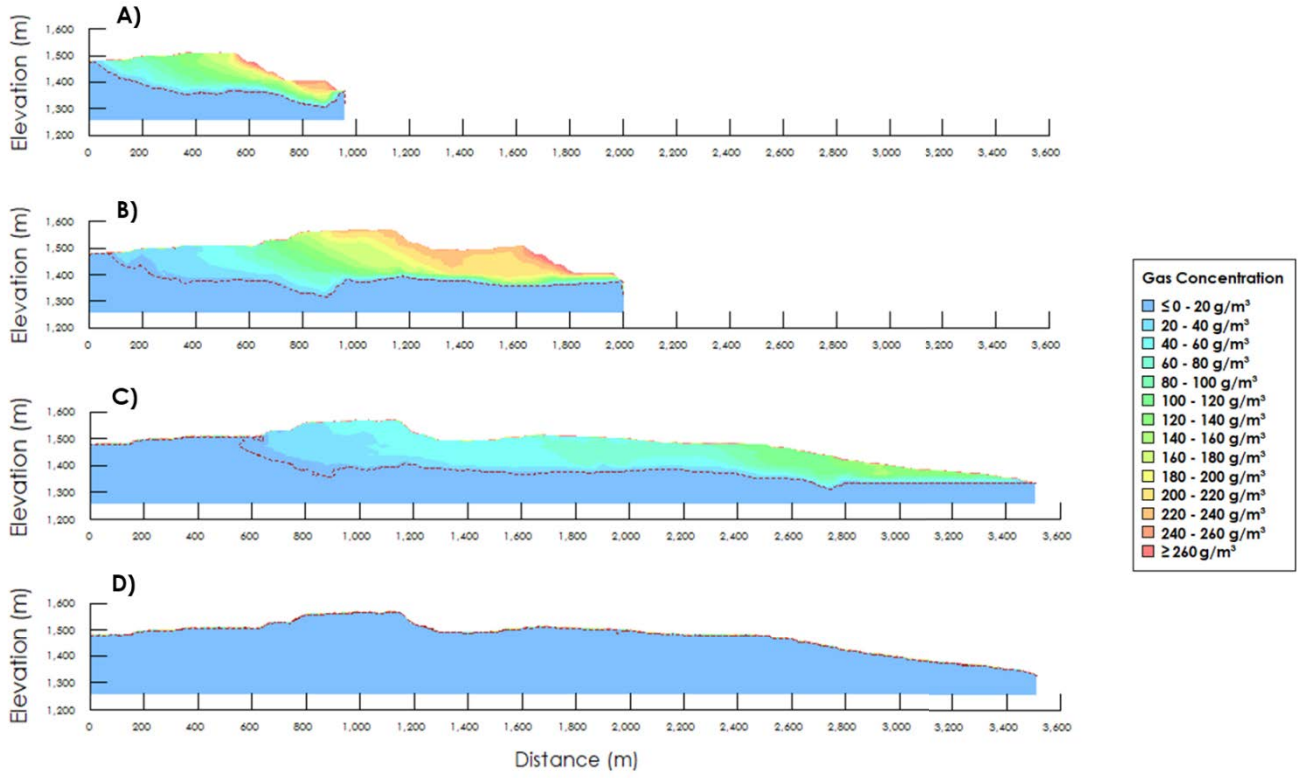


Figure 4.3: Development of suboxic zone (outlined by red dashed line in figures, which represents the zone at, or below, an O_2 concentration of 13 g/m³ or 1 vol.%) for the no internal layers scenario at A) Year 12; B) Year 17; C) Year 23; and d) Year 36/Long Term.

4.3 3D GoldSim Model Results

The 3D GoldSim model was run on calendar time with 2023 representing the first year of placement, or Year 6. The results are therefore presented in calendar time out to 2150, which represents Year 133.

4.3.1 Total Seepage

The total seepage rate of the backfilled NAG mine rock in the Open Pit was simulated in GoldSim for 100 realizations. The mean value, along with the 5th and 95th percentiles of the model results, are plotted in Figure 4.4 for all modelled scenarios. The models predicted long-term stabilized seepage rates from the covered and vegetated backfilled NAG mine rock that were between 31,000 m³/month and 36,000 m³/month for the poorly graded till and sandstone mine rock scenario, and between 14,500 m³/month and 16,000 m³/month for both the well graded till with mine rock mix scenario and the no internal layers scenario. The poorly graded till and sandstone mine rock scenario showed greater variability in monthly seepage rates due to the coarser texture of the material. Prior to cover system placement, the well graded till with mine rock mix scenario differs from the no internal layers scenario

due to the lack of overburden layers, but once the cover system is placed, the two scenarios show almost identical results.

The model results indicate that the backfilled NAG mine rock in the Open Pit will be wetted up, as indicated by the stabilization of the seepage rates, approximately 40 years following completion of construction for the poorly graded till and sandstone mine rock scenario. The finer texture of the material in both the well graded till with mine rock mix scenario and the no internal layers scenario resulted in a longer wetting up period, reaching stabilization approximately 80 years following the completion of construction.

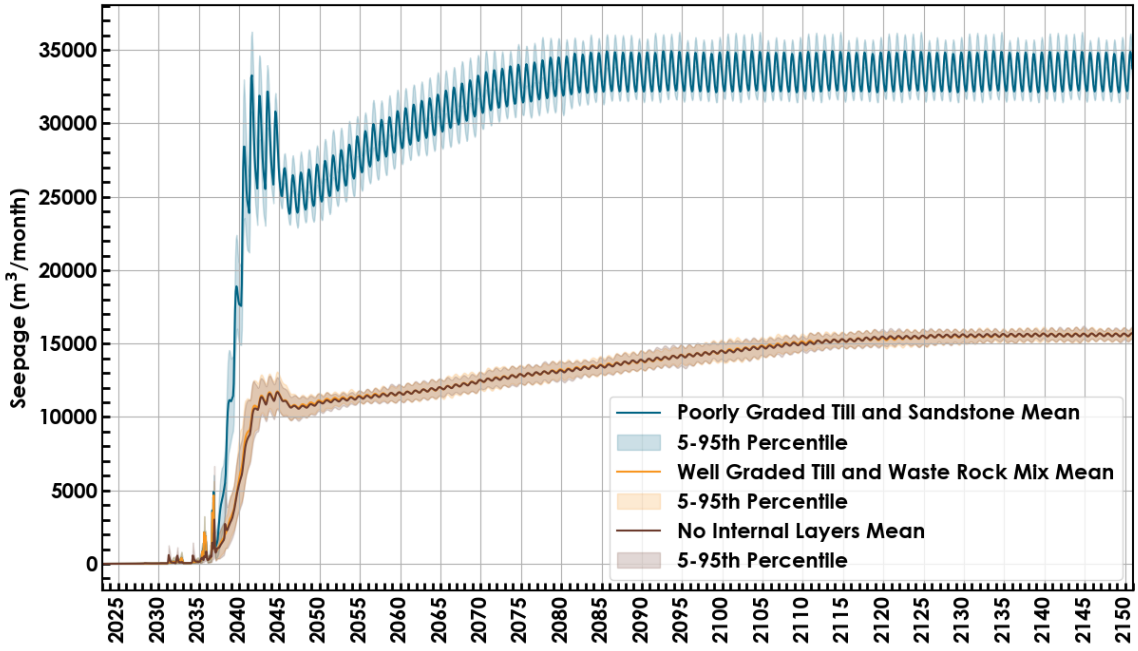


Figure 4.4: Range of seepage rates simulated by the GoldSim model for the backfilled NAG mine rock in the Open Pit for all the scenarios.

4.3.2 Total Storage

The estimated total stored water volume within the backfilled NAG mine rock for the modelled scenarios are shown in Figure 4.5. The modelled water volume increases with mine rock placement during construction before starting to stabilize once construction is complete and the cover system is placed. Similar to the seepage results, the water volume within the backfilled NAG mine rock is estimated to stabilize after approximately 40 years for the poorly graded till and sandstone mine rock scenario and approximately 70-80 years for both the well graded till with mine rock mix scenario and the no internal layers scenario. Once the stored water volume stabilized, very small variations in water volume were predicted, due to the variation in seasonal NP inputs.

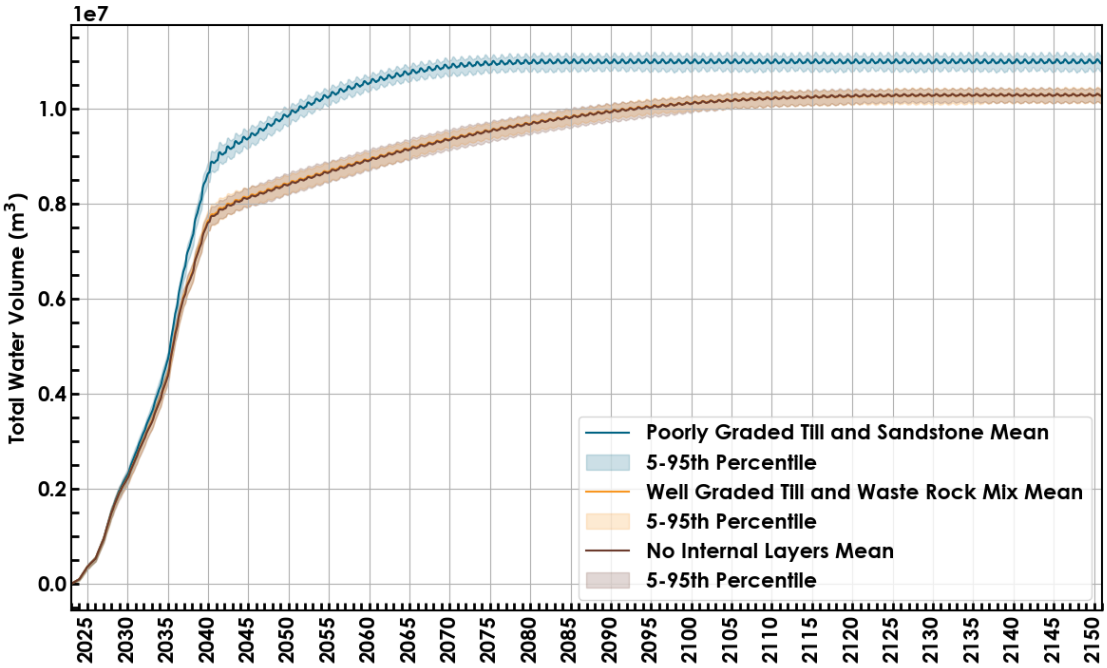


Figure 4.5: Range of total water volume within the backfilled NAG mine rock in the Open Pit simulated by the GoldSim model.

4.3.3 Oxygen Ingress

The range of oxygen ingress from the 3D GoldSim model for all modelled scenarios is presented in Figure 4.6. The well graded till with mine rock mix scenario and the no internal layers scenario both showed a higher long term average oxygen ingress despite having a shallower depth to suboxia. Due to the limitations of the GoldSim model representing each strip as a 1D column, convection is limited to density driven convection (free convection) and oxygen ingress is dominated by diffusion. In this case, with a shallower depth to suboxia, the concentration gradient across the cover system is greater, resulting in a higher diffusive oxygen ingress rate. In the poorly graded till and sandstone mine rock scenario, the depth to suboxia is greater, reducing the concentration gradient across the cover system and lowering the overall diffusive flux. When forced convection (advection) is accounted for, it is likely that the oxygen ingress rate for the poorly graded till and sandstone mine rock scenario would show higher oxygen ingress rates.

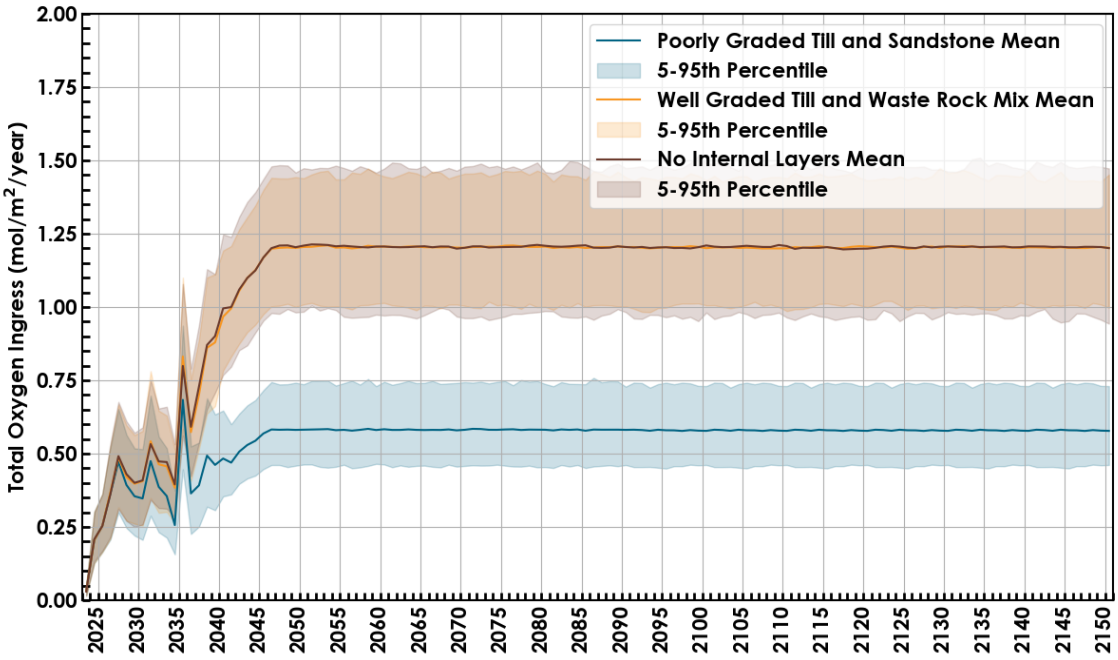


Figure 4.6: Range of oxygen ingress rates simulated by GoldSim for the backfilled NAG mine rock in the Open Pit for all modelled scenarios.

4.4 Geochemical Modelling Results

This section summarizes the results of the geochemical models of the NAG backfill cover scenarios and present a time-series of source terms for the NAG backfill during the bare surface, covered grass surface, and covered forest surface timeframes. Model results of select parameters are presented in Figure 4.7 to Figure 4.11. Tables of source terms and annual loads from the three scenarios of the NAG backfill are provided in Appendix A.

In the three modelled scenarios, the cover system construction decreases NP and limits oxygen ingress into the mine rock within the NAG backfill. Suboxic zones were established in almost half of the cells in the poorly graded till and sandstone mine rock scenario and in all but one cell in the well graded till and mine rock mix scenarios (Section 4.3.3). Sulfide oxidation only occurred in the reactive oxic zones, as a result, loading rates of oxidation products are partly controlled by the amount of suboxic mine rock in the backfill.

In general, concentrations for most modelled parameters were similar between the poorly graded till and sandstone and well graded till and mine rock mix scenarios. While the amount of suboxia increased substantially for the well graded till and mine rock mix scenarios, the volume of water infiltrating the surface of the NAG backfill decreased, resulting is less water available to dilute oxidation products from the limited reactive zone. Despite concentrations remaining similar between the three scenarios, the

annual load exiting the NAG backfill as seepage in both the well graded till and mine rock mix scenarios is roughly half the annual load exiting in the poorly graded till and sandstone scenario.

The onset of seepage from the NAG backfill occurs as cells from the model become fully wetted-up, which begins in approximately 2036. Areas of the backfill that contain smaller thicknesses of mine rock wet up faster than areas with greater thicknesses; therefore, the effects of seepage from thinner cells are observed in the model results faster than the effects from thicker cells. Thicker cells will generally produce poorer water quality than thinner cells because there is a longer pathway for water to accumulate oxidation products (ignoring the effects of suboxic zones).

After the initial wetting-up period and prior to the development of suboxic zones within the models, concentrations of parameters associated with pyrite oxidation (e.g., SO_4, Se, Cu, etc.) generally have an increasing trend. Concentrations stabilize and tend to decrease once suboxic conditions are established. After the onset of seepage, Se concentrations range between 0.03 to 0.07 mg/L, with the onset of lower concentration occurring near the end of the modelled timeframe. Concentrations of Se are trending lower near the end of the modelled timeframe for the well graded till and mine rock mix scenario. Concentrations of SO_4 and Cu are approximately 1,500 mg/L and 0.015 mg/L, respectively, near the end of the modelled timeframes for all three scenarios. Annual loads of parameters related to pyrite oxidation in the well graded till and sandstone scenarios are approximately half of the poorly graded till and mine rock mix scenario. Annual loads are generally similar between the two well graded till and waste rock mix scenarios with the largest differences observed in the last ~20 years of the modelled timeframe.

Nitrate concentrations and loads peak in the initial years that seepage occurs and are controlled by flushing of blast residues that are on the surface of the mine rock. The release of NO_3 (and subsequently NO_2 and NH_4) is spread out over many decades as the transport time is variable in different areas of the backfill depending on the cell thickness.

A slight variation in pH was observed between the modelled scenarios with the well graded till and sandstone scenarios having a slightly higher value. This is likely a result of the longer residence time of water in the suboxic zone of the carbonate-rich mine rock in the well-graded model scenario.

The NAG backfill source terms from the three modelled scenarios are summarized in Table 4.2 and represent the concentrations of parameters at the end of the modelled timeframe (year 2150). The source terms are also compared to source terms developed by SRK (2024). It should be noted that source terms developed by both SRK and Okane utilized NAG field bin data to derive source terms. Differences in source terms are attributed to the implementation of reactive transport modelling and the consideration of changes in net percolation and oxygen ingress into the NAG backfill as a result of the modelled cover systems. In general, the source terms from the current modelling work are lower than the initial SRK source terms. Due to the incorporation of wetting up in the current model, the largest differences in loading rates between both sets of models are observed in the initial 20 years of the model

time frame. Once the modelled loading rates stabilize, mass loads of constituents such as SO_4 and Se range from approximately 50 to 75% lower than the initial SRK loads (Figure 4.12).

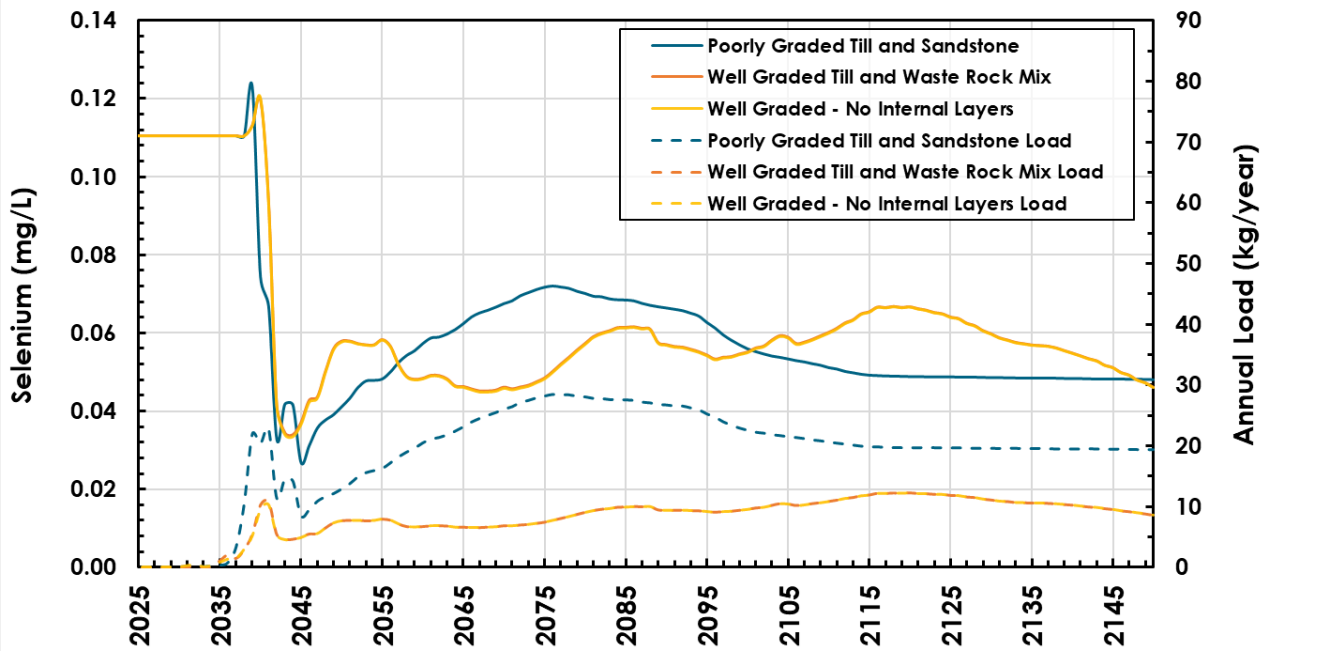


Figure 4.7: Evolution of Se concentrations and annual loads from NAG backfill seepage in the three cover system and mine rock scenarios.

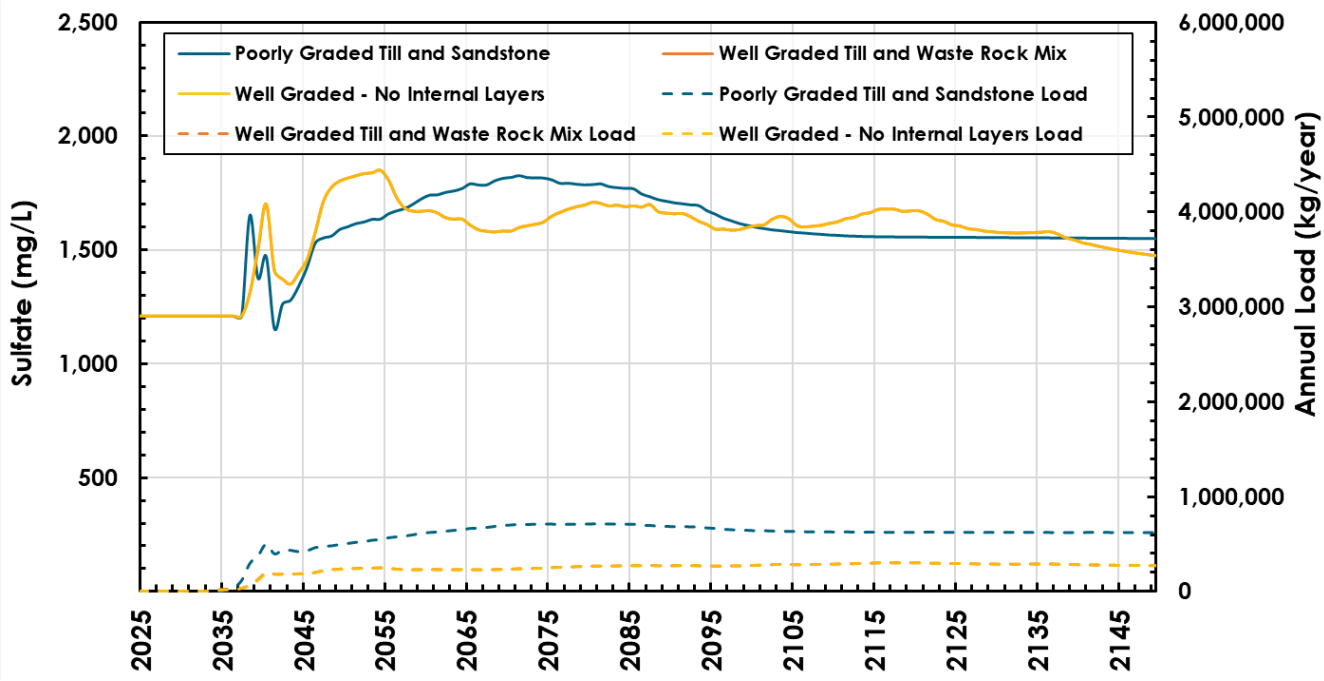


Figure 4.8: Evolution of SO_4 concentrations and annual loads from NAG backfill seepage in the three cover system and mine rock scenarios.

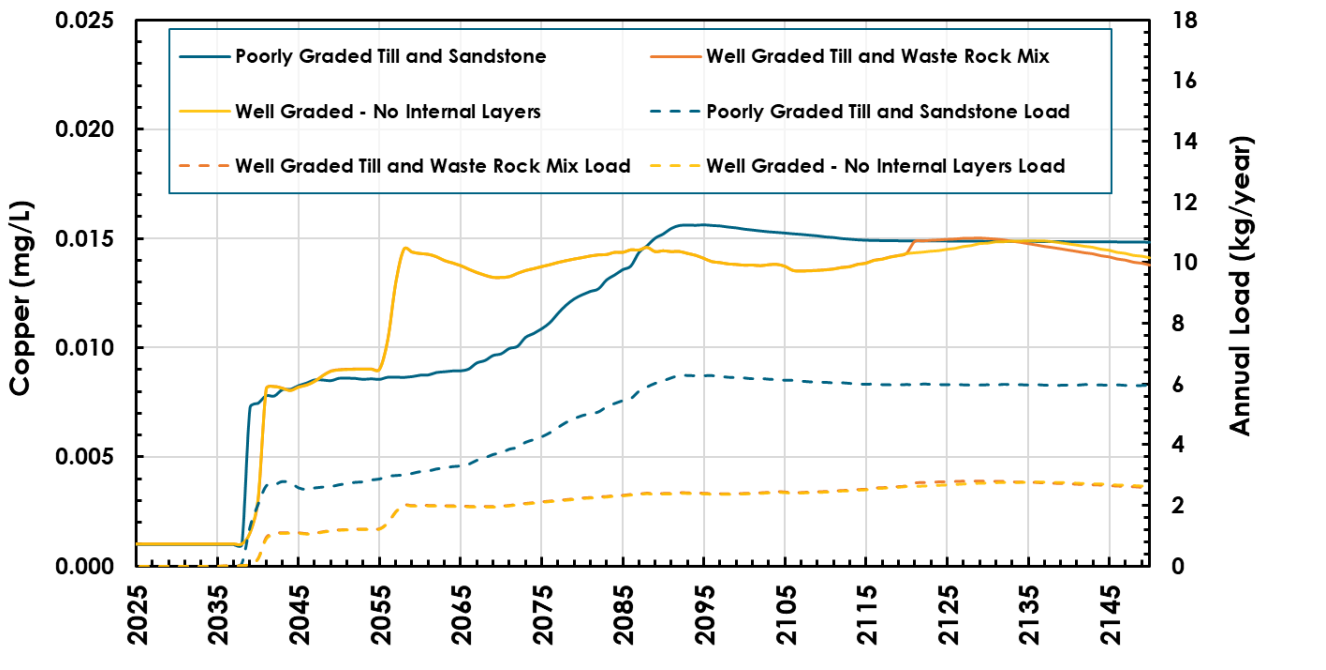


Figure 4.9: Evolution of Cu concentrations and annual loads from NAG backfill seepage in the three cover system and mine rock scenarios.

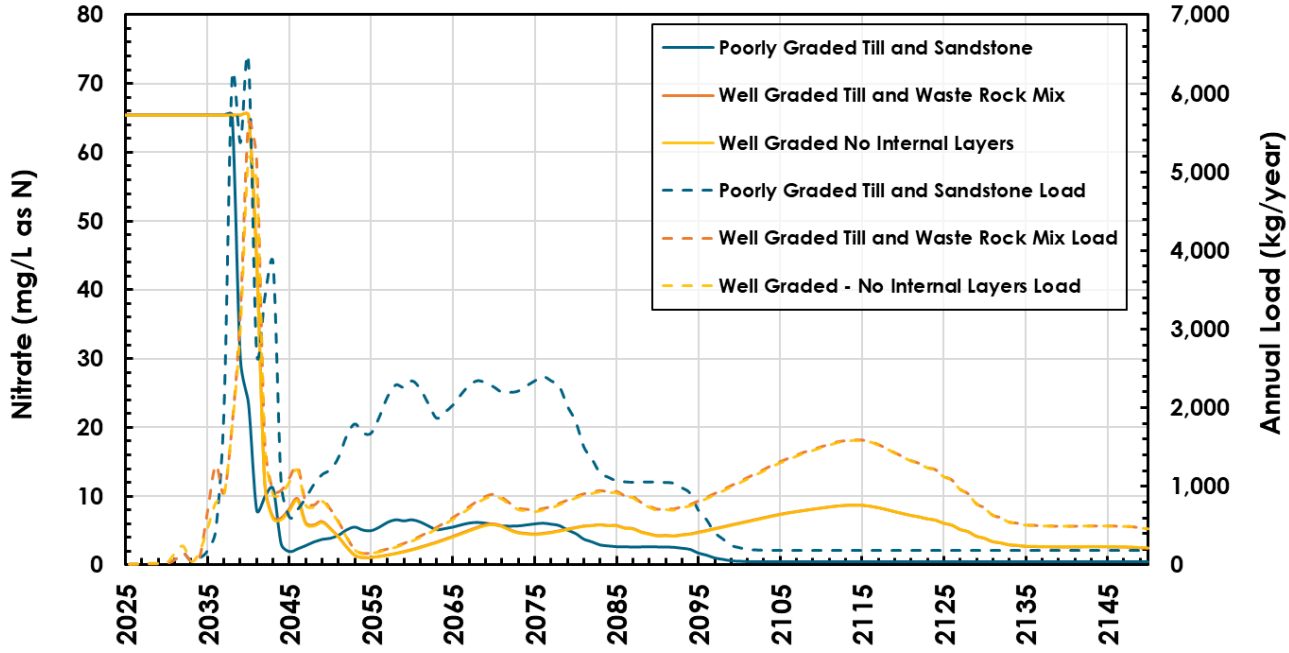


Figure 4.10: Evolution of NO_3 concentrations and annual loads from NAG backfill seepage in the three cover system and mine rock scenarios.

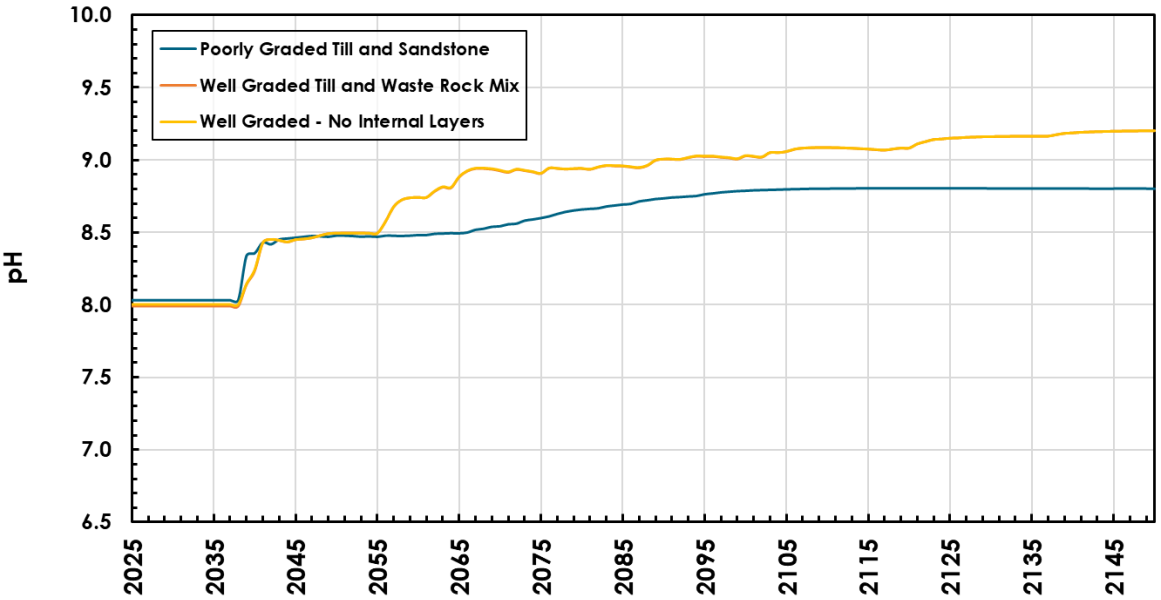


Figure 4.11: Evolution of pH from NAG backfill seepage in the three cover system and mine rock scenarios.

Table 4.2: Comparison of source terms of the NAG backfill from various model scenarios.

Parameter	Well Graded Model Source Term[1]	Well Graded with No Internal Layers Source Term[1]	Poorly Graded Model Source Term[1]	NAG Backfill – 2021-2029		NAG Backfill – 2030-2100	
				NAG Typical[2]	NAG High[2]	NAG Typical[2]	NAG High[2]
pH	9.2	9.2	8.8	8.2	8.4	8.3	8.5
Alkalinity (mg/L as $CaCO_3$)	3,445	3,445	1,947	1,904	3,398	2953	4468
Ca (mg/L)	0.85	0.85	2.6	53	95	79	119
Mg (mg/L)	84	84	54	32	57	48	72
K (mg/L)	24	24	11	13	23	20	31
Na (mg/L)	1,335	1,335	1,083	1,614	2,881	2505	3790
Cl (mg/L)	17	17	7.9	24	43	37	56
SO4 (mg/L)	1,476	1,476	1,550	1,803	3,218	2772	4193
Al (mg/L)	0.27	0.27	0.075	0.0045	0.0072	0.0064	0.0089
Sb (mg/L)	0.0026	0.0026	0.0027	0.0029	0.0052	0.0045	0.0069
As (mg/L)	0.0019	0.0019	0.002	0.0043	0.0078	0.0067	0.01
Ba (mg/L)	0.0034	0.0034	0.0026	0.045	0.08	0.069	0.1
B (mg/L)	0.78	0.78	0.36	0.45	0.8	0.7	1.1
Cd (mg/L)	0.00004	0.00005	0.00004	0.000095	0.00017	0.00014	0.00021
Cr (mg/L)	0.0005	0.0005	0.0005	0.0018	0.0033	0.0029	0.0043
Co (mg/L)	0.0039	0.0039	0.0042	0.015	0.026	0.02	0.03

Parameter	Well Graded Model Source Term[1]	Well Graded with No Internal Layers Source Term[1]	Poorly Graded Model Source Term[1]	NAG Backfill – 2021-2029		NAG Backfill – 2030-2100	
				NAG Typical[2]	NAG High[2]	NAG Typical[2]	NAG High[2]
Cu (mg/L)	0.014	0.014	0.015	0.016	0.029	0.025	0.037
Fe (mg/L)	0.05	0.05	0.05	0.00012	0.0001	0.00011	0.0001
Pb (mg/L)	0.0036	0.0036	0.004	0.0048	0.0085	0.0074	0.011
Li (mg/L)	0.43	0.43	0.2	0.14	0.24	0.21	0.32
Mn (mg/L)	0.016	0.016	0.017	0.11	0.19	0.12	0.18
Hg (mg/L)	0.000005	0.000005	0.000005	0.00001	0.000018	0.000016	0.000023
P (mg/L)	0.27	0.27	0.13	0.026	0.046	0.04	0.06
Mo (mg/L)	0.05	0.05	0.052	0.17	0.3	0.26	0.39
Ni (mg/L)	0.013	0.013	0.014	0.029	0.051	0.04	0.061
Se (mg/L)	0.046	0.046	0.048	0.089	0.16	0.14	0.21
Si (mg/L)	2.8	2.8	1.3	4.6	8.3	7.1	11
Ag (mg/L)	0.000035	0.000035	0.000037	0.000074	0.00013	0.00011	0.00017
Sr (mg/L)	1.4	1.4	0.64	0.83	1.5	1.3	1.9
Sn (mg/L)	0.0005	0.0005	0.0005	0.00078	0.0014	0.0012	0.0018
Tl (mg/L)	0.000036	0.000036	0.000037	0.000078	0.00014	0.00012	0.00018
U (mg/L)	0.016	0.016	0.017	0.019	0.034	0.029	0.044
V (mg/L)	0.005	0.005	0.005	0.004	0.0072	0.0062	0.0095
Zn (mg/L)	0.01	0.01	0.01	0.032	0.058	0.046	0.07

[1] Source term represents the parameter value at the end of the modelled timeframe (year 2150).
[2] Source term from SRK (2024).

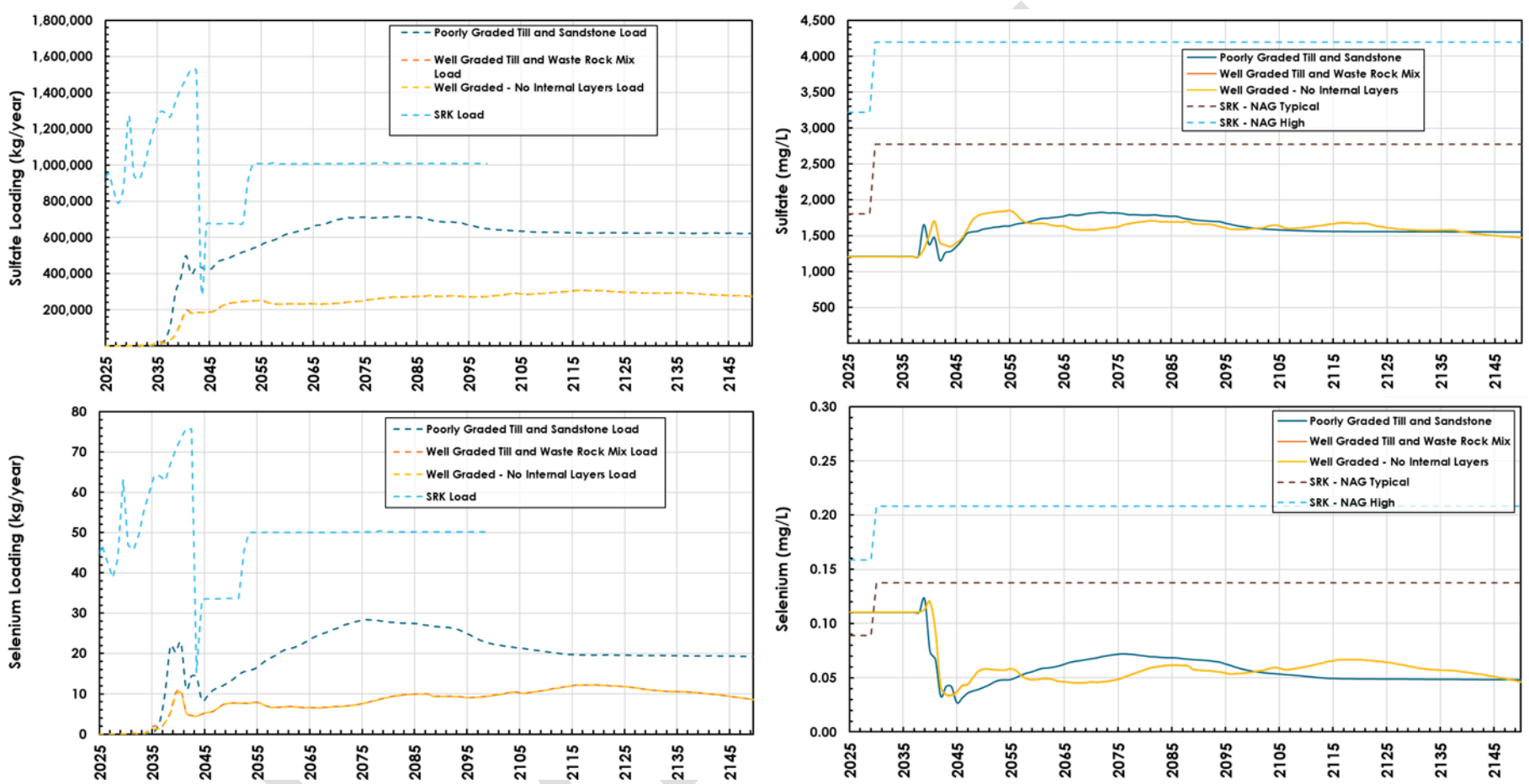


Figure 4.12: Summary of sulfate and selenium NAG backfill source terms and loading rates.

4.4.1 Nitrogen Source Term Scenarios

Nitrogen source terms decreased by 37.5% in the low nitrogen scenario and increased by 56.25% in the high nitrogen scenario throughout the first 15 years of the modelled timeframe as the initial porewater from each cell flushed out (Figure 4.13). Once individual cells began to be fully flushed, there were small variations in the percent change in nitrogen concentrations across sensitivities caused by dilution from cells that had been fully flushed of nitrogen. Overall, the differences in nitrogen source terms were similar to the 37.5% decrease or 56.25% increased applied in the respective sensitivity.

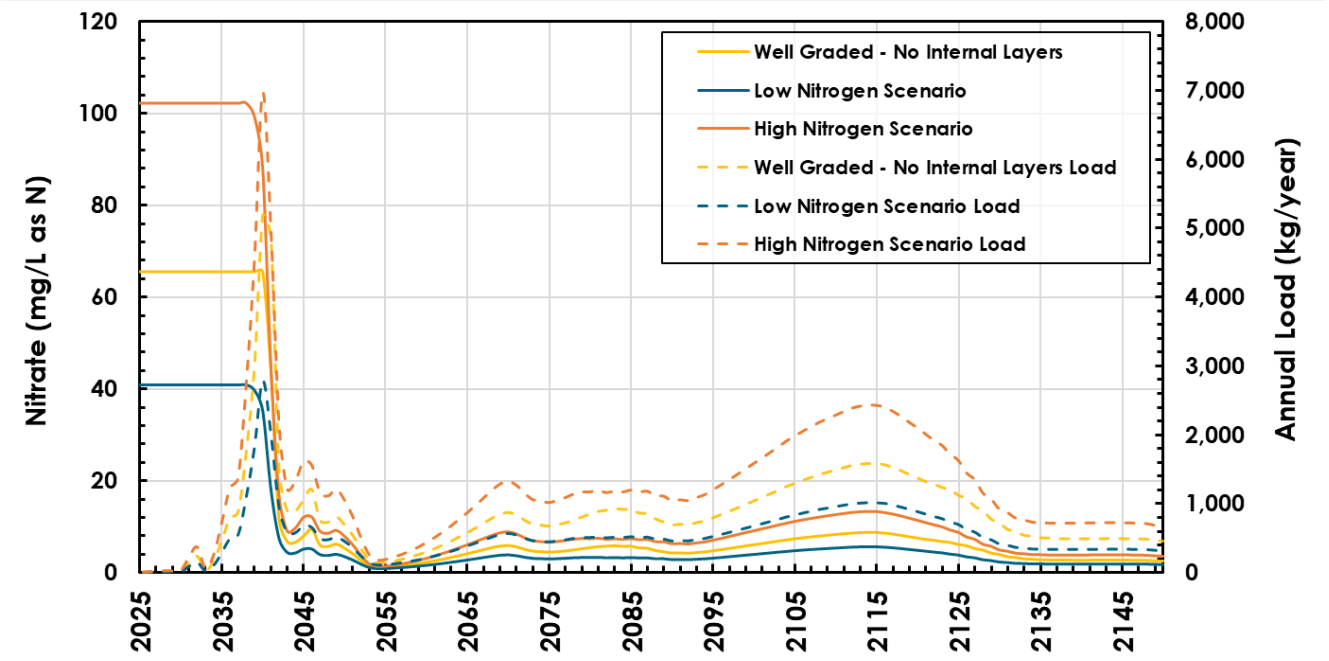


Figure 4.13: Summary of nitrate source terms and loading rates in the well graded – no internal layers scenario and two nitrogen source term scenarios.

5 CONCLUSIONS

The scope of this work was to provide Telkwa support in the development of source terms for three scenarios of backfilled NAG mine rock in lifts using bottom-up construction methodology with overburden covers. The objective of the backfilled design is to limit oxygen and water ingress to minimize the release of potential contaminants of concern such as selenium and sulfate to the receiving environment. Based on the modelling that was completed for this work, the following conclusions are made:

- GoldSim modelling indicates that the backfilled NAG mine rock in the Open Pit will be wetted up approximately 40 years following completion of construction for the poorly graded till and sandstone mine rock scenario. The well graded till with mine rock mix scenario and the no internal layers scenario will be wetted up approximately 80 years following the completion of construction due to the finer texture of material.

- Two-dimensional oxygen models indicate that the long-term depths to suboxia are, on average, 13 m for the poorly graded till and sandstone mine rock scenario and 3.3 m for the well graded till with mine rock mix scenario and the no internal layers scenario. The suboxic zone takes approximately 15 years to form in each strip modelled of the poorly graded till and sandstone mine rock once the cover system has been placed. In both the well graded till with mine rock mix scenario and the no internal layers scenario, the suboxic zone takes approximately 13 years to develop following cover system placement.

- It is likely that the oxygen ingress rate for the poorly graded till and sandstone mine rock scenario would be greater than the well graded till and mine rock mix scenarios.

- In general, concentrations in NAG backfill seepage for most modelled parameters will be similar between the three modelled scenarios.

- The decrease in oxygen ingress and infiltrating water into the NAG backfill for the well graded till and mine rock mix scenarios results in an annual chemical load (mass released per year) decrease of approximately half compared to the poorly graded till and sandstone mine rock scenario.

- As a result, mass loads of dissolved constituents such as selenium and sulfate from the NAG backfill are expected to decrease relative to initial source term and load balance models under the conditions modelled herein.

The NAG backfill source terms from this modelling work will be integrated into the site wide load balance model to quantify the effects of the backfill on water quality around the Tenas project.

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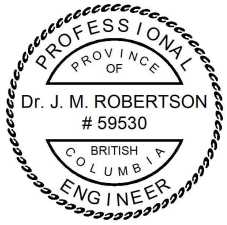
7 CLOSURE

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Appendix A

NAG Backfill Source Terms

Table A1. Source terms of the NAG backfill for the poorly graded cover system scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2023	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	16
2024	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	33
2025	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	57
2026	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	87
2027	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	116
2028	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	195
2029	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	221
2030	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	266
2031	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	961
2032	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	2,273
2033	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	710
2034	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	1,289
2035	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	2,755
2036	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	6,758
2037	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	30,026
2038	8.0	1,210	94	12	0.012	0.0021	0.0012	0.0023	0.53	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.29	20	0.034	0.000005	0.041	0.0074	0.19	17	0.11	1.9	0.000029	530	0.93	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	94,634
2039	8.3	1,652	609	12	0.022	0.0029	0.0015	0.0021	0.53	0.00005	21	0.0005	0.0068	0.002	0.05	0.0011	0.29	31	0.038	0.000005	0.056	0.011	0.19	17	0.12	1.9	0.00004	846	0.93	0.00004	0.0005	0.018	0.005	0.01	30	3.8	0.69	178,458
2040	8.4	1,376	625	12	0.023	0.0024	0.0014	0.0023	0.53	0.00005	18	0.0005	0.0044	0.0068	0.05	0.0013	0.29	27	0.023	0.000005	0.046	0.0085	0.19	17	0.074	1.9	0.000033	730	0.93	0.000033	0.0005	0.015	0.005	0.01	23	3.0	0.54	272,969
2041	8.4	1,472	753	9.4	0.028	0.0026	0.0015	0.0023	0.43	0.00005	13	0.0005	0.0041	0.008	0.05	0.0016	0.23	29	0.021	0.000005	0.05	0.0087	0.15	13	0.067	1.6	0.000035	806	0.75	0.000035	0.0005	0.016	0.005	0.01	8.0	1.0	0.18	338,914
2042	8.4	1,156	717	9.2	0.028	0.002	0.0013	0.0026	0.42	0.00005	13	0.0005	0.0024	0.0078	0.05	0.0015	0.23	24	0.011	0.000005	0.039	0.0061	0.15	13	0.033	1.5	0.000028	658	0.74	0.000028	0.0005	0.012	0.005	0.01	9.9	1.3	0.23	343,355
2043	8.5	1,262	782	9.2	0.03	0.0022	0.0014	0.0025	0.42	0.00005	11	0.0005	0.0029	0.0081	0.05	0.0016	0.23	26	0.014	0.000005	0.042	0.0072	0.15	13	0.042	1.5	0.00003	721	0.74	0.00003	0.0005	0.013	0.005	0.01	11	1.4	0.26	345,155
2044	8.5	1,280	797	9.3	0.03	0.0023	0.0014	0.0025	0.43	0.00005	11	0.0005	0.003	0.0082	0.05	0.0019	0.23	26	0.014	0.000005	0.043	0.0078	0.15	13	0.042	1.6	0.000031	733	0.75	0.000031	0.0005	0.014	0.005	0.01	3.0	0.38	0.07	339,203
2045	8.5	1,343	812	10	0.03	0.0024	0.0014	0.0024	0.46	0.00005	11	0.0005	0.0023	0.0083	0.05	0.0021	0.25	27	0.0094	0.000005	0.045	0.0074	0.16	15	0.027	1.7	0.000032	764	0.82	0.000032	0.0005	0.014	0.005	0.01	1.9	0.25	0.045	312,231
2046	8.5	1,424	827	11	0.031	0.0025	0.0015	0.0024	0.48	0.00005	11	0.0005	0.0026	0.0084	0.05	0.0024	0.26	29	0.011	0.000005	0.048	0.0085	0.17	15	0.031	1.8	0.000034	804	0.85	0.000034	0.0005	0.015	0.005	0.01	2.3	0.29	0.054	301,366
2047	8.5	1,529	845	10	0.031	0.0027	0.0017	0.0023	0.48	0.00005	11	0.0005	0.003	0.0085	0.05	0.0027	0.26	31	0.012	0.000005	0.051	0.0096	0.17	15	0.036	1.7	0.000037	855	0.84	0.000037	0.0005	0.016	0.005	0.01	2.8	0.36	0.065	302,616
2048	8.5	1,553	841	10	0.03	0.0027	0.0017	0.0023	0.47	0.00005	11	0.0005	0.0031	0.0085	0.05	0.0028	0.26	31	0.013	0.000005	0.052	0.01	0.17	15	0.038	1.7	0.000037	864	0.83	0.000037	0.0005	0.017	0.005	0.01	3.3	0.42	0.077	305,970
2049	8.5	1,561	834	10	0.03	0.0028	0.0017	0.0023	0.47	0.00005	11	0.0005	0.0032	0.0085	0.05	0.0028	0.26	31	0.013	0.000005	0.053	0.01	0.16	15	0.039	1.7	0.000037	866	0.83	0.000038	0.0005	0.017	0.005	0.01	3.7	0.47	0.086	308,547
2050	8.5	1,590	853	10	0.031	0.0028	0.0018	0.0022	0.46	0.00005	11	0.0005	0.0034	0.0086	0.05	0.003	0.25	32	0.014	0.000005	0.054	0.011	0.16	15	0.041	1.7	0.000038	884	0.82	0.000038	0.0005	0.017	0.005	0.01	3.9	0.49	0.089	311,965
2051	8.5	1,602	853	10	0.031	0.0028	0.0018	0.0022	0.46	0.00005	11	0.0005	0.0036	0.0086	0.05	0.0031	0.25	32	0.015	0.000005	0.054	0.011	0.16	14	0.043	1.7	0.000038	889	0.81	0.000039	0.0005	0.017	0.005	0.01	4.3	0.55	0.099	316,216
2052	8.5	1,616	848	9.9	0.03	0.0028	0.0018	0.0022	0.45	0.00005	11	0.0005	0.0038	0.0086	0.05	0.0032	0.25	32	0.016	0.000005	0.054	0.012	0.16	14	0.046	1.6	0.000039	894	0.79	0.000039	0.0005	0.017	0.005	0.01	5.1	0.65	0.12	321,547
2053	8.5	1,623	839	9.8	0.03	0.0029	0.0019	0.0022	0.45	0.00005	11	0.0005	0.0039	0.0085	0.05	0.0033	0.24	32	0.016	0.000005	0.055	0.012	0.16	14	0.048	1.6	0.000039	895	0.78	0.000039	0.0005	0.017	0.005	0.01	5.5	0.7	0.13	324,989
2054	8.5	1,635	843	9.6	0.03	0.0029	0.0019	0.0022	0.44	0.00005	11	0.0005	0.0039	0.0086	0.05	0.0034	0.24	32	0.016	0.000005	0.055	0.012	0.15	14	0.048	1.6	0.000039	901	0.77	0.000039	0.0005	0.017	0.005	0.01	5.1	0.64	0.12	331,093
2055	8.5	1,636	838	9.4	0.03	0.0029	0.0019	0.0022	0.43	0.00005	11	0.0005	0.0039	0.0085	0.05	0.0034	0.24	32	0.016	0.000005	0.055	0.012	0.15	14	0.048	1.6	0.000039	900	0.76	0.000039	0.0005	0.017	0.005	0.011	5.0	0.63	0.11	335,909
2056	8.5	1,659	855	9.3	0.03	0.0029	0.0019	0.0022	0.42	0.00005	11	0.0005	0.0041	0.0086	0.05	0.0035	0.23	33	0.017	0.000005	0.056	0.013	0.15	13	0.05	1.5	0.00004	915	0.75	0.00004	0.0005	0.018	0.005	0.01	5.5	0.7	0.13	342,067
2057	8.5	1,672	854	9.2	0.03	0.0029	0.002	0.0022	0.42	0.00005	11	0.0005	0.0042	0.0086	0.05	0.0036	0.23	33	0.018	0.000005	0.056	0.013	0.15	13	0.052	1.5	0.00004	920	0.74	0.00004	0.0005	0.018	0.005	0.01	6.2	0.78	0.14	345,301
2058	8.5	1,682	851	9.1	0.03	0.003	0.002	0.0022	0.42	0.00005	11	0.00051	0.0044	0.0086	0.05	0.0037	0.23	33	0.019	0.000005	0.057	0.014	0.15	13	0.054	1.5	0.00004	924	0.73	0.00004	0.0005	0.018	0.005	0.01	6.6	0.83	0.15	348,168
2059	8.5	1,701	857	9.0	0.03	0.003	0.002	0.0022	0.41	0.00005	11	0.00051	0.0045	0.0087	0.05	0.0038	0.23	34	0.019	0.000005	0.057	0.014	0.14	13	0.056	1.5	0.000041	934	0.72	0.000041	0.0005	0.018	0.005	0.01	6.4	0.81	0.15	352,107
2060	8.5	1,724	867	8.9	0.031	0.003	0.0021	0.0021	0.41	0.00005	11	0.00052	0.0046	0.0087	0.05	0.0039	0.22	34	0.02	0.000005	0.058	0.015	0.14	13	0.057	1.5	0.000041	947	0.72	0.000041	0.0005	0.018	0.005	0.01	6.6	0.83	0.15	356,256
2061	8.5	1,741	868	8.9	0.031	0.0031	0.0021	0.0021	0.41	0.00005	11	0.00052	0.0048	0.0088	0.05	0.0041	0.22	34	0.02	0.000005	0.059	0.015	0.14	13	0.059	1.5	0.000042	954	0.71	0.000042	0.0005	0.019	0.005	0.01	6.3	0.79	0.14	358,049
2062	8.5	1,742	886	8.8	0.031	0.0031	0.0022	0.0021	0.4	0.00005	11	0.00052	0.0048	0.0089	0.05	0.0042	0.22	35	0.02	0.000005	0.059	0.015	0.14	13	0.059	1.5	0.000042	959	0.71	0.000042	0.0005	0.019	0.005	0.01	5.7	0.72	0.13	361,103
2063	8.5	1,753	891	8.7	0.031	0.0031	0.0022	0.0021	0.4	0.00005	11	0.00053	0.0049	0.0089	0.05	0.0043	0.22	35	0.02	0.000005	0.059	0.016	0.14	12	0.06	1.5	0.000042	965	0.7	0.000042	0.0005	0.019	0.005	0.01	5.1	0.65	0.12	363,501
2064	8.5	1,759	896	8.6	0.031	0.0031	0.0022	0.0021	0.4	0.00005	11	0.00053	0.005	0.0089	0.05	0.0044	0.22	35	0.021	0.000005	0.059	0.016	0.14	12	0.061	1.4	0.000042	969	0.69	0.000042	0.0005	0.019	0.005	0.01	5.3	0.67	0.12	367,099
2065	8.5	1,770	895	8.6	0.031	0.0031	0.0023	0.0021	0.39	0.00005	11	0.00053	0.0051	0.0089	0.05	0.0045	0.22	35	0.021	0.000005	0.06	0.016	0.14	12	0.062	1.4	0.000042	973	0.69	0.000043	0.0005	0.019	0.005	0.01	5.5	0.7	0.13	369,105
2066	8.5	1,790	909	8.5	0.032	0.0032	0.0023	0.0021	0.39	0.00005	10	0.00054	0.0052	0.009	0.05	0.0046	0.21	36	0.022	0.000005	0.06	0.017	0.14	12	0.064	1.4	0.000043	985	0.69	0.000043	0.0005	0.019	0.005	0.01	5.8	0.74	0.13	371,946
2067	8.5	1,785	952	8.5	0.033	0.0031	0.0023	0.0021	0.39	0.00005	9.5	0.00054	0.0053	0.0093	0.05	0.0047	0.21	36	0.022	0.000005	0.06	0.017	0.14	12	0.065	1.4	0.000043	993	0.68	0.000043	0.0005	0.019	0.005	0.01	6.1	0.77	0.14	374,952
2068	8.5	1,786	969	8.4	0.034	0.0031	0.0023	0.0021	0.38	0.00005	9.2	0.00054	0.0054	0.0094	0.05	0.0047	0.21	37	0.022	0.000005	0.06	0.017	0.13	12	0.066	1.4	0.000043	996	0.67	0.000043	0.0005	0.019	0.005	0.01	6.2	0.78	0.14	378,901
2069	8.5	1,803	1,003	8.3	0.035	0.0032	0.0024	0.0021	0.38	0.00005	8.7	0.00054	0.0055	0.0096	0.05	0.0048	0.21	38	0.023	0.000005	0.061	0.017	0.13	12	0.067	1.4	0.000043	1,012	0.67	0.000043	0.0005	0.019	0.005	0.01	6.1	0.77	0.14	381,313
2070	8.5	1,815	1,013	8.3	0.036	0.0032	0.0024	0.0021	0.38	0.00005	8.6	0.00055	0.0055	0.0097	0.05	0.0049	0.21	38	0.023	0.000005	0.061	0.018	0.13	12	0.068	1.4	0.000043	1,019	0.66	0.000044	0.0005	0.019	0.005	0.01	5.9	0.74	0.14	384,374
2071	8.6	1,818	1,048	8.2	0.037	0.0032	0.0024	0.0021	0.38	0.00005	8.1	0.00055	0.0056	0.01	0.05	0.005	0.21	38	0.023	0.000005	0.061	0.018	0.13	12	0.068	1.4	0.000044	1,028	0.66	0.000044	0.0005	0.019	0.005	0.01	5.7	0.72	0.13	386,328
2072	8.6	1,826	1,060	8.2	0.037	0.0032	0.0025	0.0021	0.37	0.00005	7.9	0.00055	0.0057	0.01	0.05	0.0051	0.2	39	0.024	0.000005	0.061	0.019	0.13	12	0.07	1.4	0.000044	1,034	0.66	0.000044	0.0005	0.019	0.005	0.01	5.6	0.71	0.13	388,982
2073	8.6	1,817	1,116	8.2	0.039	0.0032	0.0025	0.0022	0.37	0.00005	7.2	0.00055	0.0058	0.01	0.05	0.0051	0.2	39	0.024	0.000005	0.061	0.019	0.13	12	0.07	1.4	0.000044	1,043	0.66	0.000044	0.0005	0.019	0.005	0.01	5.7	0.72	0.13	389,390
2074	8.6	1,817	1,139	8.1	0.04	0.0032	0.0025	0.0022	0.37	0.00005	7.0	0.00055	0.0059	0.011	0.05	0.0052	0.2	40	0.024	0.000005	0.061	0.019	0.13	12	0.071	1.4	0.000044	1,047	0.65	0.000044	0.0005	0.019	0.005	0.01	5.8	0.74	0.13	391,164
2075	8.6	1,816	1,167	8.1	0.041	0.0032	0.0025	0.0022	0.37	0.00005	6.7	0.00055	0.0059	0.011	0.05	0.0052	0.2	40	0.024	0.000005	0.061	0.019	0.13	12	0.072	1.4	0.000043	1,052	0.65	0.000044	0.0005	0.019	0.005	0.01	6.0	0.76	0.14	391,961
2076	8.6	1,808	1,202	8.1	0.043	0.0032	0.0025	0.0022	0.37	0.00005	6.3	0.00054	0.0059	0.011	0.05	0.0052	0.2	41	0.025	0.000005	0.061	0.019	0.13	12	0.072	1.3	0.000043	1,056	0.65	0.000043	0.0005	0.019	0.005	0.01	6.1	0.77	0.14	394,086
2077	8.6	1,793	1,254	8.0	0.045	0.0032	0.0025	0.0022	0.37	0.00005	5.9	0.00054	0.0059	0.012	0.05	0.0052	0.2	42	0.025	0.000005	0.06	0.019	0.13	12	0.072	1.3	0.000043	1,060	0.65	0.000043	0.0005	0.019	0.005	0.01	5.9	0.75	0.14	394,666
2078	8.6	1,793	1,299	8.0	0.046	0.0032	0.0025	0.0022	0.37	0.00005	5.5	0.00054	0.0059	0.012	0.05	0.0052	0.2	42	0.024	0.000005	0.06	0.019	0.13	11	0.071	1.3	0.000043	1,070	0.64	0.000043	0.0005	0.019	0.005	0.01	5.7	0.72	0.13	396,324
2079	8.7	1,789	1,333	8.0	0.048	0.0032	0.0025	0.0022	0.37	0.00005	5.3	0.00054	0.0058	0.012	0.05	0.0052	0.2	43	0.024	0.000005	0.06	0.019	0.13	11	0.071	1.3	0.000043	1,074	0.64	0.000043	0.0005	0.019	0.005	0.01	5.1	0.64	0.12	397,336
2080	8.7	1,786	1,355	8.0	0.049	0.0031	0.0025	0.0022	0.36	0.00005	5.1	0.00054	0.0058	0.012	0.05	0.0053	0.2	43	0.024	0.000005	0.06	0.019	0.13	11	0.07	1.3	0.000043	1,077	0.64	0.000043	0.0005	0.019	0.005	0.01	4.6	0.58	0.11	398,998
2081	8.7	1,787	1,371	7.9	0.049	0.0032	0.0025	0.0022	0.36	0.00005	5.0	0.00054	0.0058	0.013	0.05	0.0053	0.2	44	0.024	0.000005	0.06	0.019	0.13	11	0.069	1.3	0.000043	1,081	0.64	0.000043	0.0005	0.019	0.005	0.01	3.8	0.48	0.086	399,482
2082	8.7	1,790	1,384	7.9	0.05	0.0032	0.0025	0.0023	0.36	0.00005	4.9	0.00054	0.0058	0.013	0.05	0.0054	0.2	44	0.024	0.000005	0.06	0.019	0.13	11	0.069	1.3	0.000043	1,085	0.64	0.000043	0.0005	0.019	0.005	0.01	3.4	0.43	0.077	400,065
2083	8.7	1,778	1,429	7.9	0.052	0.0031	0.0025	0.0023	0.36	0.00005	4.7	0.00053	0.0058	0.013	0.05	0.0054	0.2	45	0.024	0.000005	0.06	0.019	0.13	11	0.069	1.3	0.000043	1,089	0.64	0.000043	0.0005	0.019	0.005	0.01	2.9	0.37	0.067	400,547
2084	8.7	1,773	1,453	7.9	0.053	0.0031	0.0025	0.0023	0.36	0.00005	4.5	0.00053	0.0058	0.013	0.05	0.0054	0.2	45	0.024	0.000005	0.06	0.019	0.13	11	0.069	1.3	0.000042	1,091	0.64	0.000043	0.0005	0.019	0.005	0.01	2.8	0.35	0.064	401,921
2085	8.7	1,770	1,479	7.9	0.054	0.0031	0.0025	0.0023	0.36	0.00005	4.4	0.00053	0.0058	0.014	0.05	0.0054	0.2	46	0.024	0.000005	0.06	0.019	0.13	11	0.068	1.3	0.000042	1,095	0.64	0.000043	0.0005	0.019	0.005	0.01	2.7	0.34	0.061	401,543
2086	8.7	1,769	1,496	7.9	0.054	0.0031	0.0025	0.0023	0.36	0.00005	4.3	0.00053	0.0058	0.014	0.05	0.0054	0.2	46	0.023	0.000005	0.06	0.019	0.13	11	0.068	1.3	0.000042	1,097	0.64	0.000043	0.0005	0.019	0.005	0.01	2.6	0.33	0.06	401,553
2087	8.7	1,746	1,561	7.9	0.057	0.0031	0.0025	0.0023	0.36	0.00005	4.0	0.00052	0.0057	0.014	0.05	0.0053	0.2	47	0.023	0.000005	0.059	0.019	0.13	11	0.068	1.3	0.000042	1,100	0.64	0.000042	0.0005	0.019	0.005	0.01	2.6	0.33	0.06	401,267
2088	8.7	1,734	1,593	7.9	0.059	0.0031	0.0

Table A1. Source terms of the NAG backfill for the poorly graded cover system scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2135	8.8	1,554	1,955	7.9	0.076	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.0041	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.049	1.3	0.000037	1,087	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,364
2136	8.8	1,553	1,956	7.9	0.076	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.0041	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.049	1.3	0.000037	1,087	0.63	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	402,265
2137	8.8	1,553	1,955	7.9	0.076	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.0041	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,086	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,193
2138	8.8	1,553	1,956	7.9	0.076	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.0041	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,087	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	400,659
2139	8.8	1,553	1,955	7.9	0.076	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,086	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	400,865
2140	8.8	1,552	1,951	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,623
2141	8.8	1,552	1,953	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,086	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,098
2142	8.8	1,552	1,950	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.63	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	402,800
2143	8.8	1,552	1,948	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	402,142
2144	8.8	1,552	1,949	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,911
2145	8.8	1,552	1,950	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,364
2146	8.8	1,551	1,951	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.63	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	402,265
2147	8.8	1,551	1,950	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,193
2148	8.8	1,551	1,951	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,085	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	400,659
2149	8.8	1,550	1,950	7.9	0.075	0.0027	0.0021	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,084	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	400,865
2150	8.8	1,550	1,947	7.9	0.075	0.0027	0.002	0.0026	0.36	0.00005	2.6	0.0005	0.0042	0.015	0.05	0.004	0.2	54	0.017	0.000005	0.052	0.014	0.13	11	0.048	1.3	0.000037	1,083	0.64	0.000037	0.0005	0.017	0.005	0.01	0.45	0.057	0.01	401,623

Table A2. Annual loads of the NAG backfill for the poorly graded cover system scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Ti	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2023	20	1.5	0.19	0.0002	0.000034	0.000019	0.000037	0.0086	0.00000065	0.45	0.0000081	0.000092	0.000016	0.00081	0.0000016	0.0047	0.33	0.00054	0.00	0.00066	0.00012	0.003	0.27	0.0018	0.031	0.00000047	8.5	0.015	0.00000047	0.0000081	0.00021	0.000028	0.00007	1.1	0.13	0.024	16
2024	40	3.1	0.38	0.0004	0.00007	0.00004	0.000076	0.017	0.0000013	0.92	0.000017	0.00019	0.0000033	0.0016	0.0000033	0.0096	0.67	0.0011	0.00000016	0.0013	0.00025	0.0061	0.55	0.0036	0.064	0.00000096	17	0.031	0.00000096	0.000016	0.00043	0.000058	0.00014	2.2	0.27	0.05	33
2025	69	5.4	0.67	0.0007	0.00012	0.000069	0.00013	0.03	0.0000023	1.6	0.000029	0.00033	0.000058	0.0029	0.0000058	0.017	1.2	0.0019	0.00000029	0.0023	0.00043	0.011	0.95	0.0063	0.11	0.0000017	30	0.054	0.0000017	0.000029	0.00074	0.0001	0.00025	3.8	0.48	0.086	57
2026	106	8.2	1.0	0.0011	0.00019	0.00011	0.0002	0.046	0.0000035	2.4	0.000044	0.0005	0.000088	0.0044	0.0000088	0.025	1.8	0.0029	0.00000044	0.0036	0.00065	0.016	1.5	0.0097	0.17	0.0000025	46	0.082	0.0000025	0.000044	0.0011	0.00015	0.00038	5.7	0.72	0.13	87
2027	141	11	1.3	0.0014	0.00025	0.00014	0.00027	0.062	0.0000047	3.2	0.000058	0.0007	0.00012	0.0058	0.000012	0.034	2.3	0.0039	0.00000058	0.0047	0.00086	0.022	1.9	0.013	0.22	0.0000034	62	0.11	0.0000034	0.000058	0.0015	0.0002	0.0005	7.6	0.96	0.17	116
2028	236	18	2.3	0.0024	0.00042	0.00024	0.00045	0.1	0.0000078	5.4	0.000098	0.0011	0.0002	0.0098	0.00002	0.057	3.9	0.0066	0.00000098	0.008	0.0015	0.036	3.2	0.022	0.38	0.0000057	103	0.18	0.0000057	0.000098	0.0025	0.00034	0.00084	13	1.6	0.29	195
2029	267	21	2.6	0.0027	0.00047	0.00027	0.00051	0.12	0.0000089	6.1	0.00011	0.0013	0.00022	0.011	0.0000022	0.064	4.5	0.0074	0.00000011	0.009	0.0016	0.041	3.7	0.024	0.43	0.0000064	117	0.21	0.0000064	0.00011	0.0029	0.00039	0.00095	14	1.8	0.33	221
2030	321	25	3.1	0.0032	0.00057	0.00032	0.00061	0.14	0.0000011	7.4	0.00013	0.0015	0.00027	0.013	0.0000027	0.077	5.4	0.0089	0.0000013	0.011	0.002	0.049	4.4	0.029	0.51	0.0000077	141	0.25	0.0000077	0.00013	0.0034	0.00046	0.0011	17	2.2	0.4	266
2031	1,162	91	11	0.012	0.002	0.0012	0.0022	0.51	0.0000039	27	0.00048	0.0055	0.00096	0.048	0.0000096	0.28	19	0.032	0.0000048	0.039	0.0071	0.18	16	0.11	1.9	0.000028	509	0.9	0.000028	0.00048	0.012	0.0017	0.0041	63	8.0	1.4	961
2032	2,750	214	26	0.028	0.0048	0.0027	0.0052	1.2	0.0000091	63	0.0011	0.013	0.0023	0.11	0.00023	0.66	46	0.076	0.0000011	0.093	0.017	0.42	38	0.25	4.4	0.0000066	1,204	2.1	0.0000066	0.0011	0.029	0.004	0.0098	149	19	3.4	2,273
2033	859	67	8.2	0.0086	0.0015	0.00086	0.0016	0.38	0.0000028	20	0.00036	0.0041	0.00071	0.036	0.0000071	0.21	14	0.024	0.0000036	0.029	0.0053	0.13	12	0.078	1.4	0.0000021	376	0.66	0.0000021	0.00036	0.0092	0.0012	0.0031	46	5.9	1.1	710
2034	1,559	121	15	0.016	0.0027	0.0016	0.003	0.68	0.0000052	36	0.00065	0.0074	0.0013	0.064	0.0000013	0.37	26	0.043	0.0000064	0.052	0.0096	0.24	21	0.14	2.5	0.0000037	682	1.2	0.0000037	0.00064	0.017	0.0023	0.0056	84	11	1.9	1,289
2035	3,332	260	32	0.033	0.0059	0.0033	0.0063	1.5	0.00011	77	0.0014	0.016	0.0028	0.14	0.00028	0.8	56	0.093	0.000014	0.11	0.02	0.51	46	0.3	5.3	0.00008	1,459	2.6	0.00008	0.0014	0.036	0.0048	0.012	180	23	4.1	2,755
2036	8,174	637	78	0.082	0.014	0.0081	0.016	3.6	0.00027	188	0.0034	0.039	0.0068	0.34	0.00068	2.0	137	0.23	0.0000034	0.28	0.05	1.3	112	0.75	13	0.0002	3,579	6.3	0.0002	0.0034	0.087	0.012	0.029	442	56	10	6,758
2037	36,319	2,829	349	0.36	0.064	0.036	0.069	16	0.0012	835	0.015	0.17	0.03	1.5	0.003	8.7	607	1.0	0.00015	1.2	0.22	5.6	499	3.3	58	0.00087	15,900	28	0.00087	0.015	0.39	0.053	0.13	1,966	249	45	30,026
2038	114,469	8,916	1,099	1.1	0.2	0.11	0.22	50	0.0038	2,631	0.047	0.54	0.095	4.7	0.0095	28	1,914	3.2	0.00047	3.9	0.7	18	1,572	10	183	0.0027	50,111	88	0.0028	0.047	1.2	0.17	0.41	6,195	783	142	94,634
2039	294,759	108,602	2,074	3.9	0.52	0.27	0.38	95	0.0072	3,692	0.09	1.2	0.35	8.9	0.19	52	5,595	6.7	0.00089	9.9	2.0	33	2,968	22	346	0.0071	151,047	167	0.0071	0.089	3.1	0.43	1.2	5,376	680	124	178,458
2040	375,606	170,679	3,171	6.4	0.66	0.39	0.64	145	0.011	4,853	0.14	1.2	1.9	14	0.37	79	7,282	6.4	0.0014	13	2.3	51	4,538	20	529	0.009	199,379	255	0.009	0.14	4.0	0.54	1.4	6,406	810	147	272,969
2041	498,712	255,334	3,172	9.3	0.88	0.5	0.78	145	0.014	4,424	0.17	1.4	2.7	17	0.54	79	9,903	7.2	0.0017	17	2.9	51	4,539	23	529	0.012	273,283	255	0.012	0.17	5.3	0.72	1.8	2,699	341	62	338,914
2042	396,987	246,288	3,170	9.5	0.7	0.44	0.89	145	0.014	4,317	0.17	0.81	2.7	17	0.51	79	8,082	3.8	0.0017	13	2.1	51	4,537	11	529	0.0095	226,085	255	0.0095	0.17	4.2	0.57	1.4	3,408	431	78	343,355
2043	435,552	270,005	3,171	10	0.77	0.48	0.86	145	0.014	3,874	0.17	0.99	2.8	17	0.57	79	8,919	4.7	0.0017	15	2.5	51	4,538	14	529	0.01	248,909	255	0.01	0.17	4.7	0.63	1.6	3,841	486	88	345,155
2044	434,078	270,470	3,171	10	0.77	0.49	0.84	145	0.014	3,704	0.17	1.0	2.8	17	0.63	79	8,909	4.7	0.0017	15	2.6	51	4,538	14	529	0.01	248,527	255	0.01	0.17	4.6	0.63	1.7	1,031	130	24	339,203
2045	419,201	253,400	3,171	9.5	0.74	0.45	0.76	145	0.013	3,387	0.16	0.72	2.6	16	0.65	79	8,520	2.9	0.0016	14	2.3	51	4,539	8.4	529	0.01	238,585	255	0.01	0.16	4.5	0.61	1.5	607	77	14	312,231
2046	429,085	249,341	3,172	9.2	0.76	0.47	0.71	145	0.012	3,257	0.15	0.8	2.5	15	0.72	79	8,673	3.3	0.0015	14	2.6	51	4,539	9.4	529	0.01	242,238	255	0.01	0.15	4.6	0.62	1.7	703	89	16	301,366
2047	462,700	255,572	3,172	9.3	0.82	0.5	0.69	145	0.012	3,275	0.15	0.91	2.6	15	0.81	79	9,280	3.7	0.0015	16	2.9	51	4,540	11	529	0.011	258,595	255	0.011	0.15	4.9	0.67	1.9	851	108	20	302,616
2048	475,079	257,244	3,172	9.3	0.84	0.52	0.69	145	0.012	3,367	0.15	0.96	2.6	15	0.85	80	9,496	4.0	0.0015	16	3.1	51	4,540	12	529	0.011	264,392	255	0.011	0.15	5.1	0.69	2.0	1,024	129	24	305,970
2049	481,735	257,436	3,172	9.3	0.85	0.53	0.69	145	0.012	3,453	0.15	1.	2.6	15	0.87	80	9,605	4.1	0.0015	16	3.2	51	4,541	12	529	0.012	267,313	255	0.012	0.15	5.1	0.7	2.0	1,149	145	26	308,547
2050	495,931	266,156	3,173	9.6	0.87	0.55	0.7	145	0.013	3,386	0.16	1.1	2.7	16	0.93	80	9,905	4.4	0.0016	17	3.4	51	4,541	13	529	0.012	275,624	255	0.012	0.16	5.3	0.72	2.2	1,211	153	28	311,965
2051	506,546	269,609	3,173	9.7	0.89	0.57	0.7	145	0.013	3,451	0.16	1.1	2.7	16	0.98	80	10,108	4.7	0.0016	17	3.6	51	4,541	14	529	0.012	281,043	255	0.012	0.16	5.4	0.73	2.3	1,365	173	31	316,216
2052	519,492	272,711	3,173	9.8	0.92	0.59	0.71	145	0.013	3,560	0.16	1.2	2.8	16	1.0	80	10,331	5.1	0.0016	17	3.8	51	4,541	15	529	0.012	287,399	255	0.012	0.16	5.5	0.75	2.4	1,641	208	38	321,547
2053	527,425	272,692	3,173	9.8	0.93	0.61	0.72	145	0.013	3,677	0.16	1.3	2.8	16	1.1	80	10,460	5.3	0.0016	18	4.0	51	4,541	16	529	0.013	290,813	255	0.013	0.16	5.6	0.76	2.5	1,793	227	41	324,989
2054	541,271	279,264	3,173	10.0	0.95	0.62	0.73	145	0.013	3,726	0.17	1.3	2.8	17	1.1	80	10,735	5.4	0.0017	18	4.1	51	4,541	16	529	0.013	298,374	255	0.013	0.17	5.8	0.78	2.6	1,681	212	39	331,093
2055	549,412	281,438	3,173	10	0.97	0.64	0.74	145	0.013	3,827	0.17	1.3	2.9	17	1.1	80	10,886	5.5	0.0017	18	4.2	51	4,541	16	529	0.013	302,375	255	0.013	0.17	5.9	0.79	2.7	1,677	212	39	335,909
2056	567,386	292,614	3,173	10	1.0	0.66	0.75	145	0.014	3,782	0.17	1.4	3.0	17	1.2	80	11,257	5.8	0.0017	19	4.4	51	4,541	17	529	0.014	312,895	255	0.014	0.17	6.1	0.82	2.8	1,883	238	43	342,067
2057	577,274	295,022	3,173	10	1.0	0.68	0.75	145	0.014	3,843	0.17	1.5	3.0	17	1.2	80	11,440	6.2	0.0017	19	4.6	51	4,541	18	529	0.014	317,753	255	0.014	0.17	6.2	0.83	2.9	2,140	271	49	345,301
2058	585,688	296,388	3,173	11	1.0	0.7	0.76	145	0.014	3,914	0.18	1.5	3.0	17	1.3	80	11,577	6.4	0.0017	20	4.8	51	4,541	19	529	0.014	321,759	255	0.014	0.17	6.3	0.85	3.0	2,290	289	53	348,168
2059	599,004	301,717	3,173	11	1.1	0.72	0.76	145	0.014	3,937	0.18	1.6	3.1	18	1.3	80	11,834	6.7	0.0018	20	5.0	51	4,541	20	529	0.014	328,850	255	0.014	0.18	6.4	0.87	3.1	2,259	286	52	352,107
2060	614,185	309,045	3,173	11	1.1	0.74	0.76	145	0.014	3,924	0.18	1.7	3.1	18	1.4	80	12,138	7.0	0.0018	21	5.2	51	4,542	20	529	0.015	337,224	255	0.015	0.18	6.6	0.89	3.3	2,342	296	54	356,256
2061	623,220	310,786	3,173	11	1.1	0.77	0.76	145	0.014	3,961	0.19	1.7	3.1	18	1.5	80	12,296	7.2	0.0018	21	5.4	51	4,542	21	529	0.015	341,621	255	0.015	0.18	6.7	0.9	3.4	2,238	283	51	358,049
2062	629,113	320,078	3,174	11	1.1	0.78	0.77	145	0.014	3,848	0.19	1.7	3.2	18	1.5	80	12,494	7.3	0.0018	21	5.6	51	4,542	21	529	0.015	346,334	255	0.015	0.18	6.7	0.91	3.5	2,049	259	47	361,103
2063	637,217	323,857	3,174	11	1.1	0.8	0.78	145	0.015	3,851	0.19	1.8	3.2	18	1.6	80	12,682	7.4	0.0018	21	5.8	51	4,542	22	529	0.015	350,709	255	0.015	0.18	6.8	0.92	3.6	1,868	236	43	363,501
2064	645,763	328,913	3,174	12	1.1	0.82	0.78	145	0.015	3,857	0.19	1.8	3.3	18	1.6	80	12,901	7.6	0.0018	22	5.9	51	4,542	22	529	0.015	355,546	255	0.015	0.18	6.9	0.93	3.7	1,941	245	45	367,099
2065	653,279	330,460	3,174	12	1.2	0.84	0.78	145	0.015	3,897	0.2	1.9	3.3	18	1.7	80	13,064	7.9	0.0018	22	6.1	51	4,542	23	529	0.016	359,150	255	0.016	0.18	7.0	0.94	3.8	2,035	257	47	369,105
2066	665,895	338,047	3,174	12	1.2	0.86	0.79	145	0.015	3,846	0.2	2.0	3.4	19	1.7	80	13,365	8.1	0.0019	22	6.3	51	4,543	24	529	0.016	366,415	255	0.016	0.18	7.1	0.96	3.9	2,170	274	50	371,946
2067	669,364	357,055	3,174	13	1.2	0.87	0.8	145	0.015	3,559	0.2	2.0	3.5	19	1.7	80	13,668	8.3	0.0019	23	6.4	51	4,543	24	529	0.016	372,203	255	0.016	0.19	7.1	0.97	4.0	2,287	289	53	374,952
2068	676,528	366,985	3,174	13	1.2	0.89	0.81	145	0.015	3,489	0.2	2.0	3.6	19	1.8	80	13,925	8.5	0.0019	23	6.5	51	4,543	25	529	0.016	377,499	255	0.016	0.19	7.2	0.98	4.1	2,343	296	54	378,901
2069	687,621	382,571	3,174	13	1.2	0.9	0.81	145	0.015	3,316	0.21	2.1	3.7	19	1.8	80	14,316	8.7	0.0019	23	6.7	51	4,543	25	529	0.016	385,850	255	0.017	0.19	7.3	0.99	4.2	2,318	293	53	381,313
2070	697,446	389,524	3,174	14	1.2	0.92	0.82	145	0.015	3,294	0.21	2.1	3.7	19	1.9	80	14,580	8.9	0.0019	23	6.8	51	4,543	26	529	0.017	391,677	255	0.017	0.19	7.4	1.0	4.3	2,264	286	52	384,374
2071	702,460	404,872	3,174	14	1.2	0.94	0.83	145	0.016	3,122	0.21	2.2	3.9	19	1.9	80	14,860	9.0	0.0019	24	7.0	51	4,543	26	529	0.017	397,261	255	0.017	0.19	7.5	1.0	4.4	2,197	278	51	386,328
2072	710,321	412,321	3,175	14	1.3	0.96	0.83	145	0.016	3,088	0.21	2.2	3.9	19	2.0	80	15,089	9.2	0.0019	24	7.2	51	4,543	27	529	0.017	402,363	255	0.017	0.19	7.6	1.0	4.5	2,195	278	50	388,982
2073	707,678	434,637	3,175	15	1.2	0.97	0.84	145	0.016	2,815	0.21	2.3	4.1	19	2.0	80	15,360	9.4	0.0019	24	7.3	51	4,544	27	529	0.017	405,978	255	0.017	0.19	7.6	1.0	4.6	2,213	280	51	389,390
2074	710,667	445,575	3,175	16	1.3	0.98	0.85	145	0.016	2,728	0.21	2.3	4.2	20	2.0	80	15,593	9.5	0.002	24	7.4	51	4,544	28	530	0.017	409,588	255	0.017	0.2	7.6	1.0	4.6	2,280	288	52	391,164
2075	711,723	457,301	3,175	16	1.3	0.98	0.85	145	0.016	2,620	0.21	2.3	4.3	20	2.0	80	15,849	9.6	0.002	24	7.5	51	4,544	28	530	0.017	412,422	255	0.017	0.2	7.6	1.0	4.7	2,342	296	54	391,961
2076	712,311	473,534	3,175	17	1.3	0.99	0.86	145	0.016	2,496	0.21	2.3	4.4	20	2.1	80	16,115	9.7	0.002	24	7.5	51	4,544	28	530	0.017	416,076	255	0.017	0.2	7.6	1.0	4.7	2,398	303	55	394,086
2077	707,438	494,792	3,175	18	1.2	0.99	0.87	145	0.016	2,312	0.21	2.3	4.6	20	2.1	80	16,390	9.7	0.002	24	7.5	51	4,544	28	530	0.017	418,346	255	0.017	0.2	7.6	1.0	4.7	2,343	296	54	394,666
2078	710,609	514,944	3,175	18	1.3	1.	0.88	145	0.016	2,183	0.21	2.3	4.7	20	2.1	80	16,746	9.7	0.002	24	7.5	51	4,545	28	530	0.017	423,948	255	0.017	0.2	7.6	1.0	4.7	2,271	287	52	396,324
2079	710,676	529,490	3,175	19	1.3	1.	0.89	145	0.016	2,093	0.21	2.3	4.9	20	2.1	80	17,035	9.6	0.002	24	7.6	51	4,545	28	530	0.017	426,858	255	0.017	0.2	7.6	1.0	4.7	2,020	255	46	397,336
2080	712,491	540,563	3,175	19	1.3	1.0	0.9	145	0.016	2,041	0.21	2.3	5.0	20	2.1	80	17,272	9.6	0.002	24	7.6	51	4,545	28	530	0.017	429,881	255	0.017	0.2	7.6	1.0	4.8	1,826	231	42	398,998
2081	713,835	547,810	3,176	20	1.3	1.0	0.9	145	0.016	2,003	0.21	2.3	5.0	20	2.1	80	17,466	9.5	0.002	24	7.7	51	4,545	28	530	0.017	431,860	255	0.017	0.2	7.6	1.0	4.8	1,502	190	35	399,482
2082	716,077	553,651	3,176	20	1.3	1.0	0.9	145	0.016	1,977	0.22	2.3	5.1	20	2.1	80	17,644	9.5	0.002	24	7.7	51	4,545	28	530	0.017	433,991	255	0.017	0.2	7.6	1.0	4.8	1,347	170	31	400,065
2083	712,212	572,301	3,176	21	1.3	1.0	0.91	145	0.016	1,868	0.21	2.3	5.2	20	2.2	80	17,882	9.5	0.002	24	7.7	51	4,545	28	530	0.017	436,075	255	0.017	0.2	7.6	1.0	4.8	1,166	147	27	400,547
2084	712,767	584,072	3,176	21	1.3	1.0	0.92	145	0.016	1,819	0.21	2.3	5.4	20	2.2	80	18,123	9.5	0.002	24	7.7	51	4,545	28	530	0.017	438,657	255	0.017	0.2	7.6	1.0	4.9	1,115	141	26	401,921
2085	710,811	593,882	3,176	22	1.3	1.0	0.92	145	0.016	1,763	0.21	2.3	5.5	20	2.2	80	18,323	9.4	0.002	24	7.8	51	4,545	27	530	0.017	439,649	255	0.017	0.2	7.6	1.0	4.9	1,067	135	25	401,543
2086	710,147	600,804	3,176	22	1.3	1.0	0.92	145	0.016	1,728	0.21	2.3	5.5	20	2.2	80	18,494	9.4	0.002	24	7.7	51	4,546	27	530	0.017	440,624	255	0.017	0.2	7.6	1.0	4.9	1,057	134	24	401,553
2087	700,533	626,419	3,176	23	1.2	1.0	0.94	145	0.016	1,598	0.21	2.3	5.8	20	2.1	80	18,766	9.3	0.002	24	7.7	51	4,546	27	530	0.017	441,555	255	0.017	0.2	7.5	1.0	4.8	1,051	133	24	401,267
2088	697,502	640,694	3,176	24	1.2	1.0	0.95	145	0.016	1,545	0.21	2.3	5.9	20	2.1	80	18,989	9.3	0.002	23	7.6	51	4,546	27	530	0.017	443,035	255	0.017	0.2	7.4	1.0	4.8	1,055	133	24	402,320
2089	690,123	652,790	3,176	24	1.2	1.0	0.95	145	0.016	1,479	0.21	2.3	6.0	20	2.1	80	19,138	9.2	0.002	23	7.5	51	4,546	27	530	0.017	442,064	255	0.017	0.2	7.4	1.	4.7	1,054	133	24	401,001
2090	687,743	660,781	3,176	24	1.2	1.0	0.96	145	0.016	1,449	0.21	2.3	6.1	20	2.1	80	19,281	9.2	0.002	23	7.5	51	4,546	27	530	0.016	442,513	255	0.017	0.2	7.3	0.99	4.7	1,054	133	24	401,227
2091	684,634	670,516	3,176	25	1.2	1.	0.96	145	0.016	1,411	0.21	2.2	6.2	20	2.1	80	19,472	9.1	0.002	23	7.5	51	4,546	27	530	0.016	442,513	255	0.016	0.2	7.3	0.99	4.7	1,048	133	24	401,098
2092	685,888	678,557	3,176	25	1.2	1.	0.97	145	0.016	1,397	0.21	2.2	6.3	20	2.1	80	19,672	9.1	0.002	23	7.5	51	4,546	26	530	0.016	445,054	255	0.016	0.2	7.3	0.99	4.7	1,038	131	24	402,800
2093	682,917	684,848	3,176	25	1.2	0.99	0.97	145	0.016	1,369	0.21	2.2	6.3	20	2.1	80	19,826	9.0	0.002	23	7.4	51	4,546	26	530	0.016	444,809	255	0.016	0.2	7.3	0.99	4.6	980	124	23	402,142
2094	681,159	690,162	3,177	26	1.2	0.99	0.98	145	0.016	1,348	0.2	2.2	6.3	20	2.1	80	19,971	8.9	0.002	23	7.3	51	4,546	26	530	0.016	444,956	255	0.016	0.2	7.3	0.98	4.6	909	115	21	401,911
2095	671,241	710,213

Table A2. Annual loads of the NAG backfill for the poorly graded cover system scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2135	623,599	784,746	3,177	30	1.1	0.83	1.1	145	0.016	1,049	0.2	1.7	6.0	20	1.6	80	21,701	6.8	0.002	21	5.7	51	4,547	19	530	0.015	436,162	255	0.015	0.2	6.7	0.9	3.6	182	23	4.2	401,364
2136	624,879	786,710	3,177	30	1.1	0.83	1.1	145	0.016	1,050	0.2	1.7	6.0	20	1.6	80	21,751	6.8	0.002	21	5.7	51	4,547	20	530	0.015	437,142	255	0.015	0.2	6.7	0.9	3.6	183	23	4.2	402,265
2137	623,093	784,413	3,177	30	1.1	0.83	1.1	145	0.016	1,048	0.2	1.7	6.0	20	1.6	80	21,688	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,856	255	0.015	0.2	6.7	0.9	3.6	182	23	4.2	401,193
2138	622,223	783,769	3,177	30	1.1	0.82	1.1	145	0.016	1,046	0.2	1.7	6.0	20	1.6	80	21,667	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,356	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	400,659
2139	622,343	783,571	3,177	30	1.1	0.82	1.1	145	0.016	1,047	0.2	1.7	6.0	20	1.6	80	21,664	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,380	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	400,865
2140	623,439	783,727	3,177	30	1.1	0.83	1.1	145	0.016	1,052	0.2	1.7	6.0	20	1.6	80	21,678	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,922	255	0.015	0.2	6.7	0.9	3.6	182	23	4.2	401,623
2141	622,625	783,264	3,177	30	1.1	0.82	1.1	145	0.016	1,049	0.2	1.7	6.0	20	1.6	80	21,660	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,432	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	401,098
2142	625,105	785,541	3,177	30	1.1	0.83	1.1	145	0.016	1,056	0.2	1.7	6.0	20	1.6	80	21,729	6.8	0.002	21	5.7	51	4,547	19	530	0.015	436,998	255	0.015	0.2	6.7	0.9	3.6	183	23	4.2	402,800
2143	624,044	783,533	3,177	30	1.1	0.83	1.1	145	0.016	1,056	0.2	1.7	6.0	20	1.6	80	21,677	6.7	0.002	21	5.7	51	4,547	19	530	0.015	436,123	255	0.015	0.2	6.7	0.9	3.6	183	23	4.2	402,142
2144	623,645	783,204	3,177	30	1.1	0.83	1.1	145	0.016	1,055	0.2	1.7	6.0	20	1.6	80	21,666	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,873	255	0.015	0.2	6.7	0.9	3.6	183	23	4.2	401,911
2145	622,716	782,740	3,177	30	1.1	0.82	1.1	145	0.016	1,052	0.2	1.7	6.0	20	1.6	80	21,647	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,399	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	401,364
2146	623,994	784,699	3,177	30	1.1	0.83	1.1	145	0.016	1,054	0.2	1.7	6.0	20	1.6	80	21,697	6.7	0.002	21	5.7	51	4,547	19	530	0.015	436,337	255	0.015	0.2	6.7	0.9	3.6	183	23	4.2	402,265
2147	622,211	782,407	3,177	30	1.1	0.82	1.1	145	0.016	1,051	0.2	1.7	6.0	20	1.6	80	21,635	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,094	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	401,193
2148	621,342	781,766	3,177	30	1.1	0.82	1.1	145	0.016	1,049	0.2	1.7	5.9	20	1.6	80	21,614	6.7	0.002	21	5.7	51	4,547	19	530	0.015	434,555	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	400,659
2149	621,461	781,567	3,177	30	1.1	0.82	1.1	145	0.016	1,051	0.2	1.7	5.9	20	1.6	80	21,611	6.7	0.002	21	5.7	51	4,547	19	530	0.015	434,578	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	400,865
2150	622,596	781,759	3,177	30	1.1	0.82	1.1	145	0.016	1,055	0.2	1.7	6.0	20	1.6	80	21,625	6.7	0.002	21	5.7	51	4,547	19	530	0.015	435,118	255	0.015	0.2	6.6	0.9	3.6	182	23	4.2	401,623

Table A3. Source terms of the NAG backfill for the well graded cover system scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-		mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2023	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	16
2024	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	33
2025	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	57
2026	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	87
2027	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	116
2028	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	195
2029	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	221
2030	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	266
2031	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	961
2032	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	2,273
2033	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	710
2034	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	1,284
2035	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	10,477
2036	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	19,356
2037	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	14,018
2038	8.0	1,210	94	27	0.012	0.0021	0.0012	0.0023	1.2	0.00005	28	0.0005	0.0057	0.001	0.05	0.0001	0.68	20	0.034	0.000005	0.041	0.0074	0.44	39	0.11	4.6	0.000029	528	2.2	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	27,168
2039	8.1	1,311	237	27	0.015	0.0023	0.0013	0.0023	1.2	0.00005	31	0.0005	0.006	0.0012	0.05	0.00032	0.68	23	0.035	0.000005	0.044	0.0082	0.44	39	0.11	4.6	0.000031	601	2.2	0.000032	0.0005	0.014	0.005	0.01	65	3.8	0.69	48,784
2040	8.2	1,499	470	27	0.018	0.0026	0.0015	0.0022	1.2	0.00005	32	0.0005	0.0065	0.0017	0.05	0.00084	0.68	28	0.037	0.000005	0.05	0.01	0.44	39	0.12	4.6	0.000036	735	2.2	0.000036	0.0005	0.016	0.005	0.01	65	3.0	0.54	85,906
2041	8.4	1,703	762	27	0.027	0.003	0.0016	0.0021	1.2	0.00005	14	0.00051	0.0055	0.0058	0.05	0.0017	0.69	33	0.029	0.000005	0.057	0.011	0.44	39	0.094	4.6	0.000041	909	2.2	0.000041	0.0005	0.018	0.005	0.01	44	1.0	0.18	116,049
2042	8.5	1,409	792	24	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.0005	0.003	0.0082	0.05	0.002	0.6	28	0.014	0.000005	0.047	0.008	0.39	34	0.042	4.0	0.000034	788	1.9	0.000034	0.0005	0.015	0.005	0.01	12	1.3	0.23	131,728
2043	8.4	1,372	778	23	0.029	0.0024	0.0015	0.0024	1.1	0.00005	12	0.0005	0.0027	0.0081	0.05	0.002	0.59	28	0.012	0.000005	0.046	0.0077	0.37	33	0.034	3.9	0.000033	768	1.9	0.000033	0.0005	0.015	0.005	0.01	6.9	1.4	0.26	135,614
2044	8.4	1,350	755	23	0.028	0.0024	0.0014	0.0024	1.1	0.00005	12	0.0005	0.0026	0.008	0.05	0.002	0.58	27	0.011	0.000005	0.045	0.0075	0.37	33	0.034	3.8	0.000032	752	1.8	0.000032	0.0005	0.014	0.005	0.01	6.9	0.38	0.07	137,918
2045	8.5	1,400	788	24	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.0005	0.0028	0.0082	0.05	0.002	0.59	28	0.012	0.000005	0.047	0.0079	0.38	34	0.037	3.9	0.000034	783	1.9	0.000034	0.0005	0.015	0.005	0.01	8.2	0.25	0.045	134,843
2046	8.5	1,458	800	24	0.029	0.0026	0.0016	0.0023	1.1	0.00005	12	0.0005	0.0032	0.0083	0.05	0.0023	0.61	29	0.014	0.000005	0.049	0.009	0.39	35	0.043	4.1	0.000035	811	2.0	0.000035	0.0005	0.016	0.005	0.01	9.7	0.29	0.054	129,640
2047	8.5	1,576	822	25	0.03	0.0028	0.0017	0.0022	1.1	0.00005	12	0.0005	0.0035	0.0084	0.05	0.0029	0.62	31	0.015	0.000005	0.053	0.011	0.39	35	0.044	4.1	0.000038	869	2.0	0.000038	0.0005	0.017	0.005	0.01	6.2	0.36	0.065	128,811
2048	8.5	1,713	861	24	0.03	0.003	0.0019	0.0022	1.1	0.00005	11	0.00051	0.004	0.0087	0.05	0.0034	0.61	34	0.017	0.000005	0.058	0.013	0.39	35	0.05	4.1	0.000041	939	2.0	0.000041	0.0005	0.018	0.005	0.01	5.8	0.42	0.077	130,391
2049	8.5	1,776	893	24	0.031	0.0031	0.0021	0.0021	1.1	0.00005	11	0.00053	0.0045	0.0089	0.05	0.0038	0.6	35	0.019	0.000005	0.06	0.014	0.39	35	0.056	4.0	0.000043	975	1.9	0.000043	0.0005	0.019	0.005	0.01	6.3	0.47	0.086	131,655
2050	8.5	1,804	902	24	0.031	0.0032	0.0022	0.0021	1.1	0.00005	11	0.00054	0.0047	0.009	0.05	0.0042	0.6	36	0.02	0.000005	0.061	0.015	0.38	34	0.058	4.0	0.000043	989	1.9	0.000043	0.0005	0.019	0.005	0.01	5.3	0.49	0.089	133,193
2051	8.5	1,817	903	24	0.032	0.0032	0.0022	0.0021	1.1	0.00005	11	0.00055	0.0048	0.009	0.05	0.0043	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.058	3.9	0.000044	995	1.9	0.000044	0.0005	0.019	0.005	0.01	4.1	0.55	0.099	134,254
2052	8.5	1,827	904	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0048	0.009	0.05	0.0045	0.59	36	0.02	0.000005	0.062	0.016	0.37	34	0.057	3.9	0.000044	1,000	1.9	0.000044	0.0005	0.02	0.005	0.01	2.6	0.65	0.12	135,292
2053	8.5	1,837	904	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0049	0.009	0.05	0.0046	0.59	36	0.02	0.000005	0.062	0.016	0.37	34	0.057	3.9	0.000044	1,004	1.9	0.000044	0.0005	0.02	0.005	0.01	1.4	0.7	0.13	135,311
2054	8.5	1,840	903	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0049	0.009	0.05	0.0047	0.59	36	0.02	0.000005	0.062	0.016	0.37	33	0.057	3.9	0.000044	1,006	1.9	0.000044	0.0005	0.02	0.005	0.01	1.1	0.64	0.12	135,939
2055	8.5	1,851	902	23	0.031	0.0033	0.0023	0.0021	1.1	0.00005	11	0.00056	0.005	0.009	0.05	0.0048	0.58	36	0.02	0.000005	0.062	0.016	0.37	33	0.058	3.9	0.000044	1,010	1.9	0.000044	0.0005	0.02	0.005	0.011	1.1	0.63	0.11	136,744
2056	8.6	1,807	1,101	23	0.039	0.0037	0.0022	0.0022	1.1	0.00005	7.4	0.00054	0.0049	0.011	0.05	0.0046	0.58	38	0.02	0.000005	0.061	0.017	0.37	33	0.057	3.8	0.000043	1,036	1.9	0.000043	0.0005	0.019	0.005	0.01	1.3	0.7	0.13	137,789
2057	8.7	1,730	1,420	23	0.052	0.003	0.0022	0.0023	1.1	0.00005	4.7	0.00052	0.0044	0.013	0.05	0.0042	0.58	41	0.018	0.000005	0.058	0.015	0.37	33	0.052	3.8	0.000041	1,070	1.8	0.000042	0.0005	0.018	0.005	0.01	1.5	0.78	0.14	138,099
2058	8.7	1,684	1,602	23	0.059	0.003	0.0021	0.0024	1.0	0.00005	3.8	0.00051	0.0042	0.015	0.05	0.0039	0.58	42	0.017	0.000005	0.057	0.014	0.37	33	0.049	3.8	0.00004	1,088	1.8	0.00004	0.0005	0.018	0.005	0.01	1.7	0.83	0.15	138,393
2059	8.7	1,671	1,663	23	0.062	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.37	33	0.048	3.8	0.00004	1,094	1.8	0.00004	0.0005	0.018	0.005	0.01	2.0	0.81	0.15	138,657
2060	8.7	1,670	1,675	23	0.062	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.36	33	0.048	3.8	0.00004	1,096	1.8	0.00004	0.0005	0.018	0.005	0.01	2.3	0.83	0.15	139,741
2061	8.7	1,673	1,672	23	0.062	0.003	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.36	32	0.049	3.8	0.00004	1,097	1.8	0.00004	0.0005	0.018	0.005	0.01	2.6	0.79	0.14	140,084
2062	8.8	1,663	1,742	23	0.07	0.0029	0.002	0.0025	1.0	0.00005	3.1	0.0005	0.0041	0.014	0.05	0.0037	0.56	44	0.017	0.000005	0.056	0.013	0.36	32	0.049	3.8	0.00004	1,107	1.8	0.00004	0.0005	0.018	0.005	0.01	3.0	0.72	0.13	140,942
2063	8.8	1,642	1,814	22	0.077	0.0029	0.002	0.0025	1.0	0.00005	2.8	0.0005	0.004	0.014	0.05	0.0036	0.56	45	0.017	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,113	1.8	0.000039	0.0005	0.018	0.005	0.01	3.3	0.65	0.12	141,850
2064	8.8	1,636	1,828	22	0.076	0.0029	0.002	0.0025	1.0	0.00005	2.8	0.0005	0.004	0.014	0.05	0.0036	0.56	45	0.017	0.000005	0.055	0.013	0.35	32	0.046	3.7	0.000039	1,113	1.8	0.000039	0.0005	0.017	0.005	0.01	3.8	0.67	0.12	143,090
2065	8.9	1,636	1,899	22	0.094	0.0029	0.0019	0.0026	1.0	0.00005	2.4	0.0005	0.004	0.014	0.05	0.0035	0.55	46	0.016	0.000005	0.055	0.013	0.35	32	0.046	3.7	0.000039	1,128	1.8	0.000039	0.0005	0.017	0.005	0.01	4.2	0.7	0.13	143,729
2066	8.9	1,609	1,986	22	0.11	0.0028	0.0019	0.0026	1.0	0.00005	2.1	0.0005	0.0039	0.014	0.05	0.0034	0.55	47	0.016	0.000005	0.054	0.012	0.35	31	0.046	3.7	0.000039	1,134	1.8	0.000039	0.0005	0.017	0.005	0.01	4.6	0.74	0.13	144,914
2067	8.9	1,589	2,043	22	0.11	0.0028	0.0019	0.0027	0.99	0.00005	2.0	0.0005	0.0039	0.013	0.05	0.0033	0.54	47	0.016	0.000005	0.053	0.012	0.35	31	0.045	3.6	0.000038	1,137	1.7	0.000038	0.0005	0.017	0.005	0.01	5.1	0.77	0.14	146,084
2068	8.9	1,583	2,073	22	0.11	0.0028	0.0019	0.0027	0.98	0.00005	1.9	0.0005	0.0038	0.013	0.05	0.0033	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.045	3.6	0.000038	1,140	1.7	0.000038	0.0005	0.017	0.005	0.01	5.5	0.78	0.14	147,667
2069	8.9	1,580	2,092	21	0.11	0.0028	0.0019	0.0027	0.98	0.00005	1.9	0.0005	0.0038	0.013	0.05	0.0032	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.045	3.6	0.000038	1,141	1.7	0.000038	0.0005	0.017	0.005	0.01	5.9	0.77	0.14	148,435
2070	8.9	1,584	2,093	21	0.11	0.0028	0.0019	0.0027	0.97	0.00005	2.0	0.0005	0.0039	0.013	0.05	0.0032	0.53	48	0.016	0.000005	0.053	0.012	0.34	30	0.046	3.5	0.000038	1,143	1.7	0.000038	0.0005	0.017	0.005	0.01	6.0	0.74	0.14	149,714
2071	8.9	1,584	2,095	21	0.1	0.0028	0.0019	0.0027	0.96	0.00005	2.0	0.0005	0.0038	0.013	0.05	0.0032	0.53	49	0.016	0.000005	0.053	0.012	0.34	30	0.046	3.5	0.000038	1,143	1.7	0.000038	0.0005	0.017	0.005	0.01	5.7	0.72	0.13	150,869
2072	8.9	1,600	2,101	21	0.11	0.0028	0.0019	0.0027	0.95	0.00005	2.0	0.0005	0.0038	0.013	0.05	0.0033	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.046	3.5	0.000038	1,151	1.7	0.000038	0.0005	0.017	0.005	0.01	5.1	0.71	0.13	152,259
2073	8.9	1,607	2,096	21	0.11	0.0028	0.0019	0.0027	0.95	0.00005	2.0	0.0005	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000038	1,154	1.7	0.000039	0.0005	0.017	0.005	0.01	4.7	0.72	0.13	152,620
2074	8.9	1,614	2,086	21	0.11	0.0028	0.0019	0.0026	0.95	0.00005	2.0	0.0005	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.013	0.33	30	0.047	3.5	0.000039	1,155	1.7	0.000039	0.0005	0.017	0.005	0.01	4.6	0.74	0.13	153,555
2075	8.9	1,623	2,076	21	0.1	0.0029	0.0019	0.0026	0.94	0.00005	2.1	0.0005	0.004	0.014	0.05	0.0035	0.52	49	0.017	0.000005	0.055	0.013	0.33	29	0.048	3.4	0.000039	1,157	1.7	0.000039	0.0005	0.017	0.005	0.01	4.5	0.76	0.14	154,302
2076	8.9	1,650	2,086	20	0.11	0.0029	0.002	0.0026	0.94	0.00005	2.0	0.0005	0.0041	0.014	0.05	0.0036	0.51	50	0.017	0.000005	0.056	0.013	0.33	29	0.05	3.4	0.000039	1,171	1.6	0.00004	0.0005	0.018	0.005	0.01	4.6	0.77	0.14	155,300
2077	8.9	1,666	2,081	20	0.11	0.0029	0.002	0.0026	0.93	0.00005	2.0	0.0005	0.0043	0.014	0.05	0.0038	0.51	50	0.018	0.000005	0.056	0.014	0.33	29	0.052	3.4	0.00004	1,177	1.6	0.00004	0.0005	0.018	0.005	0.01	4.8	0.75	0.14	155,642
2078	8.9	1,680	2,074	20	0.11	0.003	0.0021	0.0026	0.93	0.00005	2.0	0.00051	0.0044	0.014	0.05	0.0039	0.51	50	0.018	0.000005	0.057	0.014	0.32	29	0.054	3.4	0.00004	1,182	1.6	0.00004	0.0005	0.018	0.005	0.01	5.0	0.72	0.13	156,520
2079	8.9	1,691	2,082	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.00051	0.0046	0.014	0.05	0.004	0.51	50	0.019	0.000005	0.057	0.015	0.32	29	0.056	3.4	0.00004	1,188	1.6	0.00004	0.0005	0.018	0.005	0.01	5.2	0.64	0.12	157,526
2080	8.9	1,698	2,093	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.00051	0.0047	0.014	0.05	0.0041	0.5	50	0.02	0.000005	0.057	0.015	0.32	29	0.057	3.3	0.000041	1,194	1.6	0.00004	0.0005	0.018	0.005	0.01	5.5	0.58	0.11	158,727
2081	8.9	1,711	2,092	20	0.11	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.00051	0.0048	0.014	0.05	0.0042	0.5	51	0.02	0.000005	0.058	0.015	0.32	29	0.059	3.3	0.000041	1,199	1.6	0.000041	0.0005	0.018	0.005	0.01	5.7	0.48	0.086	159,076
2082	9.0	1,705	2,128	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.00051	0.0049	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.016	0.32	28	0.06	3.3	0.000041	1,204	1.6	0.000041	0.0005	0.018	0.005	0.01	5.8	0.43	0.077	160,041
2083	9.0	1,694	2,167	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.9	0.00051	0.0049	0.014	0.05	0.0043	0.5	52	0.021	0.000005	0.057	0.016	0.32	28	0.061	3.3	0.000041	1,207	1.6	0.000041	0.0005	0.018	0.005	0.01	5.9	0.37	0.067	160,609
2084	9.0	1,698	2,182	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.9	0.00051	0.005	0.014	0.05	0.0044	0.49	52	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.3	0.000041	1,212	1.6	0.000041	0.0005	0.018	0.005	0.01	5.7	0.35	0.064	161,869
2085	9.0	1,691	2,202	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.8	0.00051	0.005	0.014	0.05	0.0044	0.49	52	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.3	0.00004	1,212	1.6	0.000041	0.0005	0.018	0.005	0.01	5.8	0.34	0.061	162,127
2086	9.0	1,695	2,209	19	0.12	0.003	0.0023	0.0026	0.89	0.00005	1.9	0.00051	0.0051	0.014	0.05	0.0045	0.49	53	0.021	0.000005	0.057	0.016	0.31	28	0.062	3.3	0.000041	1,215	1.6	0.000041	0.0005	0.018	0.005	0.01	5.4	0.33	0.06	163,022
2087	8.9	1,689	2,222	19	0.11	0.003	0.0022	0.0026	0.89	0.00005	1.9	0.00051	0.005	0.014	0.05	0.0044	0.49	53	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.2	0.00004	1,215	1.6	0.000041	0.0005	0.018	0.005	0.01	5.3	0.33	0.06	163,716
2088	9.0	1,701	2,235	19	0.12	0.003	0.0023	0.0026	0.88	0.00005	1.8	0.00051	0.005	0.015	0.05	0.

Table A3. Source terms of the NAG backfill for the well graded cover system scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2135	9.2	1,577	3,187	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	77	0.02	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,338	1.4	0.000038	0.0005	0.017	0.005	0.01	2.7	0.057	0.01	186,587
2136	9.2	1,578	3,192	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	78	0.02	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,339	1.4	0.000038	0.0005	0.017	0.005	0.01	2.7	0.057	0.01	187,193
2137	9.2	1,581	3,204	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,342	1.4	0.000038	0.0005	0.017	0.005	0.01	2.6	0.057	0.01	186,724
2138	9.2	1,570	3,233	17	0.24	0.0028	0.0022	0.0032	0.78	0.00005	0.94	0.0005	0.0048	0.015	0.05	0.0044	0.43	79	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,342	1.4	0.000038	0.0005	0.017	0.005	0.01	2.6	0.057	0.01	186,796
2139	9.2	1,553	3,271	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.92	0.0005	0.0047	0.015	0.05	0.0043	0.43	79	0.019	0.000005	0.052	0.016	0.27	24	0.055	2.8	0.000037	1,342	1.4	0.000037	0.0005	0.017	0.005	0.01	2.6	0.057	0.01	187,060
2140	9.2	1,545	3,291	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.91	0.0005	0.0046	0.015	0.05	0.0043	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.055	2.8	0.000037	1,342	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,517
2141	9.2	1,532	3,320	17	0.25	0.0027	0.0022	0.0033	0.78	0.00005	0.9	0.0005	0.0046	0.015	0.05	0.0042	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.054	2.8	0.000037	1,341	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	186,898
2142	9.2	1,525	3,335	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.89	0.0005	0.0045	0.015	0.05	0.0042	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000036	1,341	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	186,889
2143	9.2	1,516	3,353	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.0005	0.0045	0.015	0.05	0.0041	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000036	1,340	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,035
2144	9.2	1,509	3,369	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.0005	0.0044	0.015	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.052	2.8	0.000036	1,339	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,551
2145	9.2	1,502	3,386	17	0.26	0.0026	0.0021	0.0033	0.78	0.00005	0.87	0.0005	0.0043	0.014	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.051	2.8	0.000036	1,338	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,020
2146	9.2	1,496	3,399	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.87	0.0005	0.0042	0.014	0.05	0.0039	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.05	2.8	0.000036	1,337	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,082
2147	9.2	1,490	3,412	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.0005	0.0042	0.014	0.05	0.0038	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.049	2.8	0.000036	1,337	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,212
2148	9.2	1,485	3,424	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.0005	0.0041	0.014	0.05	0.0037	0.42	84	0.017	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000035	1,336	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.057	0.01	187,667
2149	9.2	1,480	3,436	17	0.27	0.0026	0.002	0.0034	0.78	0.00005	0.85	0.0005	0.004	0.014	0.05	0.0037	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.047	2.8	0.000035	1,336	1.4	0.000036	0.0005	0.016	0.005	0.01	2.5	0.057	0.01	187,030
2150	9.2	1,476	3,445	17	0.27	0.0026	0.0019	0.0034	0.78	0.00005	0.85	0.0005	0.0039	0.014	0.05	0.0036	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000035	1,335	1.4	0.000036	0.0005	0.016	0.005	0.01	2.4	0.057	0.01	186,985

Table A4. Annual loads of the NAG backfill for the well graded cover system scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m³/year
2023	20	1.5	0.44	0.00019	0.0000034	0.0000019	0.0000037	0.02	0.00000065	0.45	0.0000081	0.000092	0.000016	0.00081	0.0000016	0.011	0.33	0.00054	0.00	0.00066	0.00012	0.007	0.63	0.0018	0.073	0.00000047	8.5	0.035	0.0000047	0.0000081	0.00021	0.000028	0.00007	1.1	0.13	0.024	16
2024	40	3.1	0.9	0.00038	0.00007	0.00004	0.000076	0.041	0.0000013	0.92	0.0000017	0.00019	0.0000033	0.0016	0.0000033	0.023	0.67	0.0011	0.00000016	0.0013	0.00025	0.014	1.3	0.0036	0.15	0.00000096	17	0.072	0.00000096	0.000016	0.00043	0.000058	0.00014	2.2	0.27	0.05	33
2025	69	5.4	1.6	0.00067	0.00012	0.0000069	0.00013	0.072	0.0000023	1.6	0.0000029	0.00033	0.0000058	0.0029	0.0000058	0.039	1.2	0.0019	0.00000029	0.0023	0.00043	0.025	2.2	0.0063	0.26	0.0000017	30	0.13	0.0000017	0.000029	0.00074	0.0001	0.00025	3.8	0.48	0.086	57
2026	106	8.2	2.4	0.001	0.00019	0.00011	0.0002	0.11	0.0000035	2.4	0.0000044	0.0005	0.0000088	0.0044	0.0000088	0.06	1.8	0.0029	0.00000044	0.0036	0.00065	0.038	3.4	0.0097	0.4	0.0000025	46	0.19	0.0000025	0.0000044	0.0011	0.00015	0.00038	5.7	0.72	0.13	87
2027	141	11	3.2	0.0013	0.00025	0.00014	0.00027	0.15	0.0000047	3.2	0.0000058	0.00067	0.00012	0.0058	0.0000012	0.08	2.3	0.0039	0.00000058	0.0047	0.00086	0.051	4.5	0.013	0.53	0.0000034	61	0.26	0.0000034	0.0000058	0.0015	0.0002	0.0005	7.6	0.96	0.17	116
2028	236	18	5.3	0.0023	0.00042	0.00024	0.00045	0.24	0.0000078	5.4	0.0000098	0.0011	0.0002	0.0098	0.00002	0.13	4.0	0.0066	0.00000098	0.008	0.0015	0.085	7.6	0.022	0.89	0.0000057	103	0.43	0.0000057	0.0000098	0.0025	0.00034	0.00084	13	1.6	0.29	195
2029	267	21	6.0	0.0026	0.00047	0.00027	0.00051	0.28	0.0000089	6.1	0.00011	0.0013	0.00022	0.011	0.0000022	0.15	4.5	0.0074	0.00000011	0.009	0.0016	0.097	8.6	0.024	1.0	0.0000064	117	0.49	0.0000064	0.00011	0.0029	0.00039	0.00095	14	1.8	0.33	221
2030	321	25	7.3	0.0031	0.00057	0.00032	0.00062	0.33	0.0000111	7.4	0.00013	0.0015	0.00027	0.013	0.0000027	0.18	5.4	0.0089	0.00000013	0.011	0.002	0.12	10	0.029	1.2	0.0000077	140	0.58	0.0000077	0.00013	0.0034	0.00046	0.0011	17	2.2	0.4	266
2031	1,162	91	26	0.011	0.002	0.0012	0.0022	1.2	0.0000039	27	0.00048	0.0055	0.00097	0.048	0.0000096	0.66	19	0.032	0.00000048	0.039	0.0071	0.42	38	0.11	4.4	0.000028	508	2.1	0.000028	0.00048	0.012	0.0017	0.0041	63	8.0	1.4	961
2032	2,750	214	62	0.026	0.0048	0.0027	0.0053	2.8	0.0000091	63	0.0011	0.013	0.0023	0.11	0.00023	1.6	46	0.076	0.00000011	0.093	0.017	0.99	89	0.25	10	0.0000066	1,201	5.0	0.0000066	0.0011	0.029	0.004	0.0098	149	19	3.4	2,273
2033	858	67	19	0.0082	0.0015	0.00086	0.0016	0.89	0.0000028	20	0.00036	0.0041	0.00071	0.035	0.0000071	0.49	14	0.024	0.00000035	0.029	0.0053	0.31	28	0.078	3.2	0.0000021	375	1.6	0.0000021	0.00035	0.0092	0.0012	0.0031	46	5.9	1.1	710
2034	1,554	121	35	0.015	0.0027	0.0015	0.003	1.6	0.0000051	36	0.00064	0.0074	0.0013	0.064	0.00013	0.88	26	0.043	0.00000064	0.052	0.0095	0.56	50	0.14	5.8	0.0000037	679	2.8	0.0000037	0.00064	0.017	0.0022	0.0055	84	11	1.9	1,284
2035	12,672	987	286	0.12	0.022	0.013	0.024	13	0.00042	291	0.0052	0.06	0.011	0.52	0.0011	7.2	212	0.35	0.0000052	0.43	0.078	4.6	409	1.2	48	0.0003	5,534	23	0.0003	0.0052	0.14	0.018	0.045	686	87	16	10,477
2036	23,413	1,824	529	0.22	0.041	0.023	0.045	24	0.00078	538	0.0097	0.11	0.019	0.97	0.0019	13	391	0.65	0.0000097	0.79	0.14	8.5	756	2.1	88	0.00056	10,225	42	0.00056	0.0097	0.25	0.034	0.084	1,267	160	29	19,356
2037	16,957	1,321	383	0.16	0.03	0.017	0.033	17	0.00056	390	0.007	0.08	0.014	0.7	0.0014	9.6	283	0.47	0.00007	0.57	0.1	6.1	548	1.5	64	0.00041	7,405	31	0.00041	0.007	0.18	0.025	0.061	918	116	21	14,018
2038	32,863	2,560	742	0.32	0.058	0.033	0.063	34	0.0011	755	0.014	0.16	0.027	1.4	0.0027	19	549	0.91	0.00014	1.1	0.2	12	1,062	3.0	124	0.00079	14,352	60	0.00079	0.014	0.35	0.048	0.12	1,778	225	41	27,168
2039	63,961	11,571	1,332	0.72	0.11	0.062	0.11	61	0.002	1,527	0.024	0.29	0.059	2.4	0.015	33	1,111	1.7	0.00024	2.2	0.4	21	1,907	5.5	222	0.0015	29,310	107	0.0015	0.024	0.68	0.092	0.23	3,194	186	34	48,784
2040	128,782	40,409	2,348	1.5	0.23	0.13	0.19	107	0.0034	2,749	0.043	0.56	0.15	4.3	0.073	59	2,362	3.2	0.00043	4.3	0.87	38	3,360	10	392	0.0031	63,111	189	0.0031	0.043	1.4	0.19	0.51	5,626	255	46	85,906
2041	197,654	88,386	3,173	3.1	0.35	0.19	0.25	145	0.0047	1,619	0.059	0.64	0.67	5.8	0.2	80	3,854	3.4	0.00058	6.7	1.2	51	4,542	11	529	0.0047	105,502	255	0.0048	0.058	2.1	0.29	0.76	5,144	117	21	116,049
2042	185,591	104,355	3,172	3.9	0.33	0.19	0.31	145	0.0053	1,539	0.066	0.4	1.1	6.6	0.26	79	3,722	1.8	0.00066	6.2	1.1	51	4,539	5.5	529	0.0045	103,736	255	0.0045	0.066	2.0	0.27	0.68	1,545	165	30	131,728
2043	186,076	105,488	3,171	3.9	0.33	0.2	0.33	145	0.0054	1,615	0.068	0.36	1.1	6.8	0.27	79	3,734	1.6	0.00068	6.3	1.0	51	4,539	4.7	529	0.0045	104,118	255	0.0045	0.068	2.0	0.27	0.68	942	191	35	135,614
2044	186,190	104,188	3,171	3.9	0.33	0.2	0.33	145	0.0055	1,717	0.069	0.36	1.1	6.9	0.27	79	3,726	1.6	0.00069	6.3	1.0	51	4,539	4.7	529	0.0045	103,774	255	0.0045	0.069	2.0	0.27	0.68	947	53	9.6	137,918
2045	188,820	106,262	3,172	3.9	0.33	0.2	0.32	145	0.0054	1,585	0.068	0.38	1.1	6.7	0.28	79	3,791	1.7	0.00067	6.4	1.1	51	4,539	5.0	529	0.0045	105,535	255	0.0045	0.067	2.0	0.27	0.69	1,107	33	6.0	134,843
2046	188,964	103,720	3,172	3.8	0.33	0.2	0.3	145	0.0052	1,515	0.065	0.41	1.1	6.5	0.3	79	3,787	1.8	0.00065	6.4	1.2	51	4,540	5.5	529	0.0045	105,107	255	0.0045	0.065	2.0	0.27	0.75	1,252	38	6.9	129,640
2047	203,032	105,866	3,173	3.8	0.36	0.22	0.29	145	0.0052	1,496	0.065	0.45	1.1	6.4	0.37	80	4,033	1.9	0.00064	6.8	1.4	51	4,541	5.6	529	0.0049	111,892	255	0.0049	0.064	2.2	0.29	0.88	792	46	8.3	128,811
2048	223,360	112,202	3,173	4.0	0.39	0.25	0.28	145	0.0052	1,458	0.067	0.53	1.1	6.5	0.45	80	4,420	2.2	0.00065	7.5	1.7	51	4,542	6.5	529	0.0054	122,389	255	0.0054	0.065	2.4	0.32	1.0	762	55	10	130,391
2049	233,846	117,629	3,174	4.1	0.41	0.27	0.28	145	0.0053	1,404	0.07	0.59	1.2	6.6	0.51	80	4,637	2.5	0.00066	7.9	1.9	51	4,543	7.4	529	0.0056	128,307	255	0.0056	0.066	2.5	0.34	1.2	833	62	11	131,655
2050	240,268	120,082	3,174	4.2	0.42	0.29	0.28	145	0.0053	1,409	0.072	0.63	1.2	6.7	0.55	80	4,757	2.6	0.00067	8.1	2.0	51	4,543	7.7	529	0.0058	131,710	255	0.0058	0.067	2.6	0.35	1.3	710	65	12	133,193
2051	243,939	121,288	3,174	4.2	0.43	0.3	0.28	145	0.0054	1,421	0.073	0.65	1.2	6.7	0.58	80	4,821	2.7	0.00067	8.2	2.1	51	4,543	7.8	529	0.0058	133,609	255	0.0059	0.067	2.6	0.35	1.3	552	73	13	134,254
2052	247,218	122,306	3,174	4.3	0.44	0.31	0.28	145	0.0054	1,435	0.074	0.66	1.2	6.8	0.61	80	4,882	2.7	0.00068	8.3	2.2	51	4,543	7.7	529	0.0059	135,278	255	0.0059	0.068	2.6	0.36	1.4	353	87	16	135,292
2053	248,540	122,377	3,174	4.3	0.44	0.31	0.28	145	0.0054	1,438	0.075	0.66	1.2	6.8	0.62	80	4,905	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.006	135,880	255	0.006	0.068	2.7	0.36	1.4	193	94	17	135,311
2054	250,169	122,780	3,174	4.3	0.44	0.31	0.29	145	0.0055	1,450	0.075	0.67	1.2	6.8	0.63	80	4,934	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.006	136,687	255	0.006	0.068	2.7	0.36	1.4	145	87	16	135,939
2055	253,168	123,343	3,174	4.3	0.45	0.32	0.29	145	0.0055	1,467	0.076	0.68	1.2	6.8	0.65	80	4,987	2.7	0.00068	8.5	2.3	51	4,543	8.0	529	0.0061	138,125	255	0.0061	0.068	2.7	0.37	1.5	151	86	16	136,744
2056	249,012	151,733	3,175	5.3	0.44	0.32	0.3	145	0.0055	1,021	0.075	0.67	1.4	6.9	0.63	80	5,237	2.7	0.00069	8.4	2.2	51	4,544	7.8	529	0.006	142,694	255	0.006	0.069	2.7	0.36	1.4	174	96	17	137,789
2057	238,870	196,129	3,175	7.1	0.42	0.3	0.32	145	0.0055	643	0.072	0.61	1.8	6.9	0.58	80	5,612	2.5	0.00069	8.0	2.1	51	4,544	7.2	530	0.0057	147,766	255	0.0057	0.069	2.6	0.35	1.3	202	108	20	138,099
2058	233,012	221,733	3,176	8.2	0.41	0.28	0.33	145	0.0056	520	0.07	0.58	2.0	6.9	0.54	80	5,863	2.3	0.00069	7.8	1.9	51	4,545	6.8	530	0.0056	150,502	255	0.0056	0.069	2.5	0.34	1.2	234	115	21	138,393
2059	231,696	230,559	3,176	8.6	0.41	0.28	0.34	145	0.0056	488	0.07	0.57	2.0	6.9	0.53	80	5,977	2.3	0.00069	7.8	1.9	51	4,545	6.7	530	0.0055	151,719	255	0.0056	0.069	2.5	0.33	1.2	271	112	20	138,657
2060	233,410	234,067	3,176	8.7	0.41	0.28	0.34	145	0.0056	486	0.07	0.57	2.0	7.0	0.53	80	6,061	2.3	0.0007	7.9	1.9	51	4,545	6.8	530	0.0056	153,184	255	0.0056	0.07	2.5	0.34	1.2	316	116	21	139,741
2061	234,402	234,276	3,176	8.7	0.41	0.28	0.34	145	0.0056	489	0.07	0.58	2.0	7.0	0.53	80	6,088	2.4	0.0007	7.9	1.9	51	4,545	6.9	530	0.0056	153,658	255	0.0056	0.07	2.5	0.34	1.2	364	111	20	140,084
2062	234,343	245,464	3,176	9.9	0.41	0.28	0.35	145	0.0057	436	0.071	0.58	2.0	7.0	0.53	80	6,206	2.4	0.0007	7.9	1.9	51	4,546	6.9	530	0.0056	156,036	255	0.0056	0.07	2.5	0.34	1.2	417	101	18	140,942
2063	232,890	257,359	3,176	11	0.41	0.28	0.36	145	0.0057	398	0.071	0.57	2.0	7.1	0.51	80	6,350	2.3	0.00071	7.8	1.9	51	4,546	6.8	530	0.0056	157,837	255	0.0056	0.071	2.5	0.34	1.2	474	92	17	141,850
2064	234,081	261,497	3,176	11	0.41	0.28	0.36	145	0.0057	402	0.072	0.57	2.0	7.2	0.51	80	6,432	2.4	0.00072	7.9	1.8	51	4,546	6.6	530	0.0056	159,202	255	0.0056	0.072	2.5	0.34	1.2	537	96	17	143,090
2065	235,155	272,984	3,176	14	0.41	0.28	0.37	145	0.0058	339	0.072	0.57	2.0	7.2	0.51	80	6,587	2.4	0.00072	7.9	1.8	51	4,546	6.6	530	0.0056	162,126	255	0.0057	0.072	2.5	0.34	1.2	600	100	18	143,729
2066	233,224	287,755	3,177	16	0.41	0.28	0.38	145	0.0058	303	0.073	0.57	2.0	7.2	0.49	80	6,742	2.4	0.00072	7.8	1.8	51	4,546	6.6	530	0.0056	164,332	255	0.0056	0.072	2.5	0.34	1.1	669	107	19	144,914
2067	232,156	298,507	3,177	17	0.41	0.28	0.39	145	0.0059	288	0.073	0.56	2.0	7.3	0.49	80	6,877	2.4	0.00073	7.8	1.8	51	4,546	6.6	530	0.0056	166,053	255	0.0056	0.073	2.5	0.34	1.1	741	113	20	146,084
2068	233,756	306,039	3,177	17	0.41	0.28	0.4	145	0.0059	287	0.074	0.57	2.0	7.4	0.48	80	7,031	2.4	0.00074	7.9	1.8	51	4,546	6.7	530	0.0056	168,266	255	0.0056	0.074	2.5	0.34	1.1	813	115	21	147,667
2069	234,467	310,511	3,177	17	0.42	0.28	0.4	145	0.006	288	0.075	0.57	2.0	7.4	0.48	80	7,136	2.4	0.00074	7.9	1.7	51	4,547	6.7	530	0.0056	169,423	255	0.0056	0.074	2.5	0.34	1.1	871	114	21	148,435
2070	237,133	313,382	3,177	16	0.42	0.28	0.4	145	0.006	297	0.075	0.58	2.0	7.5	0.49	80	7,238	2.4	0.00075	8.0	1.8	51	4,547	6.9	530	0.0057	171,153	255	0.0057	0.075	2.5	0.34	1.1	897	112	20	149,714
2071	238,917	316,056	3,177	16	0.42	0.28	0.4	145	0.0061	305	0.076	0.58	2.0	7.5	0.49	80	7,328	2.4	0.00075	8.0	1.8	51	4,547	6.9	530	0.0057	172,459	255	0.0057	0.075	2.6	0.35	1.1	857	108	20	150,869
2072	243,538	319,835	3,177	17	0.43	0.28	0.41	145	0.0061	297	0.076	0.58	2.0	7.6	0.5	80	7,448	2.4	0.00076	8.2	1.8	51	4,547	7.0	530	0.0058	175,311	255	0.0059	0.076	2.6	0.35	1.2	780	109	20	152,259
2073	245,306	319,891	3,177	17	0.43	0.29	0.41	145	0.0061	303	0.077	0.59	2.1	7.6	0.51	80	7,488	2.5	0.00076	8.3	1.9	51	4,547	7.1	530	0.0059	176,093	255	0.0059	0.076	2.6	0.35	1.2	721	110	20	152,620
2074	247,823	320,362	3,177	16	0.44	0.29	0.41	145	0.0062	312	0.077	0.6	2.1	7.7	0.53	80	7,532	2.5	0.00077	8.3	1.9	51	4,547	7.3	530	0.0059	177,310	255	0.006	0.077	2.6	0.36	1.2	707	113	21	153,555
2075	250,494	320,300	3,177	16	0.44	0.3	0.41	145	0.0062	322	0.078	0.62	2.1	7.7	0.54	80	7,577	2.6	0.00077	8.4	2.0	51	4,547	7.5	530	0.006	178,481	255	0.006	0.077	2.7	0.36	1.3	694	117	21	154,302
2076	256,213	323,939	3,177	18	0.45	0.31	0.41	145	0.0062	304	0.078	0.64	2.1	7.8	0.56	80	7,698	2.7	0.00078	8.6	2.1	51	4,547	7.8	530	0.0061	181,840	255	0.0062	0.078	2.7	0.37	1.3	716	119	22	155,300
2077	259,315	323,891	3,177	18	0.46	0.31	0.4	145	0.0063	308	0.078	0.67	2.2	7.8	0.58	80	7,746	2.8	0.00078	8.7	2.1	51	4,547	8.1	530	0.0062	183,222	255	0.0062	0.078	2.8	0.37	1.3	741	117	21	155,642
2078	262,984	324,669	3,177	17	0.46	0.32	0.4	145	0.0063	314	0.079	0.69	2.2	7.8	0.61	80	7,807	2.9	0.00078	8.9	2.2	51	4,547	8.4	530	0.0063	185,022	255	0.0063	0.078	2.8	0.38	1.4	781	113	21	156,520
2079	266,345	327,890	3,177	18	0.47	0.33	0.41	145	0.0063	314	0.08	0.72	2.2	7.9	0.63	80	7,896	3.0	0.00079	9.0	2.3	51	4,547	8.8	530	0.0064	187,204	255	0.0064	0.079	2.8	0.39	1.5	824	101	18	157,526
2080	269,535	332,232	3,177	18	0.48	0.34	0.41	145	0.0064	315	0.081	0.75	2.2	7.9	0.65	80	8,005	3.1	0.00079	9.1	2.4	51	4,547	9.1	530	0.0065	189,520	255	0.0065	0.079	2.9	0.39	1.5	867	92	17	158,727
2081	272,116	332,708	3,177	18	0.48	0.35	0.41	145	0.0064	320	0.082	0.77	2.3	8.0	0.67	80	8,059	3.2	0.0008	9.2	2.5	51	4,548	9.4	530	0.0065	190,764	255	0.0065	0.08	2.9	0.39	1.5	903	76	14	159,076
2082	272,869	340,630	3,177	19	0.48	0.35	0.41	145	0.0064	308	0.082	0.78	2.3	8.0	0.68	80	8,173	3.3	0.0008	9.2	2.5	51	4,548	9.6	530	0.0065	192,737	255	0.0066	0.08	2.9	0.39	1.6	921	68	12	160,041
2083	272,120	348,104	3,177	19	0.48	0.35	0.42	145	0.0065	299	0.082	0.79	2.3	8.0	0.69	80	8,273	3.3	0.0008	9.2	2.5	51	4,548	9.7	530	0.0065	193,919	255	0.0066	0.08	2.9	0.39	1.6	944	59	11	160,609
2084	274,821	353,230	3,178	19	0.48	0.36	0.42	145	0.0065	301	0.083	0.81	2.3	8.1	0.71	80	8,405	3.4	0.00081	9.2	2.6	51	4,548	9.9	530	0.0066	196,136	255	0.0066	0.081	2.9	0.4	1.6	930	57	10	161,869
2085	274,109	357,053	3,178	19	0.48	0.36	0.42	145	0.0065	299	0.082	0.81	2.3	8.1	0.71	80	8,478	3.4	0.00081	9.2	2.6	51	4,548	10.0	530	0.0066	196,531	255	0.0066	0.081	2.9	0.4	1.6	934	54	9.9	162,127
2086	276,257	360,164	3,178	19	0.49	0.37	0.43	145	0.0066	304	0.083	0.82	2.4	8.2	0.73	80	8,584	3.4	0.00082	9.3	2.6	51	4,548	10	530	0.0066	198,072	255	0.0067	0.082	2.9	0.4	1.7	880	54	9.9	163,022
2087	276,500	363,696	3,178	19	0.49	0.37	0.43	145	0.0066	306	0.083	0.82	2.4	8.2	0.72	80	8,675	3.4	0.00082	9.3	2.6	51	4,548	10	530	0.0066	198,833	255	0.0066	0.082	3.0	0.4	1.7	869	54	9.9	163,716
2088	280,271	368,398	3,178	20	0.49	0.37	0.43	145	0.0066	299	0.084	0.83	2.4	8.2	0.74	80	8,822	3.4	0.00082	9.4	2.7	51	4,548	10	530	0.0067	201,439	255	0.0067	0.082	3.0	0.41	1.7	795	55	9.9	164,817
2089	275,396	376,485	3,178	22	0.49	0.36	0.44	145	0.0066	274	0.083	0.78	2.4	8.3	0.7	80	8,871	3.2	0.00083	9.3	2.5	51	4,548	9.5	530	0.0066	200,891	255	0.0066	0.083	2.9	0.4	1.6	749	55	10.0	165,016
2090	275,529	383,534	3,178	23	0.49	0.36	0.45	145	0.0067	268	0.083	0.78	2.4	8.3	0.7	80	9,001	3.2	0.00083	9.3	2.5	51	4,549	9.4	530	0.0066	202,339	255	0.0066	0.083	2.9	0.4	1.6	707	55	10	165,702
2091	276,362	388,183	3,178	23	0.49	0.36	0.45	145	0.0067	268	0.084	0.78	2.4	8.3	0.7	80	9,122	3.2	0.00083	9.3	2.5	51	4,549	9.4	530	0.0066	203,575	255	0.0066	0.083	3.0	0.4	1.6	718	55	10	166,524
2092	278,748	393,879	3,178	23	0.49	0.36	0.45	145	0.0067	270	0.084	0.79	2.4	8.4	0.7	80	9,285	3.2	0.00084	9.4	2.5	51	4,549	9.5	530	0.0067	205,708	255	0.0067	0.084	3.0	0.4	1.6	711	55	9.9	167,829
2093	277,320	402,001	3,178	24	0.49	0.36	0.46	145	0.0068	260	0.085	0.78	2.4	8.4	0.69

Table A4. Annual loads of the NAG backfill for the well graded cover system scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2135	294,248	594,560	3,182	43	0.52	0.42	0.59	145	0.0075	181	0.094	0.9	2.8	9.3	0.83	80	14,424	3.7	0.00093	9.9	3.0	51	4,554	11	531	0.007	249,560	256	0.0071	0.093	3.1	0.43	1.9	506	11	1.9	186,587
2136	295,465	597,538	3,182	43	0.52	0.42	0.59	145	0.0075	181	0.094	0.9	2.8	9.4	0.83	80	14,530	3.7	0.00094	9.9	3.0	51	4,554	11	531	0.0071	250,632	256	0.0071	0.094	3.2	0.43	1.9	503	11	2.0	187,193
2137	295,267	598,264	3,182	43	0.52	0.42	0.59	145	0.0075	180	0.094	0.89	2.8	9.3	0.83	80	14,607	3.6	0.00093	9.9	3.0	51	4,554	11	531	0.0071	250,546	256	0.0071	0.093	3.2	0.43	1.9	494	11	1.9	186,724
2138	293,288	603,873	3,182	45	0.52	0.41	0.59	145	0.0075	176	0.094	0.89	2.8	9.3	0.82	80	14,678	3.6	0.00093	9.9	2.9	51	4,554	10	531	0.007	250,755	256	0.007	0.093	3.1	0.42	1.9	493	11	2.0	186,796
2139	290,505	611,856	3,182	46	0.51	0.41	0.6	145	0.0075	172	0.094	0.88	2.8	9.4	0.81	80	14,802	3.6	0.00094	9.8	2.9	51	4,554	10	531	0.0069	251,035	256	0.007	0.094	3.1	0.42	1.8	492	11	2.0	187,060
2140	289,638	617,098	3,182	47	0.51	0.41	0.61	145	0.0075	171	0.094	0.87	2.8	9.4	0.8	80	14,924	3.5	0.00094	9.7	2.9	51	4,554	10	531	0.0069	251,572	256	0.007	0.094	3.1	0.42	1.8	492	11	2.0	187,517
2141	286,309	620,463	3,182	48	0.5	0.4	0.61	145	0.0075	167	0.094	0.86	2.8	9.3	0.79	80	14,989	3.5	0.00093	9.6	2.8	51	4,555	10	531	0.0068	250,649	256	0.0069	0.093	3.1	0.41	1.8	492	11	2.0	186,898
2142	285,025	623,257	3,182	48	0.5	0.4	0.61	145	0.0075	166	0.094	0.84	2.7	9.3	0.78	80	15,070	3.4	0.00093	9.6	2.8	51	4,554	10.0	531	0.0068	250,525	256	0.0068	0.093	3.0	0.41	1.8	492	11	2.0	186,889
2143	283,564	627,204	3,182	48	0.5	0.4	0.62	145	0.0075	165	0.094	0.84	2.7	9.4	0.77	80	15,161	3.4	0.00094	9.5	2.8	51	4,554	9.9	531	0.0068	250,553	256	0.0068	0.094	3.0	0.41	1.7	493	11	2.0	187,035
2144	283,034	631,917	3,182	49	0.5	0.39	0.62	145	0.0075	164	0.094	0.82	2.7	9.4	0.75	80	15,311	3.3	0.00094	9.5	2.7	51	4,555	9.7	531	0.0068	251,094	256	0.0068	0.094	3.0	0.41	1.7	495	11	2.0	187,551
2145	280,847	633,211	3,183	49	0.5	0.39	0.62	145	0.0075	163	0.094	0.81	2.7	9.4	0.74	80	15,352	3.3	0.00094	9.5	2.7	51	4,555	9.6	531	0.0067	250,270	256	0.0068	0.094	3.0	0.41	1.7	493	11	2.0	187,020
2146	279,837	635,834	3,182	49	0.49	0.38	0.63	145	0.0075	162	0.094	0.79	2.7	9.4	0.72	80	15,458	3.2	0.00094	9.4	2.6	51	4,555	9.3	531	0.0067	250,203	256	0.0067	0.094	3.0	0.4	1.6	492	11	2.0	187,082
2147	278,890	638,693	3,183	49	0.49	0.38	0.63	145	0.0075	161	0.094	0.78	2.7	9.4	0.72	80	15,545	3.2	0.00094	9.4	2.6	51	4,555	9.2	531	0.0067	250,228	256	0.0067	0.094	3.0	0.4	1.6	488	11	2.0	187,212
2148	278,629	642,477	3,183	50	0.49	0.37	0.64	145	0.0076	161	0.094	0.76	2.7	9.4	0.7	80	15,681	3.1	0.00094	9.4	2.5	51	4,555	9.0	531	0.0067	250,723	256	0.0067	0.094	3.0	0.4	1.6	485	11	2.0	187,667
2149	276,730	642,673	3,183	50	0.49	0.37	0.64	145	0.0075	159	0.094	0.75	2.7	9.4	0.69	80	15,708	3.0	0.00094	9.3	2.5	51	4,555	8.8	531	0.0066	249,798	256	0.0067	0.094	3.0	0.4	1.6	469	11	2.0	187,030
2150	275,915	644,201	3,183	50	0.49	0.36	0.64	145	0.0075	159	0.094	0.73	2.6	9.3	0.67	80	15,786	3.0	0.00093	9.3	2.4	51	4,555	8.6	531	0.0066	249,606	256	0.0066	0.093	2.9	0.4	1.5	458	11	2.0	186,985

Table A5. Source terms of the NAG backfill for the well graded cover system and no internal layer scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2023	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	24
2024	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	44
2025	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	80
2026	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	125
2027	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	158
2028	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	289
2029	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	270
2030	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	348
2031	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	2,236
2032	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	3,634
2033	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	620
2034	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	2,492
2035	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	7,085
2036	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	12,083
2037	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	13,464
2038	8.0	1,210	94	29	0.012	0.0021	0.0012	0.0023	1.3	0.00005	28	0.0005	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	528	2.3	0.000029	0.0005	0.013	0.005	0.01	65	8.3	1.5	26,952
2039	8.1	1,310	236	29	0.015	0.0023	0.0013	0.0023	1.3	0.00005	31	0.0005	0.0059	0.004	0.05	0.00032	0.72	23	0.035	0.000005	0.044	0.0082	0.46	41	0.11	4.8	0.000031	600	2.3	0.000031	0.0005	0.014	0.005	0.01	65	8.3	1.5	45,912
2040	8.2	1,513	481	29	0.018	0.0027	0.0015	0.0022	1.3	0.00005	31	0.0005	0.0065	0.004	0.05	0.00088	0.72	28	0.037	0.000005	0.051	0.01	0.46	41	0.12	4.8	0.000035	744	2.3	0.000036	0.0005	0.016	0.005	0.01	65	8.3	1.5	79,056
2041	8.4	1,702	763	29	0.027	0.003	0.0016	0.0022	1.3	0.00005	14	0.00051	0.0055	0.0059	0.05	0.0017	0.72	33	0.029	0.000005	0.057	0.011	0.46	41	0.093	4.8	0.000036	909	2.3	0.000041	0.0005	0.018	0.005	0.01	44	5.5	1.0	110,907
2042	8.5	1,410	794	25	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.0005	0.003	0.0082	0.05	0.002	0.62	28	0.014	0.000005	0.047	0.008	0.39	35	0.041	4.1	0.000034	788	2.0	0.000034	0.0005	0.015	0.005	0.01	12	1.5	0.26	128,839
2043	8.4	1,372	781	24	0.029	0.0024	0.0015	0.0024	1.1	0.00005	12	0.0005	0.0026	0.0081	0.05	0.002	0.59	28	0.012	0.000005	0.046	0.0077	0.38	34	0.034	4.0	0.000033	768	1.9	0.000033	0.0005	0.015	0.005	0.01	6.7	0.84	0.15	133,866
2044	8.4	1,350	759	23	0.028	0.0024	0.0014	0.0024	1.1	0.00005	12	0.0005	0.0026	0.008	0.05	0.002	0.58	27	0.011	0.000005	0.045	0.0075	0.37	33	0.033	3.9	0.000032	753	1.9	0.000032	0.0005	0.014	0.005	0.01	6.5	0.83	0.15	136,575
2045	8.5	1,399	790	24	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.0005	0.0028	0.0082	0.05	0.002	0.59	28	0.012	0.000005	0.047	0.0079	0.38	34	0.037	4.0	0.000034	783	1.9	0.000034	0.0005	0.015	0.005	0.01	7.9	1.	0.18	133,758
2046	8.5	1,457	802	25	0.029	0.0026	0.0016	0.0023	1.1	0.00005	12	0.0005	0.0032	0.0083	0.05	0.0023	0.62	29	0.014	0.000005	0.049	0.009	0.39	35	0.042	4.1	0.000035	811	2.0	0.000035	0.0005	0.016	0.005	0.01	9.4	1.2	0.21	128,763
2047	8.5	1,577	824	25	0.03	0.0028	0.0017	0.0022	1.1	0.00005	12	0.0005	0.0035	0.0084	0.05	0.0029	0.62	31	0.015	0.000005	0.053	0.011	0.4	35	0.043	4.1	0.000038	870	2.0	0.000038	0.0005	0.017	0.005	0.01	5.9	0.75	0.14	128,089
2048	8.5	1,714	862	24	0.03	0.003	0.0019	0.0022	1.1	0.00005	11	0.00051	0.004	0.0087	0.05	0.0034	0.61	34	0.017	0.000005	0.058	0.013	0.39	35	0.05	4.1	0.000041	939	2.0	0.000041	0.0005	0.018	0.005	0.01	5.6	0.71	0.13	129,793
2049	8.5	1,776	894	24	0.031	0.0031	0.0021	0.0021	1.1	0.00005	11	0.00053	0.0045	0.0089	0.05	0.0038	0.61	35	0.019	0.000005	0.06	0.014	0.39	35	0.056	4.0	0.000043	975	1.9	0.000043	0.0005	0.019	0.005	0.01	6.2	0.78	0.14	131,172
2050	8.5	1,804	902	24	0.031	0.0032	0.0022	0.0021	1.1	0.00005	11	0.00054	0.0047	0.009	0.05	0.0042	0.6	36	0.02	0.000005	0.061	0.015	0.38	34	0.058	4.0	0.000043	989	1.9	0.000043	0.0005	0.019	0.005	0.01	5.2	0.66	0.12	132,811
2051	8.5	1,817	904	24	0.032	0.0032	0.0022	0.0021	1.1	0.00005	11	0.00055	0.0048	0.009	0.05	0.0043	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.058	4.0	0.000044	995	1.9	0.000044	0.0005	0.019	0.005	0.01	4.0	0.51	0.093	133,964
2052	8.5	1,827	904	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0048	0.009	0.05	0.0045	0.59	36	0.02	0.000005	0.062	0.016	0.38	34	0.057	3.9	0.000044	1,000	1.9	0.000044	0.0005	0.02	0.005	0.01	2.6	0.33	0.059	135,076
2053	8.5	1,837	905	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0049	0.009	0.05	0.0046	0.59	36	0.02	0.000005	0.062	0.016	0.38	34	0.057	3.9	0.000044	1,004	1.9	0.000044	0.0005	0.02	0.005	0.01	1.4	0.18	0.032	135,145
2054	8.5	1,841	904	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.00055	0.0049	0.009	0.05	0.0047	0.59	36	0.02	0.000005	0.062	0.016	0.37	33	0.057	3.9	0.000044	1,006	1.9	0.000044	0.0005	0.02	0.005	0.01	1.0	0.13	0.024	135,795
2055	8.5	1,852	903	23	0.031	0.0033	0.0023	0.0021	1.1	0.00005	11	0.00056	0.005	0.009	0.05	0.0048	0.58	36	0.02	0.000005	0.062	0.017	0.37	33	0.058	3.9	0.000044	1,011	1.9	0.000045	0.0005	0.02	0.005	0.011	1.1	0.13	0.024	136,601
2056	8.6	1,808	1,102	23	0.039	0.0032	0.0023	0.0022	1.1	0.00005	7.4	0.00054	0.0048	0.01	0.05	0.0046	0.58	38	0.02	0.000005	0.061	0.016	0.37	33	0.057	3.8	0.000043	1,036	1.9	0.000043	0.0005	0.019	0.005	0.01	1.2	0.15	0.028	137,639
2057	8.7	1,730	1,422	23	0.052	0.0031	0.0022	0.0023	1.1	0.00005	4.6	0.00052	0.0044	0.013	0.05	0.0042	0.58	41	0.018	0.000005	0.058	0.015	0.37	33	0.052	3.8	0.000041	1,071	1.9	0.000042	0.0005	0.018	0.005	0.01	1.4	0.18	0.032	137,940
2058	8.7	1,684	1,604	23	0.059	0.003	0.0021	0.0024	1.1	0.00005	3.7	0.00051	0.0042	0.015	0.05	0.0039	0.58	42	0.017	0.000005	0.057	0.014	0.37	33	0.049	3.8	0.00004	1,088	1.8	0.00004	0.0005	0.018	0.005	0.01	1.6	0.2	0.037	138,218
2059	8.7	1,672	1,665	23	0.062	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.37	33	0.048	3.8	0.00004	1,095	1.8	0.00004	0.0005	0.018	0.005	0.01	1.9	0.24	0.043	138,460
2060	8.7	1,671	1,678	23	0.063	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.36	33	0.048	3.8	0.00004	1,097	1.8	0.00004	0.0005	0.018	0.005	0.01	2.2	0.27	0.05	139,518
2061	8.7	1,674	1,676	23	0.062	0.003	0.002	0.0024	1.0	0.00005	3.5	0.0005	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.014	0.36	33	0.049	3.8	0.00004	1,098	1.8	0.00004	0.0005	0.018	0.005	0.01	2.5	0.31	0.057	139,838
2062	8.8	1,663	1,745	23	0.071	0.0029	0.002	0.0025	1.0	0.00005	3.1	0.0005	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.013	0.36	32	0.049	3.8	0.00004	1,108	1.8	0.00004	0.0005	0.018	0.005	0.01	2.8	0.36	0.065	140,676
2063	8.8	1,642	1,818	22	0.078	0.0029	0.002	0.0025	1.0	0.00005	2.8	0.0005	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,114	1.8	0.000039	0.0005	0.018	0.005	0.01	3.2	0.41	0.074	141,568
2064	8.8	1,637	1,831	22	0.077	0.0029	0.002	0.0025	1.0	0.00005	2.8	0.0005	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.046	3.7	0.000039	1,114	1.8	0.000039	0.0005	0.017	0.005	0.01	3.6	0.46	0.083	142,789
2065	8.9	1,636	1,903	22	0.095	0.0029	0.0019	0.0026	1.0	0.00005	2.3	0.0005	0.004	0.014	0.05	0.0035	0.56	46	0.016	0.000005	0.055	0.013	0.35	32	0.046	3.7	0.000039	1,129	1.8	0.000039	0.0005	0.017	0.005	0.01	4.0	0.51	0.093	143,409
2066	8.9	1,609	1,989	22	0.11	0.0028	0.0019	0.0026	1.0	0.00005	2.1	0.0005	0.0039	0.014	0.05	0.0034	0.55	47	0.016	0.000005	0.054	0.012	0.35	31	0.045	3.7	0.000039	1,135	1.8	0.000039	0.0005	0.017	0.005	0.01	4.5	0.57	0.1	144,573
2067	8.9	1,589	2,048	22	0.11	0.0028	0.0019	0.0027	1.	0.00005	2.0	0.0005	0.0039	0.013	0.05	0.0033	0.55	47	0.016	0.000005	0.053	0.012	0.35	31	0.045	3.6	0.000038	1,138	1.8	0.000038	0.0005	0.017	0.005	0.01	4.9	0.62	0.11	145,722
2068	8.9	1,583	2,077	22	0.11	0.0028	0.0019	0.0027	0.99	0.00005	1.9	0.0005	0.0038	0.013	0.05	0.0033	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.045	3.6	0.000038	1,140	1.7	0.000038	0.0005	0.017	0.005	0.01	5.3	0.68	0.12	147,284
2069	8.9	1,580	2,097	21	0.11	0.0028	0.0019	0.0027	0.98	0.00005	1.9	0.0005	0.0038	0.013	0.05	0.0032	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.045	3.6	0.000038	1,142	1.7	0.000038	0.0005	0.017	0.005	0.01	5.7	0.72	0.13	148,241
2070	8.9	1,584	2,098	21	0.11	0.0028	0.0019	0.0027	0.97	0.00005	2.0	0.0005	0.0038	0.013	0.05	0.0032	0.53	48	0.016	0.000005	0.053	0.012	0.34	30	0.046	3.5	0.000038	1,144	1.7	0.000038	0.0005	0.017	0.005	0.01	5.8	0.74	0.13	149,328
2071	8.9	1,584	2,100	21	0.11	0.0028	0.0019	0.0027	0.96	0.00005	2.0	0.0005	0.0038	0.013	0.05	0.0032	0.53	49	0.016	0.000005	0.053	0.012	0.34	30	0.045	3.5	0.000038	1,144	1.7	0.000038	0.0005	0.017	0.005	0.01	5.5	0.7	0.13	150,505
2072	8.9	1,599	2,104	21	0.11	0.0028	0.0019	0.0027	0.96	0.00005	1.9	0.0005	0.0038	0.013	0.05	0.0033	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.046	3.5	0.000038	1,152	1.7	0.000038	0.0005	0.017	0.005	0.01	5.0	0.63	0.12	151,916
2073	8.9	1,607	2,100	21	0.11	0.0028	0.0019	0.0027	0.95	0.00005	2.0	0.0005	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.046	3.5	0.000038	1,154	1.7	0.000039	0.0005	0.017	0.005	0.01	4.6	0.58	0.11	152,292
2074	8.9	1,614	2,090	21	0.11	0.0028	0.0019	0.0026	0.95	0.00005	2.0	0.0005	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000039	1,155	1.7	0.000039	0.0005	0.017	0.005	0.01	4.5	0.57	0.1	153,237
2075	8.9	1,623	2,079	21	0.1	0.0029	0.0019	0.0026	0.94	0.00005	2.1	0.0005	0.004	0.014	0.05	0.0035	0.52	49	0.017	0.000005	0.055	0.013	0.33	30	0.048	3.4	0.000039	1,157	1.7	0.000039	0.0005	0.017	0.005	0.01	4.4	0.55	0.1	153,995
2076	8.9	1,649	2,089	20	0.11	0.0029	0.002	0.0026	0.94	0.00005	2.0	0.0005	0.0041	0.014	0.05	0.0036	0.51	50	0.017	0.000005	0.056	0.013	0.33	29	0.05	3.4	0.000039	1,171	1.6	0.00004	0.0005	0.018	0.005	0.01	4.5	0.57	0.1	155,005
2077	8.9	1,665	2,084	20	0.11	0.0029	0.002	0.0026	0.93	0.00005	2.0	0.0005	0.0043	0.014	0.05	0.0038	0.51	50	0.018	0.000005	0.056	0.014	0.33	29	0.052	3.4	0.00004	1,177	1.6	0.00004	0.0005	0.018	0.005	0.01	4.6	0.59	0.11	155,356
2078	8.9	1,680	2,077	20	0.11	0.003	0.0021	0.0026	0.93	0.00005	2.0	0.00051	0.0044	0.014	0.05	0.0039	0.51	50	0.018	0.000005	0.057	0.014	0.32	29	0.054	3.4	0.00004	1,182	1.6	0.00004	0.0005	0.018	0.005	0.01	4.9	0.62	0.11	156,236
2079	8.9	1,690	2,084	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.00051	0.0046	0.014	0.05	0.004	0.51	50	0.019	0.000005	0.057	0.015	0.32	29	0.055	3.4	0.00004	1,189	1.6	0.00004	0.0005	0.018	0.005	0.01	5.1	0.65	0.12	157,251
2080	8.9	1,698	2,096	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.00051	0.0047	0.014	0.05	0.0041	0.5	50	0.02	0.000005	0.057	0.015	0.32	29	0.057	3.3	0.000041	1,194	1.6	0.000041	0.0005	0.018	0.005	0.01	5.4	0.68	0.12	158,470
2081	8.9	1,710	2,094	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.00051	0.0048	0.014	0.05	0.0042	0.5	51	0.02	0.000005	0.058	0.015	0.32	29	0.059	3.3	0.000041	1,202	1.6	0.000041	0.0005	0.018	0.005	0.01	5.6	0.71	0.13	158,338
2082	9.0	1,705	2,131	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.00051	0.0049	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.016	0.32	28	0.06	3.3	0.000041	1,205	1.6	0.000041	0.0005	0.018	0.005	0.01	5.7	0.72	0.13	159,814
2083	9.0	1,694	2,170	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.00051	0.0049	0.014	0.05	0.0043	0.5	52	0.021	0.000005	0.057	0.016	0.32	28	0.06	3.3	0.000041	1,208	1.6	0.000041	0.0005	0.018	0.005	0.01	5.8	0.73	0.13	160,383
2084	9.0	1,698	2,185	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.8	0.00051	0.005	0.014	0.05	0.0044	0.49	52	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.3	0.000041	1,212	1.6	0.000041	0.0005	0.018	0.005	0.01	5.7	0.72	0.13	161,637
2085	9.0	1,691	2,205	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.8	0.00051	0.005	0.014	0.05	0.0044	0.49	52	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.3	0.00004	1,213	1.6	0.000041	0.0005	0.018	0.005	0.01	5.7	0.72	0.13	161,890
2086	9.0	1,695	2,213	20	0.12	0.003	0.0023	0.0026	0.89	0.00005	1.9	0.00051	0.0051	0.015	0.05	0.0045	0.49	53	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.3	0.000041	1,216	1.6	0.000041	0.0005	0.018	0.005	0.01	5.3	0.67	0.12	162,778
2087	8.9	1,689	2,225	19	0.12	0.003	0.0022	0.0026	0.89	0.00005	1.9	0.00051	0.005	0.014	0.05	0.0044	0.49	53	0.021	0.000005	0.057	0.016	0.31	28	0.061	3.2	0.00004	1,215	1.6	0.000041	0.0005	0.018	0.005	0.01	5.2	0.66	0.12	163,470
2088	9.0	1,701	2,239	19	0.12	0.003	0.0023	0.0026	0.88	0.00005	1.8	0.00051	0.005	0.015	0.05

Table A5. Source terms of the NAG backfill for the well graded cover system and no internal layer scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2135	9.2	1,577	3,187	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	77	0.02	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,338	1.4	0.000038	0.0005	0.017	0.005	0.01	2.7	0.34	0.062	186,569
2136	9.2	1,578	3,193	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	78	0.02	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,339	1.4	0.000038	0.0005	0.017	0.005	0.01	2.7	0.34	0.062	187,180
2137	9.2	1,581	3,204	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.0005	0.0048	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,342	1.4	0.000038	0.0005	0.017	0.005	0.01	2.6	0.33	0.061	186,716
2138	9.2	1,570	3,233	17	0.24	0.0028	0.0022	0.0032	0.78	0.00005	0.94	0.0005	0.0047	0.015	0.05	0.0044	0.43	79	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,342	1.4	0.000038	0.0005	0.017	0.005	0.01	2.6	0.33	0.061	186,790
2139	9.2	1,553	3,271	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.92	0.0005	0.0047	0.015	0.05	0.0043	0.43	79	0.019	0.000005	0.052	0.016	0.27	24	0.055	2.8	0.000037	1,342	1.4	0.000037	0.0005	0.017	0.005	0.01	2.6	0.33	0.06	187,056
2140	9.2	1,545	3,291	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.91	0.0005	0.0046	0.015	0.05	0.0043	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.055	2.8	0.000037	1,342	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.33	0.06	187,514
2141	9.2	1,532	3,320	17	0.25	0.0027	0.0022	0.0033	0.78	0.00005	0.9	0.0005	0.0046	0.015	0.05	0.0042	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.054	2.8	0.000037	1,341	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.33	0.06	186,895
2142	9.2	1,525	3,335	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.89	0.0005	0.0045	0.015	0.05	0.0042	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000036	1,341	1.4	0.000037	0.0005	0.016	0.005	0.01	2.6	0.33	0.061	186,886
2143	9.2	1,516	3,354	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.0005	0.0045	0.015	0.05	0.0041	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000036	1,340	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.061	187,034
2144	9.2	1,509	3,370	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.0005	0.0044	0.015	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.052	2.8	0.000036	1,339	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.061	187,551
2145	9.2	1,502	3,386	17	0.26	0.0026	0.0021	0.0033	0.78	0.00005	0.87	0.0005	0.0043	0.014	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.051	2.8	0.000036	1,338	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.061	187,019
2146	9.2	1,496	3,399	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.87	0.0005	0.0042	0.014	0.05	0.0039	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.05	2.8	0.000036	1,337	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.06	187,081
2147	9.2	1,490	3,412	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.0005	0.0042	0.014	0.05	0.0038	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.049	2.8	0.000036	1,337	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.06	187,212
2148	9.2	1,485	3,424	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.0005	0.0041	0.014	0.05	0.0037	0.42	84	0.017	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000035	1,336	1.4	0.000036	0.0005	0.016	0.005	0.01	2.6	0.33	0.059	187,667
2149	9.2	1,480	3,436	17	0.27	0.0026	0.002	0.0034	0.78	0.00005	0.85	0.0005	0.004	0.014	0.05	0.0037	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.047	2.8	0.000035	1,336	1.4	0.000036	0.0005	0.016	0.005	0.01	2.5	0.32	0.058	187,030
2150	9.2	1,476	3,445	17	0.27	0.0026	0.0019	0.0034	0.78	0.00005	0.85	0.0005	0.0039	0.014	0.05	0.0036	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000035	1,335	1.4	0.000036	0.0005	0.016	0.005	0.01	2.4	0.31	0.056	186,985

Table A6. Annual loads of the NAG backfill for the well graded cover system and no internal layer scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m³/year
2023	29	2.3	0.69	0.00029	0.000052	0.000029	0.000056	0.032	0.0000012	0.67	0.000024	0.00014	0.000097	0.0012	0.0000024	0.017	0.49	0.00081	0.00000012	0.00098	0.00018	0.011	0.99	0.0027	0.12	0.0000007	13	0.056	0.0000007	0.000007	0.00031	0.00012	0.00024	1.6	0.2	0.036	24
2024	53	4.1	1.3	0.00052	0.000094	0.000053	0.0001	0.057	0.0000022	1.2	0.000044	0.00025	0.00018	0.0022	0.0000044	0.031	0.89	0.0015	0.00000022	0.0018	0.00033	0.02	1.8	0.0048	0.21	0.0000013	23	0.1	0.0000013	0.000013	0.00057	0.00022	0.00044	2.9	0.36	0.066	44
2025	97	7.6	2.3	0.00096	0.00017	0.000097	0.00019	0.11	0.000004	2.2	0.00008	0.00046	0.00032	0.004	0.0000081	0.058	1.6	0.0027	0.0000004	0.0033	0.0006	0.037	3.3	0.0089	0.38	0.0000023	42	0.18	0.0000023	0.000023	0.001	0.0004	0.0008	5.3	0.67	0.12	80
2026	152	12	3.6	0.0015	0.00027	0.00015	0.00029	0.16	0.0000063	3.5	0.00013	0.00072	0.0005	0.0063	0.000013	0.09	2.5	0.0042	0.00000063	0.0051	0.00093	0.057	5.1	0.014	0.6	0.0000036	66	0.29	0.0000036	0.000036	0.0016	0.00063	0.0013	8.2	1.0	0.19	125
2027	191	15	4.5	0.0019	0.00034	0.00019	0.00037	0.21	0.0000079	4.4	0.00016	0.0009	0.00063	0.0079	0.000016	0.11	3.2	0.0053	0.00000079	0.0064	0.0012	0.072	6.5	0.017	0.75	0.0000046	83	0.36	0.0000046	0.000046	0.002	0.00079	0.0016	10	1.3	0.24	158
2028	349	27	8.2	0.0034	0.00062	0.00035	0.00067	0.38	0.000014	8.0	0.00029	0.0017	0.0012	0.014	0.000029	0.21	5.8	0.0097	0.0000014	0.012	0.0021	0.13	12	0.032	1.4	0.0000084	152	0.66	0.0000084	0.000084	0.0037	0.0014	0.0029	19	2.4	0.43	289
2029	326	25	7.7	0.0032	0.00057	0.00032	0.00063	0.35	0.000013	7.5	0.00027	0.0015	0.0011	0.013	0.000027	0.19	5.5	0.0091	0.0000013	0.011	0.002	0.12	11	0.03	1.3	0.0000078	142	0.62	0.0000078	0.000078	0.0035	0.0013	0.0027	18	2.2	0.41	270
2030	421	33	9.9	0.0041	0.00074	0.00042	0.00081	0.45	0.000017	9.7	0.00035	0.002	0.0014	0.017	0.000035	0.25	7.0	0.012	0.0000017	0.014	0.0026	0.16	14	0.038	1.7	0.00001	184	0.8	0.00001	0.0001	0.0045	0.0017	0.0035	23	2.9	0.52	348
2031	2,705	211	64	0.027	0.0048	0.0027	0.0052	2.9	0.00011	62	0.0022	0.013	0.0089	0.11	0.00022	1.6	45	0.075	0.000011	0.091	0.017	1.0	91	0.25	11	0.000065	1,181	5.1	0.000065	0.00065	0.029	0.011	0.022	146	19	3.4	2,236
2032	4,396	343	104	0.043	0.0078	0.0044	0.0084	4.7	0.00018	101	0.0036	0.021	0.015	0.18	0.00036	2.6	73	0.12	0.000018	0.15	0.027	1.7	149	0.4	17	0.00011	1,919	8.3	0.00011	0.0011	0.047	0.018	0.036	238	30	5.5	3,634
2033	750	58	18	0.0074	0.0013	0.00075	0.0014	0.81	0.0000031	17	0.00062	0.0035	0.0025	0.031	0.000062	0.44	13	0.021	0.0000031	0.025	0.0046	0.28	25	0.068	3.0	0.000018	327	1.4	0.000018	0.00018	0.008	0.0031	0.0062	41	5.1	0.93	620
2034	3,014	235	71	0.03	0.0053	0.003	0.0058	3.3	0.00012	69	0.0025	0.014	0.01	0.12	0.00025	1.8	50	0.084	0.00012	0.1	0.019	1.1	102	0.28	12	0.000072	1,316	5.7	0.000072	0.00072	0.032	0.012	0.025	163	21	3.8	2,492
2035	8,570	669	202	0.084	0.015	0.0085	0.016	9.3	0.00035	197	0.0071	0.041	0.028	0.35	0.00071	5.1	143	0.24	0.000035	0.29	0.053	3.2	290	0.78	34	0.00021	3,742	16	0.00021	0.0021	0.092	0.035	0.071	464	59	11	7,085
2036	14,615	1,141	345	0.14	0.026	0.015	0.028	16	0.0006	336	0.012	0.069	0.048	0.6	0.0012	8.7	244	0.41	0.00006	0.49	0.09	5.5	494	1.3	58	0.00035	6,382	28	0.00035	0.0035	0.16	0.06	0.12	791	100	18	12,083
2037	16,286	1,271	385	0.16	0.029	0.016	0.031	18	0.00067	374	0.013	0.077	0.054	0.67	0.0014	9.6	272	0.45	0.000067	0.55	0.1	6.2	551	1.5	64	0.00039	7,112	31	0.00039	0.0039	0.17	0.067	0.13	881	111	20	13,464
2038	32,601	2,544	770	0.32	0.057	0.032	0.063	35	0.0013	749	0.027	0.15	0.11	1.3	0.0027	19	545	0.91	0.00013	1.1	0.2	12	1,102	3.0	128	0.00078	14,236	62	0.00078	0.0078	0.35	0.13	0.27	1,764	223	41	26,952
2039	60,149	10,833	1,312	0.69	0.11	0.059	0.11	60	0.0023	1,436	0.046	0.27	0.18	2.3	0.014	33	1,044	1.6	0.00023	2.0	0.38	21	1,878	5.2	219	0.0014	27,549	105	0.0014	0.014	0.64	0.23	0.46	3,006	380	69	45,912
2040	119,581	38,041	2,261	1.4	0.21	0.12	0.17	103	0.004	2,436	0.079	0.52	0.32	4.0	0.07	57	2,201	2.9	0.0004	4.0	0.81	36	3,235	9.5	377	0.0028	58,833	182	0.0029	0.029	1.3	0.4	0.79	5,177	655	119	79,056
2041	188,787	84,647	3,173	3.0	0.33	0.18	0.24	145	0.0055	1,541	0.11	0.61	0.65	5.5	0.19	80	3,682	3.2	0.00055	6.4	1.2	51	4,542	10	529	0.004	100,813	255	0.0045	0.045	2.0	0.55	1.1	4,861	615	112	110,907
2042	181,599	102,301	3,172	3.8	0.32	0.19	0.31	145	0.0064	1,499	0.13	0.39	1.1	6.4	0.25	79	3,643	1.8	0.00064	6.1	1.0	51	4,539	5.3	529	0.0044	101,547	255	0.0044	0.044	1.9	0.64	1.3	1,485	188	34	128,839
2043	183,623	104,498	3,172	3.9	0.32	0.19	0.32	145	0.0067	1,583	0.13	0.35	1.1	6.7	0.27	79	3,687	1.5	0.00067	6.2	1.0	51	4,539	4.5	529	0.0044	102,842	255	0.0044	0.044	2.0	0.67	1.3	894	113	21	133,866
2044	184,376	103,656	3,171	3.9	0.33	0.2	0.33	145	0.0068	1,686	0.14	0.35	1.1	6.8	0.27	79	3,693	1.5	0.00068	6.2	1.0	51	4,539	4.6	529	0.0044	102,878	255	0.0044	0.044	2.0	0.68	1.4	893	113	21	136,575
2045	187,168	105,697	3,172	3.9	0.33	0.2	0.32	145	0.0067	1,564	0.13	0.37	1.1	6.7	0.27	79	3,760	1.6	0.00067	6.3	1.1	51	4,539	4.9	529	0.0045	104,694	255	0.0045	0.045	2.0	0.67	1.3	1,055	133	24	133,758
2046	187,633	103,314	3,172	3.8	0.33	0.2	0.3	145	0.0064	1,497	0.13	0.41	1.1	6.4	0.3	79	3,762	1.8	0.00064	6.3	1.2	51	4,540	5.4	529	0.0045	104,445	255	0.0045	0.045	2.0	0.64	1.3	1,204	152	28	128,763
2047	202,021	105,599	3,173	3.8	0.36	0.22	0.29	145	0.0064	1,480	0.13	0.44	1.1	6.4	0.37	80	4,014	1.9	0.00064	6.8	1.4	51	4,541	5.5	529	0.0048	111,397	255	0.0049	0.049	2.2	0.64	1.3	760	96	17	128,089
2048	222,427	111,893	3,173	4.0	0.39	0.25	0.28	145	0.0065	1,447	0.13	0.52	1.1	6.5	0.45	80	4,403	2.2	0.00065	7.5	1.6	51	4,542	6.5	529	0.0053	121,916	255	0.0054	0.053	2.4	0.65	1.3	733	93	17	129,793
2049	232,948	117,236	3,174	4.1	0.41	0.27	0.28	145	0.0066	1,398	0.13	0.59	1.2	6.6	0.5	80	4,619	2.5	0.00066	7.8	1.9	51	4,542	7.3	529	0.0056	127,828	255	0.0056	0.056	2.5	0.66	1.3	808	102	19	131,172
2050	239,538	119,755	3,174	4.2	0.42	0.29	0.28	145	0.0066	1,405	0.13	0.63	1.2	6.6	0.55	80	4,743	2.6	0.00066	8.1	2.0	51	4,543	7.7	529	0.0057	131,320	255	0.0058	0.058	2.6	0.66	1.3	693	88	16	132,811
2051	243,385	121,046	3,174	4.2	0.43	0.3	0.28	145	0.0067	1,417	0.13	0.65	1.2	6.7	0.58	80	4,810	2.7	0.00067	8.2	2.1	51	4,543	7.7	529	0.0058	133,315	255	0.0058	0.059	2.6	0.67	1.3	542	68	12	133,964
2052	246,811	122,148	3,174	4.3	0.44	0.3	0.28	145	0.0068	1,432	0.14	0.65	1.2	6.8	0.61	80	4,874	2.7	0.00068	8.3	2.2	51	4,543	7.7	529	0.0059	135,071	255	0.0059	0.059	2.6	0.68	1.4	348	44	8.0	135,076
2053	248,249	122,284	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,435	0.14	0.66	1.2	6.8	0.62	80	4,899	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.0059	135,740	255	0.006	0.06	2.7	0.68	1.4	190	24	4.4	135,145
2054	249,944	122,730	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,447	0.14	0.66	1.2	6.8	0.63	80	4,930	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.006	136,583	255	0.006	0.06	2.7	0.68	1.4	140	18	3.2	135,795
2055	252,972	123,320	3,174	4.3	0.45	0.32	0.29	145	0.0068	1,463	0.14	0.68	1.2	6.8	0.65	80	4,984	2.7	0.00068	8.5	2.3	51	4,543	8.0	529	0.0061	138,056	255	0.0061	0.061	2.7	0.68	1.5	145	18	3.3	136,601
2056	248,809	151,733	3,175	5.3	0.44	0.31	0.3	145	0.0069	1,018	0.14	0.67	1.4	6.9	0.63	80	5,234	2.7	0.00069	8.4	2.2	51	4,544	7.8	529	0.006	142,407	255	0.006	0.06	2.7	0.69	1.4	166	21	3.8	137,439
2057	238,664	196,137	3,175	7.1	0.42	0.3	0.32	145	0.0069	641	0.14	0.61	1.8	6.9	0.58	80	5,609	2.5	0.00069	8.0	2.1	51	4,544	7.2	530	0.0057	147,678	255	0.0057	0.057	2.5	0.69	1.4	192	24	4.4	137,940
2058	232,800	221,757	3,176	8.2	0.41	0.28	0.33	145	0.0069	518	0.14	0.58	2.0	6.9	0.54	80	5,859	2.3	0.00069	7.8	1.9	51	4,545	6.7	530	0.0056	150,409	255	0.0056	0.056	2.5	0.69	1.4	223	28	5.1	138,218
2059	231,450	230,578	3,176	8.6	0.41	0.28	0.34	145	0.0069	486	0.14	0.57	2.0	6.9	0.53	80	5,973	2.3	0.00069	7.8	1.9	51	4,545	6.6	530	0.0055	151,614	255	0.0056	0.056	2.5	0.69	1.4	259	33	5.9	138,460
2060	233,135	234,084	3,176	8.7	0.41	0.28	0.34	145	0.007	484	0.14	0.57	2.0	7.0	0.53	80	6,057	2.3	0.0007	7.8	1.9	51	4,545	6.7	530	0.0056	153,080	255	0.0056	0.056	2.5	0.7	1.4	301	38	6.9	139,518
2061	234,102	234,298	3,176	8.7	0.41	0.28	0.34	145	0.007	487	0.14	0.58	2.0	7.0	0.53	80	6,083	2.4	0.0007	7.9	1.9	51	4,545	6.9	530	0.0056	153,528	255	0.0056	0.056	2.5	0.7	1.4	348	44	8.0	139,838
2062	233,972	245,423	3,176	10.0	0.41	0.28	0.35	145	0.007	432	0.14	0.58	2.0	7.0	0.53	80	6,199	2.4	0.0007	7.9	1.9	51	4,546	6.9	530	0.0056	155,869	255	0.0056	0.056	2.5	0.7	1.4	400	51	9.2	140,676
2063	232,497	257,328	3,176	11	0.41	0.28	0.36	145	0.0071	394	0.14	0.57	2.0	7.1	0.51	80	6,343	2.3	0.00071	7.8	1.8	51	4,546	6.8	530	0.0056	157,664	255	0.0056	0.056	2.5	0.71	1.4	456	58	10	141,568
2064	233,675	261,461	3,176	11	0.41	0.28	0.36	145	0.0071	397	0.14	0.57	2.0	7.1	0.51	80	6,425	2.4	0.00071	7.9	1.8	51	4,546	6.6	530	0.0056	159,010	255	0.0056	0.056	2.5	0.71	1.4	517	65	12	142,789
2065	234,617	272,850	3,176	14	0.41	0.28	0.37	145	0.0072	336	0.14	0.57	2.0	7.2	0.5	80	6,577	2.4	0.00072	7.9	1.8	51	4,546	6.6	530	0.0056	161,866	255	0.0056	0.056	2.5	0.72	1.4	580	73	13	143,409
2066	232,662	287,614	3,176	16	0.41	0.28	0.38	145	0.0072	300	0.14	0.56	2.0	7.2	0.49	80	6,732	2.3	0.00072	7.8	1.8	51	4,546	6.6	530	0.0056	164,062	255	0.0056	0.056	2.5	0.72	1.4	647	82	15	144,573
2067	231,552	298,380	3,177	17	0.41	0.27	0.39	145	0.0073	285	0.15	0.56	2.0	7.3	0.49	80	6,866	2.3	0.00073	7.8	1.8	51	4,546	6.5	530	0.0055	165,759	255	0.0056	0.056	2.5	0.73	1.5	717	91	16	145,722
2068	233,135	305,923	3,177	17	0.41	0.28	0.39	145	0.0074	284	0.15	0.56	2.0	7.4	0.48	80	7,020	2.4	0.00074	7.8	1.7	51	4,546	6.6	530	0.0056	167,942	255	0.0056	0.056	2.5	0.74	1.5	788	100	18	147,284
2069	233,831	310,413	3,177	17	0.41	0.27	0.4	145	0.0074	285	0.15	0.56	2.0	7.4	0.48	80	7,125	2.4	0.00074	7.7	1.7	51	4,546	6.7	530	0.0056	169,122	255	0.0056	0.056	2.5	0.74	1.5	846	107	19	148,041
2070	236,506	313,306	3,177	16	0.42	0.28	0.4	145	0.0075	293	0.15	0.57	2.0	7.5	0.48	80	7,227	2.4	0.00075	8.0	1.8	51	4,547	6.8	530	0.0057	170,877	255	0.0057	0.057	2.5	0.75	1.5	872	110	20	149,328
2071	238,355	316,001	3,177	16	0.42	0.28	0.4	145	0.0075	301	0.15	0.57	2.0	7.5	0.49	80	7,318	2.4	0.00075	8.0	1.8	51	4,547	6.8	530	0.0057	172,193	255	0.0057	0.057	2.5	0.75	1.5	835	106	19	150,505
2072	242,928	319,691	3,177	17	0.43	0.28	0.41	145	0.0076	295	0.15	0.58	2.0	7.6	0.5	80	7,437	2.4	0.00076	8.2	1.8	51	4,547	7.0	530	0.0058	175,007	255	0.0058	0.058	2.6	0.76	1.5	760	96	17	151,916
2073	244,733	319,752	3,177	17	0.43	0.29	0.41	145	0.0076	301	0.15	0.59	2.1	7.6	0.51	80	7,478	2.5	0.00076	8.2	1.9	51	4,547	7.1	530	0.0059	175,806	255	0.0059	0.059	2.6	0.76	1.5	702	89	16	152,292
2074	247,278	320,249	3,177	16	0.44	0.29	0.41	145	0.0077	310	0.15	0.6	2.1	7.7	0.53	80	7,522	2.5	0.00077	8.3	1.9	51	4,547	7.2	530	0.0059	177,050	255	0.0059	0.059	2.6	0.77	1.5	688	87	16	153,237
2075	249,980	320,217	3,177	16	0.44	0.3	0.41	145	0.0077	319	0.15	0.62	2.1	7.7	0.54	80	7,568	2.6	0.00077	8.4	2.0	51	4,547	7.4	530	0.006	178,234	255	0.006	0.06	2.7	0.77	1.5	675	85	16	153,995
2076	255,619	323,744	3,177	18	0.45	0.31	0.41	145	0.0078	302	0.16	0.64	2.1	7.8	0.56	80	7,687	2.7	0.00078	8.6	2.0	51	4,547	7.7	530	0.0061	181,527	255	0.0062	0.061	2.7	0.78	1.6	698	88	16	155,005
2077	258,731	323,701	3,177	18	0.46	0.31	0.4	145	0.0078	306	0.16	0.66	2.2	7.8	0.58	80	7,735	2.8	0.00078	8.7	2.1	51	4,547	8.0	530	0.0062	182,917	255	0.0062	0.062	2.8	0.78	1.6	722	91	17	155,356
2078	262,398	324,502	3,177	17	0.46	0.32	0.4	145	0.0078	312	0.16	0.69	2.2	7.8	0.61	80	7,796	2.9	0.00078	8.8	2.2	51	4,547	8.4	530	0.0063	184,733	255	0.0063	0.063	2.8	0.78	1.6	763	96	18	156,236
2079	265,770	327,742	3,177	18	0.47	0.33	0.41	145	0.0079	312	0.16	0.72	2.2	7.9	0.63	80	7,886	3.0	0.00079	8.9	2.3	51	4,547	8.7	530	0.0064	186,924	255	0.0064	0.064	2.8	0.79	1.6	806	102	19	157,251
2080	269,002	332,121	3,177	18	0.47	0.34	0.41	145	0.0079	313	0.16	0.74	2.2	7.9	0.65	80	7,995	3.1	0.00079	9.1	2.4	51	4,547	9.0	530	0.0064	189,260	255	0.0065	0.065	2.9	0.79	1.6	850	108	20	158,470
2081	271,645	332,624	3,177	18	0.48	0.34	0.41	145	0.0079	318	0.16	0.77	2.3	7.9	0.67	80	8,050	3.2	0.00079	9.1	2.4	51	4,548	9.3	530	0.0065	190,543	255	0.0065	0.065	2.9	0.79	1.6	888	112	20	158,838
2082	272,418	340,563	3,177	19	0.48	0.35	0.41	145	0.008	307	0.16	0.78	2.3	8.0	0.68	80	8,165	3.3	0.0008	9.2	2.5	51	4,548	9.6	530	0.0065	192,527	255	0.0066	0.066	2.9	0.8	1.6	907	115	21	159,814
2083	271,705	348,063	3,178	19	0.48	0.35	0.42	145	0.008	297	0.16	0.79	2.3	8.0	0.69	80	8,265	3.3	0.0008	9.1	2.5	51	4,548	9.7	530	0.0065	193,727	255	0.0065	0.065	2.9	0.8	1.6	930	118	21	160,383
2084	274,395	353,193	3,178	19	0.48	0.36	0.42	145	0.0081	299	0.16	0.81	2.3	8.1	0.71	80	8,398	3.4	0.00081	9.2	2.6	51	4,548	9.9	530	0.0066	195,937	255	0.0066	0.066	2.9	0.81	1.6	915	116	21	161,637
2085	273,707	357,031	3,178	19	0.48	0.36	0.42	145	0.0081	297	0.16	0.81	2.3	8.1	0.71	80	8,471	3.4	0.00081	9.2	2.6	51	4,548	9.9	530	0.0066	196,356	255	0.0066	0.066	2.9	0.81	1.6	918	116	21	161,890
2086	275,893	360,180	3,178	19	0.49	0.37	0.43	145	0.0081	302	0.16	0.82	2.4	8.1	0.73	80	8,578	3.4	0.00081	9.3	2.6	51	4,548	10	530	0.0066	197,906	255	0.0066	0.066	2.9	0.81	1.7	864	109	20	162,778
2087	276,149	363,720	3,178	19	0.49	0.37	0.43	145	0.0082	304	0.16	0.82	2.4	8.2	0.72	80	8,669	3.4	0.00082	9.3	2.6	51	4,548	10.0	530	0.0066	198,681	255	0.0066	0.066	2.9	0.82	1.7	853	108	20	163,470
2088	279,900	368,389	3,178	20	0.49	0.37	0.43	145	0.0082	297	0.16	0.83	2.4	8.2	0.74	80	8,815	3.4	0.00082	9.4	2.7	51	4,548	10	530	0.0067	201,269	255	0.0067	0.067	3.0	0.82	1.7	779	98	18	164,570
2089	274,989	376,389	3,178	22	0.48	0.36	0.44	145	0.0082	273	0.16	0.78	2.4	8.2	0.7	80	8,863	3.2	0.00082	9.3	2.5	51	4,548	9.5	530	0.0066	200,693	255	0.0066	0.066	2.9	0.82	1.6	733	93	17	164,772
2090	275,131	383,442	3,178	23	0.49	0.36	0.44	145	0.0083	267	0.17	0.78	2.4	8.3	0.7	80	8,993	3.2	0.00083	9.3	2.5	51	4,548	9.4	530	0.0066	202,145	255	0.0066	0.066	2.9	0.83	1.7	692	87	16	165,462
2091	275,947	388,093	3,178	23	0.49	0.36	0.45	145	0.0083	267	0.17	0.78	2.4	8.3	0.7	80	9,115	3.2	0.00083	9.3	2.5	51	4,549	9.4	530	0.0066	203,383	255	0.0066	0.066	2.9	0.83	1.7	702	89	16	166,285
2092	278,346	393,814	3,178	23	0.49	0.36	0.45	145	0.0084	268	0.17	0.78	2.4	8.4	0.7	80	9,278	3.2	0.00084	9.4	2.5	51	4,549	9.4	530	0.0067	205,512	255	0.0067	0.067	3.0	0.84	1.7	695	88	16	167,587
2093	276,900	401,954	3,178	24	0.49	0.36	0.46	145	0.0084	259	0.17	0.78	2.4	8.4	0.69	80	9,401	3.2	0.00084	9.3	2.5	51	4,549	9.4	530

Table A6. Annual loads of the NAG backfill for the well graded cover system and no internal layer scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2135	294,182	594,578	3,182	43	0.52	0.42	0.59	145	0.0093	181	0.19	0.9	2.8	9.3	0.83	80	14,422	3.7	0.00093	9.9	3.0	51	4,554	11	531	0.007	249,536	256	0.0071	0.071	3.1	0.93	1.9	505	64	12	186,569
2136	295,407	597,572	3,182	43	0.52	0.42	0.59	145	0.0094	181	0.19	0.9	2.8	9.4	0.83	80	14,529	3.7	0.00094	9.9	3.0	51	4,554	11	531	0.0071	250,615	256	0.0071	0.071	3.2	0.94	1.9	502	63	12	187,180
2137	295,235	598,275	3,182	43	0.52	0.42	0.59	145	0.0093	180	0.19	0.89	2.8	9.3	0.83	80	14,606	3.6	0.00093	9.9	3.0	51	4,554	11	531	0.0071	250,535	256	0.0071	0.071	3.2	0.93	1.9	493	62	11	186,716
2138	293,260	603,891	3,182	45	0.52	0.41	0.59	145	0.0093	176	0.19	0.89	2.8	9.3	0.82	80	14,678	3.6	0.00093	9.9	2.9	51	4,554	10	531	0.007	250,747	256	0.007	0.071	3.1	0.93	1.9	492	62	11	186,790
2139	290,498	611,880	3,182	46	0.51	0.41	0.6	145	0.0094	172	0.19	0.88	2.8	9.4	0.81	80	14,802	3.6	0.00094	9.8	2.9	51	4,554	10	531	0.0069	251,030	256	0.007	0.07	3.1	0.94	1.9	491	62	11	187,056
2140	289,615	617,108	3,182	47	0.51	0.41	0.61	145	0.0094	171	0.19	0.87	2.8	9.4	0.8	80	14,924	3.5	0.00094	9.7	2.9	51	4,554	10	531	0.0069	251,587	256	0.007	0.07	3.1	0.94	1.9	492	62	11	187,514
2141	286,304	620,491	3,182	48	0.5	0.4	0.61	145	0.0093	167	0.19	0.86	2.8	9.3	0.79	80	14,988	3.5	0.00093	9.6	2.8	51	4,554	10	531	0.0068	250,645	256	0.0069	0.069	3.1	0.93	1.9	491	62	11	186,895
2142	285,021	623,285	3,182	48	0.5	0.4	0.61	145	0.0093	166	0.19	0.84	2.7	9.3	0.78	80	15,070	3.4	0.00093	9.6	2.8	51	4,554	10.0	531	0.0068	250,521	256	0.0068	0.069	3.0	0.93	1.9	492	62	11	186,886
2143	283,562	627,217	3,182	48	0.5	0.4	0.62	145	0.0094	165	0.19	0.84	2.7	9.4	0.77	80	15,161	3.4	0.00094	9.5	2.8	51	4,555	9.9	531	0.0068	250,550	256	0.0068	0.068	3.0	0.94	1.9	493	62	11	187,034
2144	283,033	631,952	3,182	49	0.5	0.39	0.62	145	0.0094	164	0.19	0.82	2.7	9.4	0.75	80	15,311	3.3	0.00094	9.5	2.7	51	4,555	9.7	531	0.0068	251,111	256	0.0068	0.068	3.0	0.94	1.9	494	63	11	187,551
2145	280,846	633,246	3,183	49	0.5	0.39	0.62	145	0.0094	163	0.19	0.81	2.7	9.4	0.74	80	15,352	3.3	0.00094	9.5	2.7	51	4,555	9.6	531	0.0067	250,287	256	0.0068	0.068	3.0	0.94	1.9	493	62	11	187,019
2146	279,836	635,870	3,182	49	0.49	0.38	0.63	145	0.0094	162	0.19	0.79	2.7	9.4	0.72	80	15,458	3.2	0.00094	9.4	2.6	51	4,555	9.3	531	0.0067	250,202	256	0.0067	0.067	3.0	0.94	1.9	492	62	11	187,081
2147	278,890	638,712	3,183	49	0.49	0.38	0.63	145	0.0094	161	0.19	0.78	2.7	9.4	0.72	80	15,545	3.2	0.00094	9.4	2.6	51	4,555	9.2	531	0.0067	250,228	256	0.0067	0.067	3.0	0.94	1.9	488	62	11	187,212
2148	278,629	642,514	3,183	50	0.49	0.37	0.64	145	0.0094	161	0.19	0.76	2.7	9.4	0.7	80	15,681	3.1	0.00094	9.4	2.5	51	4,555	9.0	531	0.0067	250,723	256	0.0067	0.067	3.0	0.94	1.9	485	61	11	187,667
2149	276,730	642,692	3,183	50	0.49	0.37	0.64	145	0.0094	160	0.19	0.75	2.7	9.4	0.69	80	15,708	3.0	0.00094	9.3	2.5	51	4,555	8.8	531	0.0066	249,797	256	0.0067	0.067	3.0	0.94	1.9	469	59	11	187,030
2150	275,915	644,238	3,183	50	0.49	0.36	0.64	145	0.0093	159	0.19	0.73	2.6	9.3	0.67	80	15,786	3.0	0.00093	9.3	2.4	51	4,555	8.6	531	0.0066	249,625	256	0.0066	0.066	2.9	0.93	1.9	458	58	11	186,985

Table A7. Source terms of the NAG backfill for the low nitrogen scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2023	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	24
2024	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	44
2025	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	80
2026	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	125
2027	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	158
2028	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	289
2029	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	270
2030	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	348
2031	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	2,236
2032	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	3,634
2033	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	620
2034	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	2,492
2035	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	7,085
2036	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	12,083
2037	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	13,464
2038	8.2	1,210	73	29	0.017	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	540	2.3	0.000029	0.00029	0.013	0.005	0.01	41	5.2	0.94	26,952
2039	8.3	1,301	139	29	0.021	0.0023	0.0013	0.0023	1.3	0.00005	31	0.001	0.0058	0.004	0.05	0.00032	0.72	23	0.034	0.000005	0.044	0.008	0.46	41	0.11	4.8	0.000031	606	2.3	0.000031	0.00031	0.014	0.005	0.01	40	5.0	0.91	45,912
2040	8.3	1,464	246	29	0.018	0.0026	0.0014	0.0022	1.3	0.00005	29	0.001	0.0057	0.004	0.05	0.00082	0.72	27	0.032	0.000005	0.049	0.009	0.46	41	0.1	4.8	0.000035	728	2.3	0.000035	0.00035	0.016	0.005	0.01	35	4.5	0.81	79,056
2041	8.4	1,507	382	29	0.028	0.0027	0.0015	0.0023	1.3	0.00005	13	0.001	0.0042	0.0081	0.05	0.0017	0.72	30	0.021	0.000005	0.051	0.0089	0.46	41	0.067	4.8	0.000036	823	2.3	0.000036	0.00036	0.016	0.005	0.01	18	2.3	0.42	110,907
2042	8.5	1,408	398	25	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.001	0.003	0.0082	0.05	0.002	0.62	28	0.014	0.000005	0.047	0.008	0.39	35	0.042	4.1	0.000034	788	2.0	0.000034	0.00034	0.015	0.005	0.01	7.3	0.93	0.17	128,839
2043	8.4	1,371	392	24	0.029	0.0024	0.0015	0.0024	1.1	0.00005	12	0.001	0.0026	0.0081	0.05	0.002	0.59	28	0.012	0.000005	0.046	0.0077	0.38	34	0.034	4.0	0.000033	769	1.9	0.000033	0.00033	0.015	0.005	0.01	4.3	0.55	0.099	133,866
2044	8.4	1,350	381	23	0.028	0.0024	0.0014	0.0024	1.1	0.00005	12	0.001	0.0026	0.008	0.05	0.002	0.58	27	0.011	0.000005	0.045	0.0075	0.37	33	0.033	3.9	0.000032	754	1.9	0.000032	0.00032	0.014	0.005	0.01	4.2	0.54	0.098	136,575
2045	8.5	1,399	396	24	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.001	0.0028	0.0082	0.05	0.002	0.59	28	0.012	0.000005	0.047	0.0079	0.38	34	0.037	4.0	0.000034	783	1.9	0.000034	0.00034	0.015	0.005	0.01	5.1	0.64	0.12	133,758
2046	8.5	1,450	402	25	0.03	0.0026	0.0016	0.0023	1.1	0.00005	12	0.001	0.003	0.0083	0.05	0.0023	0.62	29	0.013	0.000005	0.049	0.0089	0.39	35	0.04	4.1	0.000035	809	2.0	0.000035	0.00035	0.015	0.005	0.01	5.1	0.64	0.12	128,763
2047	8.5	1,577	414	25	0.03	0.0028	0.0017	0.0023	1.1	0.00005	11	0.001	0.0035	0.0084	0.05	0.0029	0.62	31	0.015	0.000005	0.053	0.011	0.4	35	0.043	4.1	0.000038	870	2.0	0.000038	0.00038	0.017	0.005	0.01	3.9	0.49	0.089	128,089
2048	8.5	1,714	432	24	0.031	0.003	0.0019	0.0022	1.1	0.00005	11	0.001	0.004	0.0087	0.05	0.0034	0.61	34	0.017	0.000005	0.058	0.013	0.39	35	0.05	4.1	0.000041	940	2.0	0.000041	0.00041	0.018	0.005	0.01	3.7	0.47	0.085	129,793
2049	8.5	1,775	447	24	0.031	0.0031	0.0021	0.0021	1.1	0.00005	11	0.001	0.0045	0.0089	0.05	0.0038	0.61	35	0.019	0.000005	0.06	0.014	0.39	35	0.056	4.0	0.000043	974	1.9	0.000043	0.00043	0.019	0.005	0.01	3.9	0.5	0.09	131,172
2050	8.5	1,803	451	24	0.032	0.0032	0.0022	0.0021	1.1	0.00005	11	0.001	0.0047	0.009	0.05	0.0042	0.6	36	0.02	0.000005	0.061	0.015	0.38	34	0.058	4.0	0.000043	989	1.9	0.000043	0.00043	0.019	0.005	0.01	3.4	0.43	0.079	132,811
2051	8.5	1,816	452	24	0.032	0.0032	0.0022	0.0021	1.1	0.00005	11	0.001	0.0048	0.009	0.05	0.0043	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.058	4.0	0.000044	995	1.9	0.000044	0.00044	0.019	0.005	0.01	2.7	0.34	0.062	133,964
2052	8.5	1,827	452	23	0.032	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0048	0.009	0.05	0.0045	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.057	3.9	0.000044	1,000	1.9	0.000044	0.00044	0.02	0.005	0.01	1.8	0.22	0.041	135,076
2053	8.5	1,837	453	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0049	0.009	0.05	0.0046	0.59	36	0.02	0.000005	0.062	0.016	0.38	34	0.057	3.9	0.000044	1,004	1.9	0.000044	0.00044	0.02	0.005	0.01	1.0	0.13	0.024	135,145
2054	8.5	1,841	452	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0049	0.009	0.05	0.0047	0.59	36	0.02	0.000005	0.062	0.016	0.37	33	0.057	3.9	0.000044	1,006	1.9	0.000044	0.00044	0.02	0.005	0.01	0.81	0.1	0.02	135,795
2055	8.5	1,852	452	23	0.031	0.0033	0.0023	0.0021	1.1	0.00005	11	0.001	0.005	0.009	0.05	0.0048	0.58	36	0.02	0.000005	0.062	0.017	0.37	33	0.058	3.9	0.000044	1,011	1.9	0.000045	0.00045	0.02	0.005	0.011	0.83	0.1	0.02	136,601
2056	8.6	1,808	551	23	0.039	0.0032	0.0023	0.0022	1.1	0.00005	7.4	0.001	0.0048	0.01	0.05	0.0046	0.58	38	0.02	0.000005	0.061	0.016	0.37	33	0.057	3.8	0.000043	1,036	1.9	0.000043	0.00043	0.019	0.005	0.01	0.92	0.12	0.021	137,639
2057	8.7	1,730	711	23	0.052	0.0031	0.0022	0.0023	1.1	0.00005	4.6	0.001	0.0044	0.013	0.05	0.0042	0.58	41	0.018	0.000005	0.058	0.015	0.37	33	0.052	3.8	0.000041	1,071	1.9	0.000042	0.00042	0.018	0.005	0.01	1.0	0.13	0.024	137,940
2058	8.7	1,684	803	23	0.059	0.003	0.0021	0.0024	1.1	0.00005	3.7	0.001	0.0042	0.015	0.05	0.0039	0.58	42	0.017	0.000005	0.057	0.014	0.37	33	0.049	3.8	0.00004	1,088	1.8	0.00004	0.00041	0.018	0.005	0.01	1.2	0.15	0.027	138,218
2059	8.7	1,672	833	23	0.063	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.37	33	0.048	3.8	0.00004	1,095	1.8	0.00004	0.0004	0.018	0.005	0.01	1.3	0.17	0.031	138,460
2060	8.7	1,671	840	23	0.063	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.36	33	0.048	3.8	0.00004	1,098	1.8	0.00004	0.0004	0.018	0.005	0.01	1.5	0.19	0.035	139,518
2061	8.7	1,674	839	23	0.063	0.003	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.014	0.36	33	0.049	3.8	0.00004	1,098	1.8	0.00004	0.0004	0.018	0.005	0.01	1.7	0.22	0.04	139,838
2062	8.8	1,663	873	23	0.073	0.0029	0.002	0.0025	1.0	0.00005	3.0	0.001	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.013	0.36	32	0.049	3.8	0.00004	1,108	1.8	0.00004	0.0004	0.018	0.005	0.01	1.9	0.25	0.045	140,676
2063	8.8	1,642	909	22	0.08	0.0029	0.002	0.0025	1.0	0.00005	2.7	0.001	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,114	1.8	0.000039	0.00039	0.018	0.005	0.01	2.2	0.28	0.05	141,568
2064	8.8	1,636	916	22	0.079	0.0029	0.002	0.0025	1.0	0.00005	2.7	0.001	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,114	1.8	0.000039	0.00039	0.017	0.005	0.01	2.4	0.31	0.056	142,789
2065	8.9	1,636	951	22	0.096	0.0029	0.0019	0.0026	1.0	0.00005	2.3	0.001	0.004	0.014	0.05	0.0035	0.56	46	0.016	0.000005	0.055	0.013	0.35	32	0.048	3.7	0.000039	1,129	1.8	0.000039	0.00039	0.017	0.005	0.01	2.7	0.34	0.062	143,409
2066	8.9	1,609	995	22	0.11	0.0028	0.0019	0.0026	1.0	0.00005	2.1	0.001	0.0039	0.014	0.05	0.0034	0.55	47	0.016	0.000005	0.054	0.012	0.35	31	0.048	3.7	0.000039	1,135	1.8	0.000039	0.00039	0.017	0.005	0.01	3.0	0.37	0.068	144,573
2067	8.9	1,588	1,024	22	0.12	0.0028	0.0019	0.0027	1.	0.00005	1.9	0.001	0.0039	0.013	0.05	0.0033	0.55	47	0.016	0.000005	0.053	0.012	0.35	31	0.047	3.6	0.000038	1,137	1.8	0.000038	0.00038	0.017	0.005	0.01	3.2	0.41	0.074	145,722
2068	9.0	1,582	1,039	22	0.12	0.0028	0.0019	0.0027	0.99	0.00005	1.9	0.001	0.0038	0.013	0.05	0.0033	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.047	3.6	0.000038	1,140	1.7	0.000038	0.00038	0.017	0.005	0.01	3.5	0.44	0.08	147,284
2069	8.9	1,579	1,049	21	0.12	0.0028	0.0019	0.0027	0.98	0.00005	1.9	0.001	0.0038	0.013	0.05	0.0032	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.047	3.6	0.000038	1,142	1.7	0.000038	0.00038	0.017	0.005	0.01	3.7	0.47	0.086	148,104
2070	8.9	1,583	1,050	21	0.11	0.0028	0.0019	0.0027	0.97	0.00005	1.9	0.001	0.0038	0.013	0.05	0.0032	0.53	48	0.016	0.000005	0.053	0.012	0.34	30	0.048	3.5	0.000038	1,144	1.7	0.000038	0.00038	0.017	0.005	0.01	3.8	0.48	0.088	149,328
2071	8.9	1,583	1,051	21	0.11	0.0028	0.0019	0.0027	0.96	0.00005	2.0	0.001	0.0038	0.013	0.05	0.0032	0.53	49	0.016	0.000005	0.053	0.012	0.34	30	0.047	3.5	0.000038	1,144	1.7	0.000038	0.00038	0.017	0.005	0.01	3.6	0.46	0.083	150,505
2072	8.9	1,599	1,053	21	0.11	0.0028	0.0019	0.0027	0.96	0.00005	1.9	0.001	0.0038	0.013	0.05	0.0033	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000038	1,152	1.7	0.000038	0.00038	0.017	0.005	0.01	3.3	0.42	0.076	151,916
2073	8.9	1,607	1,050	21	0.11	0.0028	0.0019	0.0027	0.95	0.00005	2.0	0.001	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000038	1,155	1.7	0.000039	0.00039	0.017	0.005	0.01	3.0	0.38	0.07	152,292
2074	8.9	1,613	1,046	21	0.11	0.0028	0.0019	0.0027	0.95	0.00005	2.0	0.001	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.013	0.33	30	0.048	3.5	0.000039	1,155	1.7	0.000039	0.00039	0.017	0.005	0.01	3.0	0.37	0.068	153,237
2075	8.9	1,623	1,040	21	0.11	0.0029	0.0019	0.0026	0.94	0.00005	2.0	0.001	0.004	0.014	0.05	0.0035	0.52	49	0.017	0.000005	0.055	0.013	0.33	30	0.049	3.4	0.000039	1,158	1.7	0.000039	0.00039	0.017	0.005	0.01	2.9	0.37	0.067	153,995
2076	8.9	1,649	1,044	20	0.11	0.0029	0.002	0.0026	0.94	0.00005	1.9	0.001	0.0041	0.014	0.05	0.0036	0.51	50	0.017	0.000005	0.055	0.013	0.33	29	0.05	3.4	0.000039	1,171	1.6	0.00004	0.0004	0.018	0.005	0.01	3.0	0.38	0.068	155,005
2077	8.9	1,665	1,042	20	0.11	0.0029	0.002	0.0026	0.93	0.00005	2.0	0.001	0.0043	0.014	0.05	0.0038	0.51	50	0.018	0.000005	0.056	0.014	0.33	29	0.052	3.4	0.00004	1,177	1.6	0.00004	0.0004	0.018	0.005	0.01	3.1	0.39	0.07	155,356
2078	8.9	1,678	1,039	20	0.11	0.003	0.0021	0.0026	0.93	0.00005	2.0	0.001	0.0044	0.014	0.05	0.0039	0.51	50	0.018	0.000005	0.056	0.014	0.32	29	0.054	3.4	0.00004	1,182	1.6	0.00004	0.0004	0.018	0.005	0.01	3.2	0.4	0.073	156,236
2079	8.9	1,688	1,042	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.001	0.0045	0.014	0.05	0.004	0.51	50	0.019	0.000005	0.057	0.015	0.32	29	0.055	3.4	0.00004	1,188	1.6	0.00004	0.00041	0.018	0.005	0.01	3.2	0.41	0.074	157,251
2080	8.9	1,694	1,048	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.001	0.0046	0.014	0.05	0.0041	0.5	50	0.019	0.000005	0.057	0.015	0.32	29	0.057	3.3	0.000041	1,193	1.6	0.00004	0.00041	0.018	0.005	0.01	3.2	0.41	0.074	158,470
2081	8.9	1,705	1,047	20	0.11	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.001	0.0045	0.014	0.05	0.0042	0.5	51	0.02	0.000005	0.057	0.015	0.32	29	0.058	3.3	0.000041	1,198	1.6	0.00004	0.00041	0.018	0.005	0.01	3.3	0.41	0.075	158,338
2082	9.0	1,698	1,066	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.001	0.0048	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.015	0.32	28	0.058	3.3	0.000041	1,202	1.6	0.00004	0.00041	0.018	0.005	0.01	3.2	0.4	0.073	159,814
2083	9.0	1,686	1,086	20	0.12	0.003	0.0022	0.0026	0.91	0.00005	1.8	0.001	0.0048	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.016	0.32	28	0.059	3.3	0.000041	1,205	1.6	0.000041	0.00041	0.018	0.005	0.01	3.2	0.41	0.074	160,383
2084	9.0	1,688	1,093	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.8	0.001	0.0049	0.014	0.05	0.0044	0.49	52	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.000041	1,208	1.6	0.000041	0.00041	0.018	0.005	0.01	3.2	0.4	0.072	161,637
2085	9.0	1,681	1,104	20	0.12	0.003	0.0022	0.0026	0.9	0.00005	1.8	0.001	0.0049	0.014	0.05	0.0044	0.49	52	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.00004	1,209	1.6	0.00004	0.0004	0.018	0.005	0.01	3.2	0.41	0.074	161,890
2086	9.0	1,685	1,107	20	0.12	0.003	0.0022	0.0026	0.89	0.00005	1.8	0.001	0.005	0.015	0.05	0.0044	0.49	53	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.000041	1,212	1.6	0.00004	0.00041	0.018	0.005	0.01	3.1	0.4	0.072	162,778
2087	9.0	1,679	1,114	19	0.12	0.003	0.0022	0.0026	0.89	0.00005	1.8	0.001	0.0049	0.015	0.05	0.0044	0.49	53	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.2	0.00004	1,211	1.6	0.00004	0.0004	0.018	0.005	0.01	3.1	0.4	0.072	163,470
2088	9.0	1,691	1,120	19	0.12	0.003	0.0023	0.0026	0.88	0.00005	1.8	0.001	0.0049	0.015	0.05	0.0044	0.48	53	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.2	0.000041	1,219	1.6

Table A7. Source terms of the NAG backfill for the low nitrogen scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2135	9.2	1,573	1,597	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.97	0.001	0.0048	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,337	1.4	0.000038	0.00038	0.017	0.005	0.01	1.8	0.23	0.042	186,569
2136	9.2	1,572	1,603	17	0.23	0.0028	0.0022	0.0032	0.78	0.00005	0.96	0.001	0.0047	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,338	1.4	0.000038	0.00038	0.017	0.005	0.01	1.8	0.23	0.041	187,180
2137	9.2	1,578	1,606	17	0.23	0.0028	0.0022	0.0031	0.78	0.00005	0.96	0.001	0.0048	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,341	1.4	0.000038	0.00038	0.017	0.005	0.01	1.8	0.23	0.041	186,716
2138	9.2	1,565	1,622	17	0.24	0.0028	0.0022	0.0032	0.78	0.00005	0.94	0.001	0.0047	0.015	0.05	0.0043	0.43	79	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,342	1.4	0.000038	0.00038	0.017	0.005	0.01	1.8	0.23	0.041	186,790
2139	9.2	1,549	1,640	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.92	0.001	0.0046	0.015	0.05	0.0043	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.055	2.8	0.000037	1,341	1.4	0.000037	0.00037	0.017	0.005	0.01	1.8	0.23	0.041	187,056
2140	9.2	1,541	1,650	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.91	0.001	0.0046	0.015	0.05	0.0042	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.054	2.8	0.000037	1,341	1.4	0.000037	0.00037	0.016	0.005	0.01	1.8	0.23	0.041	187,514
2141	9.2	1,529	1,664	17	0.26	0.0027	0.0022	0.0033	0.78	0.00005	0.89	0.001	0.0045	0.015	0.05	0.0042	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.054	2.8	0.000037	1,341	1.4	0.000037	0.00037	0.016	0.005	0.01	1.8	0.23	0.042	186,895
2142	9.2	1,523	1,670	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.89	0.001	0.0045	0.015	0.05	0.0041	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000036	1,340	1.4	0.000037	0.00037	0.016	0.005	0.01	1.8	0.23	0.042	186,886
2143	9.2	1,512	1,682	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.001	0.0044	0.015	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.052	2.8	0.000036	1,339	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.042	187,034
2144	9.2	1,507	1,687	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.87	0.001	0.0043	0.014	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.051	2.8	0.000036	1,338	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.042	187,551
2145	9.2	1,498	1,697	17	0.26	0.0026	0.0021	0.0034	0.78	0.00005	0.87	0.001	0.0042	0.014	0.05	0.0039	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.05	2.8	0.000036	1,338	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.042	187,019
2146	9.2	1,494	1,702	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.0042	0.014	0.05	0.0038	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.049	2.8	0.000036	1,337	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.042	187,081
2147	9.2	1,487	1,710	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.0041	0.014	0.05	0.0037	0.43	83	0.017	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000036	1,336	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.041	187,212
2148	9.2	1,483	1,714	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.004	0.014	0.05	0.0037	0.42	84	0.016	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000035	1,336	1.4	0.000036	0.00036	0.016	0.005	0.01	1.8	0.23	0.041	187,667
2149	9.2	1,477	1,721	17	0.27	0.0026	0.002	0.0034	0.78	0.00005	0.85	0.001	0.0039	0.014	0.05	0.0036	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000035	1,335	1.4	0.000036	0.00036	0.016	0.005	0.01	1.7	0.22	0.04	187,030
2150	9.2	1,474	1,724	17	0.27	0.0026	0.0019	0.0034	0.78	0.00005	0.85	0.001	0.0039	0.014	0.05	0.0035	0.43	85	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000035	1,335	1.4	0.000035	0.00035	0.016	0.005	0.01	1.7	0.21	0.039	186,985

Table A8. Annual loads of the NAG backfill for the low nitrogen scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2023	29	1.8	0.69	0.00041	0.000052	0.000029	0.000057	0.032	0.0000012	0.67	0.000024	0.00014	0.000097	0.0012	0.0000024	0.017	0.49	0.00081	0.00000012	0.00098	0.00018	0.011	0.99	0.0027	0.12	0.0000007	13	0.056	0.0000007	0.000007	0.00031	0.00012	0.00024	0.99	0.13	0.023	24
2024	53	3.2	1.3	0.00074	0.000094	0.000053	0.0001	0.057	0.0000022	1.2	0.000044	0.00025	0.00018	0.0022	0.0000044	0.031	0.89	0.0015	0.00000022	0.0018	0.00033	0.02	1.8	0.0048	0.21	0.0000013	24	0.1	0.0000013	0.000013	0.00057	0.00022	0.00044	1.8	0.23	0.041	44
2025	97	5.9	2.3	0.0014	0.00017	0.000097	0.00019	0.11	0.000004	2.2	0.00008	0.00046	0.00032	0.004	0.00000081	0.058	1.6	0.0027	0.000004	0.0033	0.0006	0.037	3.3	0.0089	0.38	0.0000023	43	0.18	0.0000023	0.000023	0.001	0.0004	0.0008	3.3	0.42	0.076	80
2026	152	9.1	3.6	0.0021	0.00027	0.00015	0.00029	0.16	0.0000063	3.5	0.00013	0.00072	0.0005	0.0063	0.000013	0.09	2.5	0.0042	0.00000063	0.0051	0.00093	0.057	5.1	0.014	0.6	0.0000036	68	0.29	0.0000036	0.000036	0.0016	0.00063	0.0013	5.1	0.65	0.12	125
2027	191	11	4.5	0.0027	0.00034	0.00019	0.00037	0.21	0.0000079	4.4	0.00016	0.0009	0.00063	0.0079	0.000016	0.11	3.2	0.0053	0.00000079	0.0064	0.0012	0.072	6.5	0.017	0.75	0.0000046	85	0.36	0.0000046	0.000046	0.002	0.00079	0.0016	6.5	0.82	0.15	158
2028	349	21	8.2	0.0048	0.00062	0.00035	0.00068	0.38	0.000014	8.0	0.00029	0.0017	0.0012	0.014	0.000029	0.21	5.8	0.0097	0.0000014	0.012	0.0021	0.13	12	0.032	1.4	0.0000084	156	0.66	0.0000084	0.000084	0.0037	0.0014	0.0029	12	1.5	0.27	289
2029	326	20	7.7	0.0045	0.00057	0.00032	0.00063	0.35	0.000013	7.5	0.00027	0.0015	0.0011	0.013	0.000027	0.19	5.5	0.0091	0.0000013	0.011	0.002	0.12	11	0.03	1.3	0.0000078	146	0.62	0.0000078	0.000078	0.0035	0.0013	0.0027	11	1.4	0.25	270
2030	421	25	9.9	0.0058	0.00074	0.00042	0.00081	0.45	0.000017	9.7	0.00035	0.002	0.0014	0.017	0.000035	0.25	7.0	0.012	0.0000017	0.014	0.0026	0.16	14	0.038	1.7	0.00001	188	0.8	0.00001	0.0001	0.0045	0.0017	0.0035	14	1.8	0.33	348
2031	2,705	163	64	0.038	0.0048	0.0027	0.0052	2.9	0.00011	62	0.0022	0.013	0.0089	0.11	0.00022	1.6	45	0.075	0.000011	0.091	0.017	1.0	91	0.25	11	0.000065	1,208	5.1	0.000065	0.00065	0.029	0.011	0.022	92	12	2.1	2,236
2032	4,396	264	104	0.061	0.0078	0.0044	0.0085	4.7	0.00018	101	0.0036	0.021	0.015	0.18	0.00036	2.6	73	0.12	0.000018	0.15	0.027	1.7	149	0.4	17	0.00011	1,962	8.3	0.00011	0.0011	0.047	0.018	0.036	149	19	3.4	3,634
2033	750	45	18	0.01	0.0013	0.00075	0.0015	0.81	0.0000031	17	0.00062	0.0035	0.0025	0.031	0.0000062	0.44	13	0.021	0.0000031	0.025	0.0046	0.28	25	0.068	3.0	0.000018	335	1.4	0.000018	0.00018	0.008	0.0031	0.0062	25	3.2	0.58	620
2034	3,015	181	71	0.042	0.0053	0.003	0.0058	3.3	0.00012	69	0.0025	0.014	0.01	0.12	0.00025	1.8	50	0.084	0.000012	0.1	0.019	1.1	102	0.28	12	0.000072	1,346	5.7	0.000072	0.00072	0.032	0.012	0.025	102	13	2.3	2,492
2035	8,570	516	202	0.12	0.015	0.0085	0.017	9.3	0.00035	197	0.0071	0.041	0.028	0.35	0.00071	5.1	143	0.24	0.000035	0.29	0.053	3.2	290	0.78	34	0.00021	3,825	16	0.00021	0.0021	0.092	0.035	0.071	290	37	6.7	7,085
2036	14,616	879	345	0.2	0.026	0.015	0.028	16	0.0006	336	0.012	0.069	0.048	0.6	0.0012	8.7	244	0.41	0.00006	0.49	0.09	5.5	494	1.3	58	0.00035	6,524	28	0.00035	0.0035	0.16	0.06	0.12	494	63	11	12,083
2037	16,287	980	385	0.23	0.029	0.016	0.032	18	0.00067	374	0.013	0.077	0.054	0.67	0.0014	9.6	272	0.45	0.000067	0.55	0.1	6.2	551	1.5	64	0.00039	7,270	31	0.00039	0.0039	0.17	0.067	0.13	551	70	13	13,464
2038	32,604	1,961	770	0.45	0.057	0.032	0.063	35	0.0013	749	0.027	0.15	0.11	1.3	0.0027	19	545	0.91	0.00013	1.1	0.2	12	1,102	3.0	128	0.00078	14,553	62	0.00078	0.0078	0.35	0.13	0.27	1,103	139	25	26,952
2039	59,745	6,372	1,312	0.94	0.11	0.058	0.11	60	0.0023	1,423	0.046	0.27	0.18	2.3	0.015	33	1,035	1.5	0.00023	2.0	0.37	21	1,878	5.0	219	0.0014	27,828	105	0.0014	0.014	0.64	0.23	0.46	1,824	231	42	45,912
2040	115,715	19,463	2,260	1.5	0.2	0.11	0.18	103	0.004	2,290	0.079	0.45	0.32	4.0	0.065	57	2,115	2.5	0.0004	3.9	0.71	36	3,235	8.2	377	0.0028	57,514	182	0.0028	0.028	1.2	0.4	0.79	2,790	353	64	79,056
2041	167,182	42,337	3,172	3.1	0.29	0.16	0.25	145	0.0055	1,440	0.11	0.46	0.9	5.5	0.18	79	3,299	2.4	0.00055	5.6	0.98	51	4,540	7.5	529	0.004	91,316	255	0.004	0.04	1.8	0.55	1.1	2,013	255	46	110,907
2042	181,431	51,233	3,172	3.8	0.32	0.19	0.31	145	0.0064	1,494	0.13	0.39	1.1	6.4	0.25	79	3,643	1.8	0.00064	6.1	1.0	51	4,539	5.4	529	0.0044	101,510	255	0.0044	0.044	1.9	0.64	1.3	946	120	22	128,839
2043	183,557	52,414	3,172	3.9	0.32	0.19	0.32	145	0.0067	1,574	0.13	0.35	1.1	6.7	0.27	79	3,688	1.5	0.00067	6.2	1.0	51	4,539	4.6	529	0.0044	102,890	255	0.0044	0.044	2.0	0.67	1.3	579	73	13	133,866
2044	184,376	52,092	3,171	3.9	0.33	0.2	0.33	145	0.0068	1,671	0.14	0.35	1.1	6.8	0.27	79	3,693	1.5	0.00068	6.2	1.0	51	4,539	4.6	529	0.0044	103,017	255	0.0044	0.044	2.0	0.68	1.4	579	73	13	136,575
2045	187,155	52,976	3,172	3.9	0.33	0.2	0.32	145	0.0067	1,557	0.13	0.37	1.1	6.7	0.27	79	3,757	1.6	0.00067	6.3	1.1	51	4,539	4.9	529	0.0045	104,762	255	0.0045	0.045	2.0	0.67	1.3	679	86	16	133,758
2046	186,745	51,799	3,172	3.8	0.33	0.2	0.3	145	0.0064	1,486	0.13	0.39	1.1	6.4	0.3	79	3,742	1.7	0.00064	6.3	1.1	51	4,540	5.1	529	0.0045	104,136	255	0.0045	0.045	2.0	0.64	1.3	655	83	15	128,763
2047	201,983	52,985	3,173	3.8	0.36	0.22	0.29	145	0.0064	1,470	0.13	0.44	1.1	6.4	0.37	80	4,015	1.9	0.00064	6.8	1.4	51	4,541	5.6	529	0.0048	111,476	255	0.0049	0.049	2.2	0.64	1.3	495	63	11	128,089
2048	222,414	56,058	3,173	4.0	0.39	0.25	0.28	145	0.0065	1,442	0.13	0.52	1.1	6.5	0.45	80	4,401	2.2	0.00065	7.5	1.6	51	4,542	6.5	529	0.0053	121,971	255	0.0054	0.053	2.4	0.65	1.3	479	61	11	129,793
2049	232,882	58,638	3,174	4.1	0.41	0.27	0.28	145	0.0066	1,397	0.13	0.59	1.2	6.6	0.5	80	4,615	2.5	0.00066	7.8	1.9	51	4,542	7.3	529	0.0056	127,814	255	0.0056	0.056	2.5	0.66	1.3	516	65	12	131,172
2050	239,485	59,886	3,174	4.2	0.42	0.29	0.28	145	0.0066	1,404	0.13	0.63	1.2	6.6	0.55	80	4,741	2.6	0.00066	8.1	2.0	51	4,543	7.7	529	0.0057	131,300	255	0.0058	0.058	2.6	0.66	1.3	454	57	10	132,811
2051	243,278	60,526	3,174	4.2	0.43	0.3	0.28	145	0.0067	1,417	0.13	0.65	1.2	6.7	0.58	80	4,811	2.7	0.00067	8.2	2.1	51	4,543	7.8	529	0.0058	133,263	255	0.0058	0.059	2.6	0.67	1.3	360	46	8.3	133,964
2052	246,757	61,084	3,174	4.3	0.44	0.3	0.28	145	0.0068	1,431	0.14	0.65	1.2	6.8	0.61	80	4,875	2.7	0.00068	8.3	2.2	51	4,543	7.7	529	0.0059	135,046	255	0.0059	0.059	2.6	0.68	1.4	239	30	5.5	135,076
2053	248,235	61,157	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,435	0.14	0.66	1.2	6.8	0.62	80	4,900	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.0059	135,740	255	0.006	0.06	2.7	0.68	1.4	141	18	3.2	135,145
2054	249,944	61,387	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,446	0.14	0.66	1.2	6.8	0.63	80	4,930	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.006	136,596	255	0.006	0.06	2.7	0.68	1.4	111	14	2.7	135,795
2055	252,972	61,688	3,174	4.3	0.45	0.32	0.29	145	0.0068	1,462	0.14	0.68	1.2	6.8	0.65	80	4,984	2.7	0.00068	8.5	2.3	51	4,543	8.0	529	0.0061	138,049	255	0.0061	0.061	2.7	0.68	1.5	113	14	2.7	136,601
2056	248,809	75,905	3,175	5.4	0.44	0.31	0.3	145	0.0069	1,017	0.14	0.67	1.4	6.9	0.63	80	5,234	2.7	0.00069	8.4	2.2	51	4,544	7.8	529	0.006	142,435	255	0.006	0.06	2.7	0.69	1.4	127	16	2.9	137,439
2057	238,664	98,121	3,176	7.1	0.42	0.3	0.32	145	0.0069	641	0.14	0.61	1.8	6.9	0.58	80	5,609	2.5	0.00069	8.0	2.1	51	4,544	7.2	530	0.0057	147,692	255	0.0057	0.057	2.5	0.69	1.4	143	18	3.3	137,940
2058	232,800	110,938	3,176	8.2	0.41	0.28	0.33	145	0.0069	518	0.14	0.58	2.0	6.9	0.54	80	5,859	2.3	0.00069	7.8	1.9	51	4,545	6.7	530	0.0056	150,436	255	0.0056	0.056	2.5	0.69	1.4	162	21	3.7	138,218
2059	231,450	115,350	3,176	8.7	0.41	0.28	0.34	145	0.0069	480	0.14	0.57	2.0	6.9	0.53	80	5,973	2.3	0.00069	7.8	1.9	51	4,545	6.6	530	0.0055	151,656	255	0.0056	0.056	2.5	0.69	1.4	185	23	4.2	138,460
2060	233,135	117,134	3,176	8.8	0.41	0.28	0.34	145	0.007	483	0.14	0.57	2.0	7.0	0.53	80	6,057	2.3	0.0007	7.8	1.9	51	4,545	6.7	530	0.0056	153,122	255	0.0056	0.056	2.5	0.7	1.4	212	27	4.9	139,518
2061	234,102	117,262	3,176	8.7	0.41	0.28	0.34	145	0.007	486	0.14	0.58	2.0	7.0	0.53	80	6,083	2.4	0.0007	7.9	1.9	51	4,545	6.9	530	0.0056	153,584	255	0.0056	0.056	2.5	0.7	1.4	240	30	5.5	139,838
2062	233,972	122,782	3,176	10	0.41	0.28	0.35	145	0.007	425	0.14	0.58	2.0	7.0	0.53	80	6,199	2.4	0.0007	7.9	1.9	51	4,546	6.9	530	0.0056	155,911	255	0.0056	0.056	2.5	0.7	1.4	273	35	6.3	140,676
2063	232,497	128,745	3,176	11	0.41	0.28	0.36	145	0.0071	387	0.14	0.57	2.0	7.1	0.51	80	6,343	2.3	0.00071	7.8	1.8	51	4,546	6.8	530	0.0056	157,707	255	0.0056	0.056	2.5	0.71	1.4	308	39	7.1	141,568
2064	233,632	130,824	3,176	11	0.41	0.28	0.36	145	0.0071	389	0.14	0.57	2.0	7.1	0.51	80	6,425	2.4	0.00071	7.9	1.8	51	4,546	6.9	530	0.0056	159,053	255	0.0056	0.056	2.5	0.71	1.4	346	44	8.0	142,789
2065	234,574	136,451	3,176	14	0.41	0.28	0.37	145	0.0072	335	0.14	0.57	2.0	7.2	0.5	80	6,576	2.4	0.00072	7.9	1.8	51	4,546	6.9	530	0.0056	161,851	255	0.0056	0.056	2.5	0.72	1.4	385	49	8.9	143,409
2066	232,619	143,839	3,176	16	0.41	0.28	0.38	145	0.0072	299	0.14	0.56	2.0	7.2	0.49	80	6,730	2.3	0.00072	7.8	1.8	51	4,546	6.9	530	0.0056	164,047	255	0.0056	0.056	2.5	0.72	1.4	427	54	9.8	144,573
2067	231,421	149,219	3,177	17	0.41	0.27	0.39	145	0.0073	283	0.15	0.56	2.0	7.3	0.49	80	6,867	2.3	0.00073	7.8	1.8	51	4,546	6.9	530	0.0055	165,715	255	0.0056	0.056	2.5	0.73	1.5	471	60	11	145,722
2068	232,988	153,013	3,177	17	0.41	0.28	0.4	145	0.0074	281	0.15	0.56	2.0	7.4	0.48	80	7,020	2.4	0.00074	7.8	1.8	51	4,546	7.0	530	0.0056	167,918	255	0.0056	0.056	2.5	0.74	1.5	516	65	12	147,284
2069	233,683	155,281	3,177	17	0.42	0.28	0.4	145	0.0074	282	0.15	0.56	2.0	7.4	0.48	80	7,126	2.4	0.00074	7.9	1.8	51	4,546	7.0	530	0.0056	169,093	255	0.0056	0.056	2.5	0.74	1.5	552	70	13	148,041
2070	236,372	156,735	3,177	17	0.42	0.28	0.4	145	0.0075	289	0.15	0.57	2.0	7.5	0.48	80	7,228	2.4	0.00075	8.0	1.8	51	4,547	7.1	530	0.0057	170,847	255	0.0057	0.057	2.5	0.75	1.5	569	72	13	149,328
2071	238,235	158,106	3,177	16	0.42	0.28	0.4	145	0.0075	296	0.15	0.57	2.0	7.5	0.49	80	7,319	2.4	0.00075	8.0	1.8	51	4,547	7.1	530	0.0057	172,193	255	0.0057	0.057	2.5	0.75	1.5	545	69	13	150,505
2072	242,837	159,906	3,177	17	0.43	0.29	0.41	145	0.0076	292	0.15	0.58	2.0	7.6	0.5	80	7,437	2.4	0.00076	8.2	1.8	51	4,547	7.1	530	0.0058	174,992	255	0.0058	0.058	2.6	0.76	1.5	499	63	11	151,916
2073	244,688	159,952	3,177	17	0.43	0.29	0.41	145	0.0076	297	0.15	0.59	2.1	7.6	0.51	80	7,477	2.5	0.00076	8.2	1.9	51	4,547	7.2	530	0.0059	175,821	255	0.0059	0.059	2.6	0.76	1.5	463	59	11	152,292
2074	247,186	160,209	3,177	17	0.44	0.29	0.41	145	0.0077	305	0.15	0.6	2.1	7.7	0.53	80	7,523	2.5	0.00077	8.3	1.9	51	4,547	7.3	530	0.0059	177,034	255	0.0059	0.059	2.6	0.77	1.5	454	57	10	153,237
2075	249,903	160,201	3,177	16	0.44	0.3	0.41	145	0.0077	314	0.15	0.62	2.1	7.7	0.54	80	7,568	2.6	0.00077	8.4	2.0	51	4,547	7.5	530	0.006	178,249	255	0.006	0.06	2.7	0.77	1.5	447	56	10	153,995
2076	255,542	161,888	3,177	18	0.45	0.31	0.41	145	0.0078	302	0.16	0.64	2.1	7.8	0.56	80	7,686	2.7	0.00078	8.6	2.0	51	4,547	7.8	530	0.0061	181,511	255	0.0062	0.061	2.7	0.78	1.6	461	58	11	155,005
2077	258,668	161,866	3,177	18	0.46	0.32	0.4	145	0.0078	305	0.16	0.66	2.2	7.8	0.58	80	7,734	2.8	0.00078	8.7	2.1	51	4,547	8.1	530	0.0062	182,886	255	0.0062	0.062	2.8	0.78	1.6	476	60	11	155,356
2078	262,211	162,267	3,177	18	0.46	0.32	0.4	145	0.0078	311	0.16	0.69	2.2	7.8	0.61	80	7,796	2.9	0.00078	8.8	2.2	51	4,547	8.4	530	0.0063	184,639	255	0.0063	0.063	2.8	0.78	1.6	496	63	11	156,236
2079	265,455	163,902	3,177	18	0.47	0.33	0.41	145	0.0079	311	0.16	0.71	2.2	7.9	0.63	80	7,884	3.0	0.00079	8.9	2.3	51	4,547	8.7	530	0.0064	186,782	255	0.0064	0.064	2.8	0.79	1.6	509	64	12	157,251
2080	268,416	166,108	3,177	18	0.47	0.34	0.41	145	0.0079	311	0.16	0.74	2.3	7.9	0.65	80	7,990	3.1	0.00079	9.0	2.4	51	4,547	9.0	530	0.0064	189,023	255	0.0064	0.065	2.9	0.79	1.6	510	64	12	158,470
2081	270,883	166,367	3,177	18	0.48	0.35	0.41	145	0.0079	316	0.16	0.76	2.3	7.9	0.67	80	8,041	3.1	0.00079	9.1	2.4	51	4,548	9.2	530	0.0065	190,209	255	0.0065	0.065	2.9	0.79	1.6	518	65	12	158,838
2082	271,299	170,361	3,177	19	0.48	0.35	0.41	145	0.008	304	0.16	0.77	2.3	8.0	0.68	80	8,150	3.2	0.0008	9.1	2.5	51	4,548	9.3	530	0.0065	192,048	255	0.0065	0.065	2.9	0.8	1.6	505	64	12	159,814
2083	270,406	174,128	3,178	20	0.48	0.35	0.42	145	0.008	294	0.16	0.78	2.3	8.0	0.69	80	8,248	3.2	0.0008	9.1	2.5	51	4,548	9.4	530	0.0065	193,181	255	0.0065	0.065	2.9	0.8	1.6	514	65	12	160,383
2084	272,860	176,718	3,178	20	0.48	0.36	0.42	145	0.0081	295	0.16	0.79	2.3	8.1	0.7	80	8,376	3.3	0.00081	9.2	2.6	51	4,548	9.6	530	0.0066	195,290	255	0.0066	0.066	2.9	0.81	1.6	510	64	12	161,637
2085	272,104	178,645	3,178	20	0.48	0.36	0.43	145	0.0081	293	0.16	0.79	2.3	8.1	0.7	80	8,448	3.3	0.00081	9.2	2.6	51	4,548	9.7	530	0.0066	195,692	255	0.0065	0.065	2.9	0.81	1.6	520	66	12	161,890
2086	274,233	180,244	3,178	20	0.48	0.37	0.43	145	0.0081	296	0.16	0.81	2.4	8.1	0.72	80	8,554	3.3	0.00081	9.2	2.6	51	4,548	9.8	530	0.0066	197,239	255	0.0066	0.066	2.9	0.81	1.6	510	64	12	162,778
2087	274,498	182,023	3,178	19	0.48	0.37	0.43	145	0.0082	298	0.16	0.8	2.4	8.2	0.72	80	8,645	3.3	0.00082	9.2	2.6	51	4,548	9.8	530	0.0066	198,011	255	0.0066	0.066	2.9	0.82	1.6	514	65	12	163,470
2088	278,287	184,335	3,178	20	0.49	0.37	0.43	145	0.0082	293	0.16	0.81	2.4	8.2	0.73	80	8,791	3.4	0.00082	9.4	2.6	51	4,548	9.9	530	0.0067	200,610	255	0.0067	0.067	3.0	0.82	1.7	488	62	11	164,570
2089	278,103	188,088	3,178	22	0.49	0.37	0.44	145	0.0082	274	0.16	0.81	2.4	8.2	0.72	80	8,913	3.3	0.00082	9.4	2.6	51	4,548	9.8	530	0.0066	202,044	255	0.0067	0.067	3.0	0.82	1.7	486	61	11	164,772
2090	277,811	191,638	3,178	23	0.49	0.37	0.44	145	0.0083	268	0.17	0.81	2.4	8.3	0.73	80	9,038	3.3	0.00083	9.4	2.6	51	4,549	9.7	530	0.0066	203,304	255	0.0067	0.067	3.0	0.83	1.7	459	58	11	165,462
2091	278,428	193,988	3,178	23	0.49	0.37	0.45	145	0.0083	267	0.17	0.81	2.4	8.3	0.72	80	9,159	3.3	0.00083	9.4	2.6	51	4,549	9.7	530	0.0066	204,448	255	0.0067	0.067	3.0	0.83	1.7	466	59	11	166,285
2092	280,491	196,915	3,178	23	0.49	0.37	0.45	145	0.0084	268	0.17	0.81	2.4	8.4	0.73	80	9,318	3.3	0.00084	9.4	2.6	51	4,549	9.8	530	0.0067	206,468	255	0.0068	0.067	3.0	0.84	1.7	462	58	11	167,587
2093	278,918	201,019	3,178	24	0.49	0.37	0.46	145	0.0084	258	0.17	0.8	2.4	8.4	0.72	80	9,439	3.3	0.00084	9.4	2.6	51	4,549	9.7

Table A8. Annual loads of the NAG backfill for the low nitrogen scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2135	293,473	298,007	3,182	43	0.52	0.42	0.59	145	0.0093	180	0.19	0.89	2.8	9.3	0.82	80	14,473	3.6	0.00093	9.9	2.9	51	4,554	11	531	0.007	249,424	256	0.0071	0.071	3.1	0.93	1.9	341	43	7.8	186,569
2136	294,228	300,087	3,182	44	0.52	0.42	0.59	145	0.0094	180	0.19	0.88	2.8	9.4	0.82	80	14,624	3.6	0.00094	9.9	2.9	51	4,554	10	531	0.0071	250,465	256	0.0071	0.071	3.1	0.94	1.9	338	43	7.8	187,180
2137	294,638	299,791	3,182	43	0.52	0.42	0.59	145	0.0093	180	0.19	0.89	2.8	9.3	0.82	80	14,657	3.6	0.00093	9.9	2.9	51	4,554	11	531	0.0071	250,461	256	0.0071	0.071	3.1	0.93	1.9	337	43	7.7	186,716
2138	292,401	302,917	3,182	45	0.52	0.41	0.59	145	0.0093	175	0.19	0.88	2.8	9.3	0.81	80	14,754	3.6	0.00093	9.8	2.9	51	4,554	10	531	0.007	250,635	256	0.007	0.07	3.1	0.93	1.9	337	43	7.7	186,790
2139	289,806	306,735	3,182	46	0.51	0.41	0.6	145	0.0094	171	0.19	0.87	2.8	9.4	0.8	80	14,872	3.5	0.00094	9.8	2.9	51	4,554	10	531	0.0069	250,917	256	0.007	0.07	3.1	0.94	1.9	337	43	7.7	187,056
2140	288,865	309,435	3,182	47	0.51	0.41	0.61	145	0.0094	170	0.19	0.86	2.8	9.4	0.79	80	15,001	3.5	0.00094	9.7	2.8	51	4,554	10	531	0.0069	251,475	256	0.0069	0.069	3.1	0.94	1.9	338	43	7.8	187,514
2141	285,669	310,955	3,182	48	0.5	0.4	0.61	145	0.0093	167	0.19	0.84	2.7	9.3	0.78	80	15,058	3.4	0.00093	9.6	2.8	51	4,554	10	531	0.0068	250,532	256	0.0069	0.069	3.0	0.93	1.9	338	43	7.8	186,895
2142	284,553	312,156	3,182	48	0.5	0.4	0.61	145	0.0093	166	0.19	0.84	2.7	9.3	0.77	80	15,121	3.4	0.00093	9.6	2.8	51	4,555	10	531	0.0068	250,428	256	0.0068	0.068	3.0	0.93	1.9	338	43	7.8	186,886
2143	282,757	314,534	3,182	48	0.5	0.39	0.62	145	0.0094	164	0.19	0.82	2.7	9.4	0.75	80	15,255	3.3	0.00094	9.5	2.7	51	4,555	10	531	0.0068	250,419	256	0.0068	0.068	3.0	0.94	1.9	339	43	7.8	187,034
2144	282,620	316,435	3,182	49	0.5	0.39	0.62	145	0.0094	164	0.19	0.81	2.7	9.4	0.75	80	15,360	3.3	0.00094	9.5	2.7	51	4,555	10	531	0.0068	251,018	256	0.0068	0.068	3.0	0.94	1.9	340	43	7.8	187,551
2145	280,136	317,427	3,183	49	0.49	0.38	0.63	145	0.0094	162	0.19	0.79	2.7	9.4	0.72	80	15,442	3.2	0.00094	9.4	2.6	51	4,555	9.4	531	0.0067	250,138	256	0.0067	0.067	3.0	0.94	1.9	339	43	7.8	187,019
2146	279,462	318,319	3,183	49	0.49	0.38	0.63	145	0.0094	162	0.19	0.78	2.7	9.4	0.72	80	15,504	3.2	0.00094	9.4	2.6	51	4,555	9.2	531	0.0067	250,109	256	0.0067	0.067	3.0	0.94	1.9	338	43	7.8	187,081
2147	278,291	320,039	3,183	49	0.49	0.38	0.63	145	0.0094	161	0.19	0.76	2.7	9.4	0.7	80	15,627	3.1	0.00094	9.4	2.5	51	4,555	9.0	531	0.0067	250,097	256	0.0067	0.067	3.0	0.94	1.9	336	42	7.7	187,212
2148	278,328	321,567	3,183	50	0.49	0.37	0.64	145	0.0094	161	0.19	0.75	2.7	9.4	0.69	80	15,722	3.1	0.00094	9.4	2.5	51	4,555	8.9	531	0.0067	250,648	256	0.0067	0.067	3.0	0.94	1.9	334	42	7.7	187,667
2149	276,244	321,860	3,183	50	0.49	0.37	0.64	145	0.0094	159	0.19	0.73	2.6	9.4	0.67	80	15,777	3.0	0.00094	9.3	2.4	51	4,555	8.7	531	0.0066	249,685	256	0.0066	0.066	2.9	0.94	1.9	324	41	7.5	187,030
2150	275,672	322,362	3,183	50	0.49	0.36	0.64	145	0.0093	159	0.19	0.72	2.6	9.3	0.66	80	15,820	2.9	0.00093	9.3	2.4	51	4,555	8.6	531	0.0066	249,550	256	0.0066	0.066	2.9	0.93	1.9	317	40	7.3	186,985

Table A9. Source terms of the NAG backfill for the high nitrogen scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
-	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2023	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	24
2024	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	44
2025	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	80
2026	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	125
2027	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	158
2028	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	289
2029	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	270
2030	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	348
2031	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	2,236
2032	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	3,634
2033	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	620
2034	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	2,492
2035	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	7,085
2036	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	12,083
2037	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	13,464
2038	6.9	1,210	8.4	29	0.15	0.0021	0.0012	0.0023	1.3	0.00005	28	0.001	0.0057	0.004	0.05	0.0001	0.72	20	0.034	0.000005	0.041	0.0074	0.46	41	0.11	4.8	0.000029	510	2.3	0.000029	0.00029	0.013	0.005	0.01	102	13	2.4	26,952
2039	7.8	1,302	85	29	0.0094	0.0023	0.0013	0.0023	1.3	0.00005	31	0.001	0.0058	0.004	0.05	0.00032	0.72	23	0.034	0.000005	0.044	0.008	0.46	41	0.11	4.8	0.000031	581	2.3	0.000031	0.00031	0.014	0.005	0.01	99	13	2.3	45,912
2040	8.2	1,465	225	29	0.017	0.0026	0.0014	0.0022	1.3	0.00005	34	0.001	0.0057	0.004	0.05	0.00082	0.72	27	0.032	0.000005	0.049	0.009	0.46	41	0.1	4.8	0.000035	712	2.3	0.000035	0.00035	0.016	0.005	0.01	88	11	2.0	79,056
2041	8.4	1,508	378	29	0.028	0.0027	0.0015	0.0023	1.3	0.00005	13	0.001	0.0042	0.0081	0.05	0.0017	0.72	30	0.021	0.000005	0.051	0.0089	0.46	41	0.067	4.8	0.000036	821	2.3	0.000036	0.00036	0.016	0.005	0.01	45	5.7	1.0	110,907
2042	8.5	1,409	396	25	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.001	0.003	0.0082	0.05	0.002	0.62	28	0.014	0.000005	0.047	0.008	0.39	35	0.042	4.1	0.000034	787	2.0	0.000034	0.00034	0.015	0.005	0.01	17	2.1	0.38	128,839
2043	8.4	1,372	388	24	0.029	0.0024	0.0015	0.0024	1.1	0.00005	12	0.001	0.0026	0.0081	0.05	0.002	0.59	28	0.012	0.000005	0.046	0.0077	0.38	34	0.034	4.0	0.000033	767	1.9	0.000033	0.00033	0.015	0.005	0.01	9.1	1.1	0.21	133,866
2044	8.4	1,350	377	23	0.028	0.0024	0.0014	0.0024	1.1	0.00005	13	0.001	0.0026	0.008	0.05	0.002	0.58	27	0.011	0.000005	0.045	0.0075	0.37	33	0.033	3.9	0.000032	752	1.9	0.000032	0.00032	0.014	0.005	0.01	9.8	1.2	0.22	136,575
2045	8.5	1,399	394	24	0.029	0.0025	0.0015	0.0024	1.1	0.00005	12	0.001	0.0028	0.0082	0.05	0.002	0.59	28	0.012	0.000005	0.047	0.0079	0.38	34	0.037	4.0	0.000034	782	1.9	0.000034	0.00034	0.015	0.005	0.01	12	1.5	0.28	133,758
2046	8.5	1,450	399	25	0.029	0.0026	0.0016	0.0023	1.1	0.00005	12	0.001	0.003	0.0082	0.05	0.0023	0.62	29	0.013	0.000005	0.049	0.0089	0.39	35	0.04	4.1	0.000035	807	2.0	0.000035	0.00035	0.015	0.005	0.01	12	1.5	0.28	128,763
2047	8.5	1,577	410	25	0.03	0.0028	0.0017	0.0022	1.1	0.00005	12	0.001	0.0035	0.0084	0.05	0.0029	0.62	31	0.015	0.000005	0.053	0.011	0.4	35	0.043	4.1	0.000038	868	2.0	0.000038	0.00038	0.017	0.005	0.01	9.0	1.1	0.21	128,089
2048	8.5	1,714	430	24	0.03	0.003	0.0019	0.0022	1.1	0.00005	11	0.001	0.004	0.0087	0.05	0.0034	0.61	34	0.017	0.000005	0.058	0.013	0.39	35	0.05	4.1	0.000041	939	2.0	0.000041	0.00041	0.018	0.005	0.01	8.6	1.1	0.2	129,793
2049	8.5	1,776	447	24	0.031	0.0031	0.0021	0.0021	1.1	0.00005	11	0.001	0.0045	0.0089	0.05	0.0038	0.61	35	0.019	0.000005	0.06	0.014	0.39	35	0.056	4.0	0.000043	974	1.9	0.000043	0.00043	0.019	0.005	0.01	9.2	1.2	0.21	131,172
2050	8.5	1,803	451	24	0.031	0.0032	0.0022	0.0021	1.1	0.00005	11	0.001	0.0047	0.009	0.05	0.0042	0.6	36	0.02	0.000005	0.061	0.015	0.38	34	0.058	4.0	0.000043	988	1.9	0.000043	0.00043	0.019	0.005	0.01	7.9	1.0	0.18	132,811
2051	8.5	1,816	452	24	0.031	0.0032	0.0022	0.0021	1.1	0.00005	11	0.001	0.0048	0.009	0.05	0.0043	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.058	4.0	0.000044	995	1.9	0.000044	0.00044	0.019	0.005	0.01	6.1	0.77	0.14	133,964
2052	8.5	1,827	452	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0048	0.009	0.05	0.0045	0.59	36	0.02	0.000005	0.061	0.016	0.38	34	0.057	3.9	0.000044	1,000	1.9	0.000044	0.00044	0.02	0.005	0.01	3.8	0.48	0.087	135,076
2053	8.5	1,837	452	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0049	0.009	0.05	0.0046	0.59	36	0.02	0.000005	0.062	0.016	0.38	34	0.057	3.9	0.000044	1,004	1.9	0.000044	0.00044	0.02	0.005	0.01	1.9	0.25	0.045	135,145
2054	8.5	1,841	452	23	0.031	0.0032	0.0023	0.0021	1.1	0.00005	11	0.001	0.0049	0.009	0.05	0.0047	0.59	36	0.02	0.000005	0.062	0.016	0.37	33	0.057	3.9	0.000044	1,006	1.9	0.000044	0.00044	0.02	0.005	0.01	1.4	0.17	0.031	135,795
2055	8.5	1,852	451	23	0.031	0.0033	0.0023	0.0021	1.1	0.00005	11	0.001	0.005	0.009	0.05	0.0048	0.58	36	0.02	0.000005	0.062	0.017	0.37	33	0.058	3.9	0.000044	1,010	1.9	0.000045	0.00045	0.02	0.005	0.011	1.4	0.18	0.032	136,601
2056	8.6	1,808	551	23	0.039	0.0032	0.0023	0.0022	1.1	0.00005	7.4	0.001	0.0048	0.01	0.05	0.0046	0.58	38	0.02	0.000005	0.061	0.016	0.37	33	0.057	3.8	0.000043	1,036	1.9	0.000043	0.00043	0.019	0.005	0.01	1.6	0.21	0.037	137,639
2057	8.7	1,730	710	23	0.052	0.0031	0.0022	0.0023	1.1	0.00005	4.7	0.001	0.0044	0.013	0.05	0.0042	0.58	41	0.018	0.000005	0.058	0.015	0.37	33	0.052	3.8	0.000041	1,070	1.9	0.000042	0.00042	0.018	0.005	0.01	1.9	0.24	0.044	137,940
2058	8.7	1,684	801	23	0.059	0.003	0.0021	0.0024	1.1	0.00005	3.8	0.001	0.0042	0.015	0.05	0.0039	0.58	42	0.017	0.000005	0.057	0.014	0.37	33	0.049	3.8	0.00004	1,088	1.8	0.00004	0.00041	0.018	0.005	0.01	2.3	0.29	0.052	138,218
2059	8.7	1,672	832	23	0.062	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.37	33	0.048	3.8	0.00004	1,095	1.8	0.00004	0.0004	0.018	0.005	0.01	2.7	0.34	0.061	138,460
2060	8.7	1,671	838	23	0.062	0.0029	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	43	0.017	0.000005	0.056	0.014	0.36	33	0.048	3.8	0.00004	1,097	1.8	0.00004	0.0004	0.018	0.005	0.01	3.1	0.4	0.072	139,518
2061	8.7	1,674	837	23	0.062	0.003	0.002	0.0024	1.0	0.00005	3.5	0.001	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.014	0.36	33	0.049	3.8	0.00004	1,097	1.8	0.00004	0.0004	0.018	0.005	0.01	3.6	0.46	0.084	139,838
2062	8.8	1,663	872	23	0.065	0.0029	0.002	0.0025	1.0	0.00005	3.3	0.001	0.0041	0.014	0.05	0.0038	0.57	44	0.017	0.000005	0.056	0.013	0.36	32	0.049	3.8	0.00004	1,108	1.8	0.00004	0.0004	0.018	0.005	0.01	4.2	0.53	0.096	140,676
2063	8.8	1,642	908	22	0.07	0.0029	0.002	0.0025	1.0	0.00005	3.0	0.001	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,113	1.8	0.000039	0.00039	0.018	0.005	0.01	4.8	0.61	0.11	141,568
2064	8.8	1,636	915	22	0.069	0.0029	0.002	0.0025	1.0	0.00005	3.0	0.001	0.004	0.014	0.05	0.0036	0.56	45	0.016	0.000005	0.055	0.013	0.36	32	0.048	3.7	0.000039	1,113	1.8	0.000039	0.00039	0.017	0.005	0.01	5.4	0.68	0.12	142,789
2065	8.9	1,636	951	22	0.092	0.0029	0.0019	0.0026	1.0	0.00005	2.4	0.001	0.004	0.014	0.05	0.0035	0.56	46	0.016	0.000005	0.055	0.013	0.35	32	0.048	3.7	0.000039	1,128	1.8	0.000039	0.00039	0.017	0.005	0.01	6.1	0.77	0.14	143,409
2066	8.9	1,609	994	22	0.1	0.0028	0.0019	0.0026	1.0	0.00005	2.1	0.001	0.0039	0.014	0.05	0.0034	0.55	47	0.016	0.000005	0.054	0.012	0.35	31	0.048	3.7	0.000039	1,134	1.8	0.000039	0.00039	0.017	0.005	0.01	6.8	0.85	0.16	144,573
2067	8.9	1,588	1,023	22	0.11	0.0028	0.0019	0.0027	1.	0.00005	2.0	0.001	0.0039	0.013	0.05	0.0033	0.55	47	0.016	0.000005	0.053	0.012	0.35	31	0.047	3.6	0.000038	1,137	1.8	0.000038	0.00038	0.017	0.005	0.01	7.5	0.94	0.17	145,722
2068	8.9	1,582	1,038	22	0.11	0.0028	0.0019	0.0027	0.99	0.00005	2.0	0.001	0.0038	0.013	0.05	0.0033	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.047	3.6	0.000038	1,139	1.7	0.000038	0.00038	0.017	0.005	0.01	8.1	1.0	0.19	147,284
2069	8.9	1,578	1,048	21	0.1	0.0028	0.0019	0.0027	0.98	0.00005	2.0	0.001	0.0038	0.013	0.05	0.0032	0.54	48	0.016	0.000005	0.053	0.012	0.34	31	0.047	3.6	0.000038	1,141	1.7	0.000038	0.00038	0.017	0.005	0.01	8.7	1.1	0.2	148,201
2070	8.9	1,583	1,048	21	0.1	0.0028	0.0019	0.0027	0.97	0.00005	2.1	0.001	0.0038	0.013	0.05	0.0032	0.53	48	0.016	0.000005	0.053	0.012	0.34	30	0.048	3.5	0.000038	1,143	1.7	0.000038	0.00038	0.017	0.005	0.01	8.9	1.1	0.2	149,328
2071	8.9	1,583	1,049	21	0.095	0.0028	0.0019	0.0027	0.96	0.00005	2.1	0.001	0.0038	0.013	0.05	0.0032	0.53	49	0.016	0.000005	0.053	0.012	0.34	30	0.047	3.5	0.000038	1,143	1.7	0.000038	0.00038	0.017	0.005	0.01	8.4	1.1	0.19	150,505
2072	8.9	1,598	1,052	21	0.1	0.0028	0.0019	0.0027	0.96	0.00005	2.0	0.001	0.0038	0.013	0.05	0.0033	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000038	1,151	1.7	0.000038	0.00038	0.017	0.005	0.01	7.6	0.96	0.17	151,916
2073	8.9	1,607	1,049	21	0.1	0.0028	0.0019	0.0027	0.95	0.00005	2.1	0.001	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.012	0.33	30	0.047	3.5	0.000038	1,154	1.7	0.000039	0.00039	0.017	0.005	0.01	7.0	0.88	0.16	152,292
2074	8.9	1,613	1,044	21	0.097	0.0028	0.0019	0.0026	0.95	0.00005	2.1	0.001	0.0039	0.014	0.05	0.0034	0.52	49	0.016	0.000005	0.054	0.013	0.33	30	0.048	3.5	0.000039	1,155	1.7	0.000039	0.00039	0.017	0.005	0.01	6.8	0.86	0.16	153,237
2075	8.9	1,623	1,039	21	0.093	0.0029	0.0019	0.0026	0.94	0.00005	2.2	0.001	0.004	0.014	0.05	0.0035	0.52	49	0.017	0.000005	0.055	0.013	0.33	30	0.049	3.4	0.000039	1,157	1.7	0.000039	0.00039	0.017	0.005	0.01	6.6	0.84	0.15	153,995
2076	8.9	1,649	1,044	20	0.11	0.0029	0.002	0.0026	0.94	0.00005	2.0	0.001	0.0041	0.014	0.05	0.0036	0.51	50	0.017	0.000005	0.055	0.013	0.33	29	0.05	3.4	0.000039	1,171	1.6	0.00004	0.0004	0.018	0.005	0.01	6.8	0.86	0.16	155,005
2077	8.9	1,665	1,042	20	0.11	0.0029	0.002	0.0026	0.93	0.00005	2.0	0.001	0.0043	0.014	0.05	0.0038	0.51	50	0.018	0.000005	0.056	0.014	0.33	29	0.052	3.4	0.00004	1,177	1.6	0.00004	0.0004	0.018	0.005	0.01	7.0	0.89	0.16	155,356
2078	8.9	1,678	1,038	20	0.11	0.003	0.0021	0.0026	0.93	0.00005	2.0	0.001	0.0044	0.014	0.05	0.0039	0.51	50	0.018	0.000005	0.056	0.014	0.32	29	0.054	3.4	0.00004	1,182	1.6	0.00004	0.0004	0.018	0.005	0.01	7.3	0.92	0.17	156,236
2079	8.9	1,688	1,042	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.001	0.0045	0.014	0.05	0.004	0.51	50	0.019	0.000005	0.057	0.015	0.32	29	0.055	3.4	0.00004	1,187	1.6	0.00004	0.00041	0.018	0.005	0.01	7.5	0.94	0.17	157,251
2080	8.9	1,694	1,048	20	0.11	0.003	0.0021	0.0026	0.92	0.00005	2.0	0.001	0.0046	0.014	0.05	0.0041	0.5	50	0.019	0.000005	0.057	0.015	0.32	29	0.057	3.3	0.00004	1,192	1.6	0.00004	0.00041	0.018	0.005	0.01	7.4	0.94	0.17	158,470
2081	8.9	1,705	1,047	20	0.11	0.003	0.0022	0.0026	0.91	0.00005	2.0	0.001	0.0048	0.014	0.05	0.0042	0.5	51	0.02	0.000005	0.057	0.015	0.32	29	0.058	3.3	0.00004	1,197	1.6	0.00004	0.00041	0.018	0.005	0.01	7.5	0.95	0.17	158,338
2082	8.9	1,697	1,065	20	0.11	0.003	0.0022	0.0026	0.91	0.00005	2.0	0.001	0.0048	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.015	0.32	28	0.058	3.3	0.00004	1,201	1.6	0.00004	0.00041	0.018	0.005	0.01	7.3	0.92	0.17	159,814
2083	8.9	1,686	1,085	20	0.11	0.003	0.0022	0.0026	0.91	0.00005	1.9	0.001	0.0048	0.014	0.05	0.0043	0.5	51	0.02	0.000005	0.057	0.016	0.32	28	0.059	3.3	0.00004	1,204	1.6	0.00004	0.00041	0.018	0.005	0.01	7.4	0.93	0.17	160,383
2084	8.9	1,688	1,092	20	0.11	0.003	0.0022	0.0026	0.9	0.00005	1.9	0.001	0.0049	0.014	0.05	0.0044	0.49	52	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.00004	1,207	1.6	0.00004	0.00041	0.018	0.005	0.01	7.2	0.92	0.17	161,637
2085	8.9	1,680	1,102	20	0.11	0.003	0.0022	0.0026	0.9	0.00005	1.9	0.001	0.0049	0.014	0.05	0.0044	0.49	52	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.00004	1,208	1.6	0.00004	0.0004	0.018	0.005	0.01	7.4	0.94	0.17	161,890
2086	8.9	1,684	1,106	20	0.11	0.003	0.0022	0.0026	0.89	0.00005	1.9	0.001	0.005	0.015	0.05	0.0044	0.49	53	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.3	0.00004	1,211	1.6	0.00004	0.00041	0.018	0.005	0.01	7.2	0.91	0.17	162,778
2087	8.9	1,679	1,112	19	0.1	0.003	0.0022	0.0026	0.89	0.00005	2.0	0.001	0.0049	0.015	0.05	0.0044	0.49	53	0.02	0.000005	0.056	0.016	0.31	28	0.06	3.2	0.00004	1,210	1.6	0.00004	0.0004	0.018	0.005	0.01	7.2	0.91	0.17	163,470
2088	8.9	1,691	1,119	19	0.11	0.003	0.0023	0.0026	0.88	0.00005	1.9	0.001	0.0049	0.015	0.05	0.0044	0.48	53	0.02	0.000005	0.057	0.016	0.31	28	0.06	3.2	0.00004	1,218	1.6	0.00004	0.

Table A9. Source terms of the NAG backfill for the high nitrogen scenario.

Model Year	pH	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	-	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m^3/year
2135	9.2	1,573	1,597	17	0.23	0.0028	0.0022	0.0032	0.78	0.00005	0.97	0.001	0.0048	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.057	2.8	0.000038	1,337	1.4	0.000038	0.00038	0.017	0.005	0.01	3.9	0.49	0.09	186,569
2136	9.2	1,571	1,603	17	0.23	0.0028	0.0022	0.0032	0.78	0.00005	0.96	0.001	0.0047	0.015	0.05	0.0044	0.43	78	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,338	1.4	0.000038	0.00038	0.017	0.005	0.01	3.8	0.49	0.088	187,180
2137	9.2	1,577	1,606	17	0.23	0.0028	0.0022	0.0032	0.78	0.00005	0.96	0.001	0.0048	0.015	0.05	0.0044	0.43	79	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,341	1.4	0.000038	0.00038	0.017	0.005	0.01	3.9	0.49	0.089	186,716
2138	9.2	1,565	1,622	17	0.24	0.0028	0.0022	0.0032	0.78	0.00005	0.94	0.001	0.0047	0.015	0.05	0.0043	0.43	79	0.019	0.000005	0.053	0.016	0.27	24	0.056	2.8	0.000038	1,342	1.4	0.000038	0.00038	0.017	0.005	0.01	3.8	0.49	0.088	186,790
2139	9.2	1,549	1,640	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.92	0.001	0.0046	0.015	0.05	0.0043	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.055	2.8	0.000037	1,341	1.4	0.000037	0.00037	0.017	0.005	0.01	3.8	0.49	0.088	187,056
2140	9.2	1,540	1,650	17	0.25	0.0027	0.0022	0.0032	0.78	0.00005	0.91	0.001	0.0046	0.015	0.05	0.0042	0.43	80	0.019	0.000005	0.052	0.015	0.27	24	0.054	2.8	0.000037	1,341	1.4	0.000037	0.00037	0.016	0.005	0.01	3.8	0.49	0.088	187,514
2141	9.2	1,528	1,664	17	0.26	0.0027	0.0022	0.0033	0.78	0.00005	0.89	0.001	0.0045	0.015	0.05	0.0042	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.054	2.8	0.000037	1,340	1.4	0.000037	0.00037	0.016	0.005	0.01	3.9	0.49	0.089	186,895
2142	9.2	1,522	1,670	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.89	0.001	0.0045	0.015	0.05	0.0041	0.43	81	0.018	0.000005	0.051	0.015	0.27	24	0.053	2.8	0.000037	1,340	1.4	0.000037	0.00037	0.016	0.005	0.01	3.9	0.49	0.089	186,886
2143	9.2	1,512	1,682	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.88	0.001	0.0044	0.015	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.052	2.8	0.000036	1,339	1.4	0.000036	0.00036	0.016	0.005	0.01	3.9	0.49	0.089	187,034
2144	9.2	1,507	1,687	17	0.26	0.0027	0.0021	0.0033	0.78	0.00005	0.87	0.001	0.0043	0.014	0.05	0.004	0.43	82	0.018	0.000005	0.051	0.014	0.27	24	0.051	2.8	0.000036	1,338	1.4	0.000036	0.00036	0.016	0.005	0.01	3.9	0.49	0.089	187,551
2145	9.2	1,498	1,697	17	0.26	0.0026	0.0021	0.0034	0.78	0.00005	0.87	0.001	0.0042	0.014	0.05	0.0039	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.05	2.8	0.000036	1,337	1.4	0.000036	0.00036	0.016	0.005	0.01	3.9	0.49	0.089	187,019
2146	9.2	1,494	1,701	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.0042	0.014	0.05	0.0038	0.43	83	0.017	0.000005	0.05	0.014	0.27	24	0.049	2.8	0.000036	1,337	1.4	0.000036	0.00036	0.016	0.005	0.01	3.9	0.49	0.089	187,081
2147	9.2	1,486	1,709	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.0041	0.014	0.05	0.0037	0.43	83	0.017	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000036	1,336	1.4	0.000036	0.00036	0.016	0.005	0.01	3.8	0.48	0.088	187,212
2148	9.2	1,483	1,714	17	0.26	0.0026	0.002	0.0034	0.78	0.00005	0.86	0.001	0.004	0.014	0.05	0.0037	0.42	84	0.016	0.000005	0.05	0.013	0.27	24	0.048	2.8	0.000036	1,335	1.4	0.000036	0.00036	0.016	0.005	0.01	3.8	0.48	0.087	187,667
2149	9.2	1,477	1,721	17	0.27	0.0026	0.002	0.0034	0.78	0.00005	0.85	0.001	0.0039	0.014	0.05	0.0036	0.43	84	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000036	1,335	1.4	0.000036	0.00036	0.016	0.005	0.01	3.7	0.46	0.084	187,030
2150	9.2	1,474	1,724	17	0.27	0.0026	0.0019	0.0034	0.78	0.00005	0.85	0.001	0.0039	0.014	0.05	0.0035	0.43	85	0.016	0.000005	0.05	0.013	0.27	24	0.046	2.8	0.000035	1,335	1.4	0.000035	0.00035	0.016	0.005	0.01	3.6	0.45	0.082	186,985

Table A10. Annual loads of the NAG backfill for the high nitrogen scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m³/year
2023	29	0.2	0.69	0.0037	0.000052	0.000029	0.000055	0.032	0.0000012	0.67	0.000024	0.00014	0.000097	0.0012	0.0000024	0.017	0.49	0.00081	0.00000012	0.00098	0.00018	0.011	0.99	0.0027	0.12	0.0000007	12	0.056	0.0000007	0.000007	0.00031	0.00012	0.00024	2.5	0.31	0.057	24
2024	53	0.37	1.3	0.0067	0.000094	0.000053	0.0001	0.057	0.0000022	1.2	0.000044	0.00025	0.00018	0.0022	0.0000044	0.031	0.89	0.0015	0.00000022	0.0018	0.00033	0.02	1.8	0.0048	0.21	0.0000013	22	0.1	0.0000013	0.000013	0.00057	0.00022	0.00044	4.5	0.57	0.1	44
2025	97	0.68	2.3	0.012	0.00017	0.000097	0.00018	0.11	0.000004	2.2	0.00008	0.00046	0.00032	0.004	0.0000081	0.058	1.6	0.0027	0.000004	0.0033	0.0006	0.037	3.3	0.0089	0.38	0.0000023	41	0.18	0.0000023	0.000023	0.001	0.0004	0.0008	8.2	1.0	0.19	80
2026	152	1.1	3.6	0.019	0.00027	0.00015	0.00029	0.16	0.0000063	3.5	0.00013	0.00072	0.0005	0.0063	0.0000013	0.09	2.5	0.0042	0.00000063	0.0051	0.00093	0.057	5.1	0.014	0.6	0.0000036	64	0.29	0.0000036	0.000036	0.0016	0.00063	0.0013	13	1.6	0.3	125
2027	191	1.3	4.5	0.024	0.00034	0.00019	0.00036	0.21	0.0000079	4.4	0.00016	0.0009	0.00063	0.0079	0.0000016	0.11	3.2	0.0053	0.00000079	0.0064	0.0012	0.072	6.5	0.017	0.75	0.0000046	81	0.36	0.0000046	0.000046	0.002	0.00079	0.0016	16	2.0	0.37	158
2028	349	2.4	8.2	0.044	0.00062	0.00035	0.00066	0.38	0.0000014	8.0	0.00029	0.0017	0.0012	0.014	0.000029	0.21	5.8	0.0097	0.0000014	0.012	0.0021	0.13	12	0.032	1.4	0.0000084	147	0.66	0.0000084	0.000084	0.0037	0.0014	0.0029	30	3.7	0.68	289
2029	326	2.3	7.7	0.041	0.00057	0.00032	0.00062	0.35	0.0000013	7.5	0.00027	0.0015	0.0011	0.013	0.0000027	0.19	5.5	0.0091	0.0000013	0.011	0.002	0.12	11	0.03	1.3	0.0000078	138	0.62	0.0000078	0.000078	0.0035	0.0013	0.0027	28	3.5	0.63	270
2030	421	2.9	9.9	0.053	0.00074	0.00042	0.0008	0.45	0.0000017	9.7	0.00035	0.002	0.0014	0.017	0.000035	0.25	7.0	0.012	0.0000017	0.014	0.0026	0.16	14	0.038	1.7	0.00001	178	0.8	0.00001	0.0001	0.0045	0.0017	0.0035	36	4.5	0.82	348
2031	2,706	19	64	0.34	0.0048	0.0027	0.0051	2.9	0.00011	62	0.0022	0.013	0.0089	0.11	0.00022	1.6	45	0.075	0.000011	0.091	0.017	1.0	91	0.25	11	0.000065	1,141	5.1	0.000065	0.00065	0.029	0.011	0.022	229	29	5.3	2,236
2032	4,396	31	104	0.56	0.0078	0.0044	0.0083	4.7	0.00018	101	0.0036	0.021	0.015	0.18	0.00036	2.6	73	0.12	0.000018	0.15	0.027	1.7	149	0.4	17	0.0011	1,854	8.3	0.00011	0.0011	0.047	0.018	0.036	372	47	8.5	3,634
2033	750	5.2	18	0.095	0.0013	0.00075	0.0014	0.81	0.0000031	17	0.00062	0.0035	0.0025	0.031	0.0000062	0.44	13	0.021	0.0000031	0.025	0.0046	0.28	25	0.068	3.0	0.000018	316	1.4	0.000018	0.00018	0.008	0.0031	0.0062	63	8.0	1.5	620
2034	3,015	21	71	0.38	0.0053	0.003	0.0057	3.3	0.00012	69	0.0025	0.014	0.01	0.12	0.000025	1.8	50	0.084	0.000012	0.1	0.019	1.1	102	0.28	12	0.000072	1,271	5.7	0.000072	0.00072	0.032	0.012	0.025	255	32	5.9	2,492
2035	8,571	60	202	1.1	0.015	0.0085	0.016	9.3	0.00035	197	0.0071	0.041	0.028	0.35	0.00071	5.1	143	0.24	0.000035	0.29	0.053	3.2	290	0.78	34	0.00021	3,614	16	0.00021	0.0021	0.092	0.035	0.071	725	92	17	7,085
2036	14,618	102	345	1.9	0.026	0.015	0.028	16	0.0006	336	0.012	0.069	0.048	0.6	0.0012	8.7	244	0.41	0.00006	0.49	0.09	5.5	494	1.3	58	0.00035	6,163	28	0.00035	0.0035	0.16	0.06	0.12	1,236	156	28	12,083
2037	16,289	113	385	2.1	0.029	0.016	0.031	18	0.00067	374	0.013	0.077	0.054	0.67	0.0014	9.6	272	0.45	0.000067	0.55	0.1	6.2	551	1.5	64	0.00039	6,868	31	0.00039	0.0039	0.17	0.067	0.13	1,377	174	32	13,464
2038	32,606	227	770	4.1	0.057	0.032	0.062	35	0.0013	749	0.027	0.15	0.11	1.3	0.0027	19	545	0.91	0.00013	1.1	0.2	12	1,102	3.0	128	0.00078	13,748	62	0.00078	0.0078	0.35	0.13	0.27	2,757	349	63	26,952
2039	59,768	3,889	1,312	0.43	0.11	0.058	0.1	60	0.0023	1,430	0.046	0.27	0.18	2.3	0.015	33	1,040	1.5	0.00023	2.0	0.37	21	1,878	5.0	219	0.0014	26,682	105	0.0014	0.014	0.64	0.23	0.46	4,560	577	105	45,912
2040	115,810	17,792	2,260	1.3	0.2	0.11	0.18	103	0.004	2,717	0.079	0.45	0.32	4.0	0.065	57	2,136	2.5	0.0004	3.9	0.71	36	3,235	8.2	377	0.0028	56,264	182	0.0028	0.028	1.2	0.4	0.79	6,967	881	160	79,056
2041	167,259	41,951	3,172	3.1	0.29	0.16	0.25	145	0.0055	1,465	0.11	0.46	0.89	5.5	0.18	79	3,331	2.4	0.00055	5.6	0.98	51	4,540	7.5	529	0.004	91,088	255	0.004	0.04	1.8	0.55	1.1	4,991	631	115	110,907
2042	181,534	50,979	3,172	3.8	0.32	0.19	0.31	145	0.0064	1,508	0.13	0.39	1.1	6.4	0.25	79	3,653	1.8	0.00064	6.1	1.0	51	4,539	5.4	529	0.0044	101,408	255	0.0044	0.044	1.9	0.64	1.3	2,152	272	49	128,839
2043	183,623	51,985	3,171	3.9	0.32	0.19	0.32	145	0.0067	1,598	0.13	0.35	1.1	6.7	0.27	79	3,688	1.5	0.00067	6.2	1.0	51	4,539	4.6	529	0.0044	102,699	255	0.0044	0.044	2.0	0.67	1.3	1,212	153	28	133,866
2044	184,376	51,422	3,171	3.8	0.33	0.2	0.33	145	0.0068	1,711	0.14	0.35	1.1	6.8	0.27	79	3,693	1.5	0.00068	6.2	1.0	51	4,539	4.6	529	0.0044	102,665	255	0.0044	0.044	2.0	0.68	1.4	1,333	169	31	136,575
2045	187,181	52,658	3,172	3.9	0.33	0.2	0.32	145	0.0067	1,574	0.13	0.37	1.1	6.7	0.27	79	3,765	1.6	0.00067	6.3	1.1	51	4,539	4.9	529	0.0045	104,596	255	0.0045	0.045	2.0	0.67	1.3	1,614	204	37	133,758
2046	186,758	51,405	3,172	3.8	0.33	0.2	0.3	145	0.0064	1,506	0.13	0.39	1.1	6.4	0.3	79	3,749	1.7	0.00064	6.3	1.1	51	4,540	5.1	529	0.0045	103,927	255	0.0045	0.045	2.0	0.64	1.3	1,560	197	36	128,763
2047	201,983	52,505	3,173	3.8	0.36	0.22	0.29	145	0.0064	1,495	0.13	0.44	1.1	6.4	0.37	80	4,017	1.9	0.00064	6.8	1.4	51	4,541	5.6	529	0.0048	111,227	255	0.0049	0.049	2.2	0.64	1.3	1,157	146	27	128,089
2048	222,440	55,777	3,173	3.9	0.39	0.25	0.28	145	0.0065	1,455	0.13	0.52	1.1	6.5	0.45	80	4,406	2.2	0.00065	7.5	1.6	51	4,542	6.5	529	0.0053	121,828	255	0.0054	0.053	2.4	0.65	1.3	1,115	141	26	129,793
2049	232,908	58,594	3,174	4.1	0.41	0.27	0.28	145	0.0066	1,399	0.13	0.59	1.2	6.6	0.5	80	4,623	2.5	0.00066	7.8	1.9	51	4,542	7.3	529	0.0056	127,787	255	0.0056	0.056	2.5	0.66	1.3	1,209	153	28	131,172
2050	239,498	59,850	3,174	4.2	0.42	0.29	0.28	145	0.0066	1,406	0.13	0.63	1.2	6.6	0.55	80	4,749	2.6	0.00066	8.1	2.0	51	4,543	7.7	529	0.0057	131,275	255	0.0058	0.058	2.6	0.66	1.3	1,052	133	24	132,811
2051	243,292	60,490	3,174	4.2	0.43	0.3	0.28	145	0.0067	1,419	0.13	0.64	1.2	6.7	0.58	80	4,816	2.7	0.00067	8.2	2.1	51	4,543	7.8	529	0.0058	133,239	255	0.0058	0.059	2.6	0.67	1.3	814	103	19	133,964
2052	246,757	61,046	3,174	4.3	0.44	0.3	0.28	145	0.0068	1,433	0.14	0.65	1.2	6.8	0.61	80	4,878	2.7	0.00068	8.3	2.2	51	4,543	7.7	529	0.0059	135,022	255	0.0059	0.059	2.6	0.68	1.4	510	64	12	135,076
2053	248,235	61,113	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,436	0.14	0.66	1.2	6.8	0.62	80	4,900	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.0059	135,713	255	0.006	0.06	2.7	0.68	1.4	262	33	6.0	135,145
2054	249,944	61,330	3,174	4.3	0.44	0.31	0.28	145	0.0068	1,448	0.14	0.66	1.2	6.8	0.63	80	4,930	2.7	0.00068	8.4	2.2	51	4,543	7.7	529	0.006	136,555	255	0.006	0.06	2.7	0.68	1.4	185	23	4.2	135,795
2055	252,972	61,615	3,174	4.3	0.45	0.32	0.29	145	0.0068	1,465	0.14	0.68	1.2	6.8	0.65	80	4,984	2.7	0.00068	8.5	2.3	51	4,543	8.0	529	0.0061	138,022	255	0.0061	0.061	2.7	0.68	1.5	191	24	4.4	136,601
2056	248,809	75,807	3,175	5.3	0.44	0.31	0.3	145	0.0069	1,019	0.14	0.67	1.4	6.9	0.63	80	5,234	2.7	0.00069	8.4	2.2	51	4,544	7.8	529	0.006	142,580	255	0.006	0.06	2.7	0.69	1.4	224	28	5.2	137,439
2057	238,664	97,994	3,175	7.1	0.42	0.3	0.32	145	0.0069	642	0.14	0.61	1.8	6.9	0.58	80	5,609	2.5	0.00069	8.0	2.1	51	4,544	7.2	530	0.0057	147,637	255	0.0057	0.057	2.5	0.69	1.4	265	34	6.1	137,940
2058	232,800	110,780	3,176	8.2	0.41	0.28	0.33	145	0.0069	519	0.14	0.58	2.0	6.9	0.54	80	5,859	2.3	0.00069	7.8	1.9	51	4,545	6.7	530	0.0056	150,367	255	0.0056	0.056	2.5	0.69	1.4	314	40	7.2	138,218
2059	231,450	115,170	3,176	8.6	0.41	0.28	0.34	145	0.0069	487	0.14	0.57	2.0	6.9	0.53	80	5,973	2.3	0.00069	7.8	1.9	51	4,545	6.6	530	0.0055	151,559	255	0.0056	0.056	2.5	0.69	1.4	370	47	8.5	138,460
2060	233,135	116,900	3,176	8.7	0.41	0.28	0.34	145	0.007	485	0.14	0.57	2.0	7.0	0.53	80	6,057	2.3	0.0007	7.8	1.9	51	4,545	6.7	530	0.0056	153,010	255	0.0056	0.056	2.5	0.7	1.4	436	55	10	139,518
2061	234,102	116,981	3,176	8.7	0.41	0.28	0.34	145	0.007	488	0.14	0.58	2.0	7.0	0.53	80	6,083	2.4	0.0007	7.9	1.9	51	4,545	6.9	530	0.0056	153,444	255	0.0056	0.056	2.5	0.7	1.4	509	64	12	139,838
2062	233,986	122,647	3,176	9.2	0.41	0.28	0.35	145	0.007	457	0.14	0.58	2.0	7.0	0.53	80	6,200	2.4	0.0007	7.9	1.9	51	4,546	6.9	530	0.0056	155,812	255	0.0056	0.056	2.5	0.7	1.4	590	75	14	140,676
2063	232,497	128,575	3,176	9.9	0.41	0.28	0.36	145	0.0071	422	0.14	0.57	2.0	7.1	0.51	80	6,344	2.3	0.00071	7.8	1.8	51	4,546	6.8	530	0.0056	157,594	255	0.0056	0.056	2.5	0.71	1.4	678	86	16	141,568
2064	233,632	130,611	3,176	9.9	0.41	0.28	0.36	145	0.0071	426	0.14	0.57	2.0	7.1	0.51	80	6,427	2.4	0.00071	7.9	1.8	51	4,546	6.9	530	0.0056	158,910	255	0.0056	0.056	2.5	0.71	1.4	773	98	18	142,789
2065	234,589	136,385	3,176	13	0.41	0.28	0.37	145	0.0072	343	0.14	0.57	2.0	7.2	0.5	80	6,581	2.4	0.00072	7.9	1.8	51	4,546	6.9	530	0.0056	161,808	255	0.0056	0.056	2.5	0.72	1.4	871	110	20	143,409
2066	232,604	143,755	3,176	15	0.41	0.28	0.38	145	0.0072	307	0.14	0.56	2.0	7.2	0.49	80	6,736	2.3	0.00072	7.8	1.8	51	4,546	6.9	530	0.0056	163,990	255	0.0056	0.056	2.5	0.72	1.4	976	123	22	144,573
2067	231,421	149,117	3,177	16	0.41	0.27	0.39	145	0.0073	293	0.15	0.56	2.0	7.3	0.49	80	6,873	2.3	0.00073	7.8	1.8	51	4,546	6.9	530	0.0055	165,642	255	0.0056	0.056	2.5	0.73	1.5	1,086	137	25	145,722
2068	232,959	152,880	3,177	16	0.41	0.28	0.39	145	0.0074	294	0.15	0.56	2.0	7.4	0.48	80	7,026	2.4	0.00074	7.8	1.8	51	4,546	7.0	530	0.0056	167,815	255	0.0056	0.056	2.5	0.74	1.5	1,196	151	27	147,284
2069	233,639	155,103	3,177	16	0.41	0.27	0.4	145	0.0074	299	0.15	0.56	2.0	7.4	0.48	80	7,131	2.4	0.00074	7.8	1.8	51	4,546	7.0	530	0.0056	168,960	255	0.0056	0.056	2.5	0.74	1.5	1,287	163	30	148,041
2070	236,312	156,526	3,177	15	0.42	0.28	0.4	145	0.0075	311	0.15	0.57	2.0	7.5	0.48	80	7,234	2.4	0.00075	8.0	1.8	51	4,547	7.1	530	0.0057	170,682	255	0.0057	0.057	2.5	0.75	1.5	1,328	168	31	149,328
2071	238,190	157,850	3,177	14	0.42	0.28	0.4	145	0.0075	323	0.15	0.57	2.0	7.5	0.49	80	7,324	2.4	0.00075	8.0	1.8	51	4,547	7.1	530	0.0057	172,012	255	0.0057	0.057	2.5	0.75	1.5	1,269	160	29	150,505
2072	242,807	159,755	3,177	16	0.43	0.29	0.41	145	0.0076	307	0.15	0.58	2.0	7.6	0.5	80	7,442	2.4	0.00076	8.2	1.8	51	4,547	7.1	530	0.0058	174,885	255	0.0058	0.058	2.6	0.76	1.5	1,151	146	26	151,916
2073	244,657	159,770	3,177	15	0.43	0.29	0.4	145	0.0076	315	0.15	0.59	2.1	7.6	0.51	80	7,481	2.5	0.00076	8.2	1.9	51	4,547	7.2	530	0.0059	175,699	255	0.0059	0.059	2.6	0.76	1.5	1,061	134	24	152,292
2074	247,171	160,010	3,177	15	0.44	0.29	0.41	145	0.0077	327	0.15	0.6	2.1	7.7	0.53	80	7,527	2.5	0.00077	8.3	1.9	51	4,547	7.3	530	0.0059	176,912	255	0.0059	0.059	2.6	0.77	1.5	1,038	131	24	153,237
2075	249,872	159,970	3,177	14	0.44	0.3	0.4	145	0.0077	340	0.15	0.62	2.1	7.7	0.54	80	7,572	2.6	0.00077	8.4	2.0	51	4,547	7.5	530	0.006	178,095	255	0.006	0.06	2.7	0.77	1.5	1,018	129	23	153,995
2076	255,542	161,841	3,177	17	0.45	0.31	0.41	145	0.0078	305	0.16	0.64	2.1	7.8	0.56	80	7,693	2.7	0.00078	8.6	2.0	51	4,547	7.8	530	0.0061	181,465	255	0.0062	0.061	2.7	0.78	1.6	1,053	133	24	155,005
2077	258,637	161,819	3,177	17	0.46	0.32	0.4	145	0.0078	309	0.16	0.66	2.2	7.8	0.58	80	7,740	2.8	0.00078	8.7	2.1	51	4,547	8.1	530	0.0062	182,839	255	0.0062	0.062	2.8	0.78	1.6	1,091	138	25	155,356
2078	262,179	162,204	3,177	17	0.46	0.32	0.4	145	0.0078	316	0.16	0.69	2.2	7.8	0.61	80	7,803	2.9	0.00078	8.8	2.2	51	4,547	8.4	530	0.0062	184,593	255	0.0063	0.063	2.8	0.78	1.6	1,141	144	26	156,236
2079	265,408	163,840	3,177	17	0.47	0.33	0.41	145	0.0079	317	0.16	0.71	2.2	7.9	0.63	80	7,891	3.0	0.00079	8.9	2.3	51	4,547	8.7	530	0.0063	186,720	255	0.0064	0.064	2.8	0.79	1.6	1,172	148	27	157,251
2080	268,368	166,029	3,177	17	0.47	0.34	0.41	145	0.0079	319	0.16	0.74	2.3	7.9	0.65	80	7,996	3.1	0.00079	9.0	2.4	51	4,547	9.0	530	0.0064	188,943	255	0.0064	0.065	2.9	0.79	1.6	1,173	148	27	158,470
2081	270,820	166,272	3,177	17	0.48	0.35	0.41	145	0.0079	325	0.16	0.76	2.3	7.9	0.67	80	8,048	3.1	0.00079	9.1	2.4	51	4,548	9.2	530	0.0064	190,130	255	0.0065	0.065	2.9	0.79	1.6	1,193	151	27	158,838
2082	271,220	170,249	3,177	18	0.48	0.35	0.41	145	0.008	314	0.16	0.77	2.3	8.0	0.68	80	8,156	3.2	0.0008	9.1	2.5	51	4,548	9.3	530	0.0064	191,952	255	0.0065	0.065	2.9	0.8	1.6	1,162	147	27	159,814
2083	270,326	173,983	3,178	18	0.48	0.35	0.42	145	0.008	306	0.16	0.78	2.3	8.0	0.69	80	8,253	3.2	0.0008	9.1	2.5	51	4,548	9.4	530	0.0064	193,053	255	0.0065	0.065	2.9	0.8	1.6	1,183	150	27	160,383
2084	272,779	176,556	3,178	18	0.48	0.36	0.42	145	0.0081	310	0.16	0.79	2.3	8.1	0.7	80	8,381	3.3	0.00081	9.2	2.6	51	4,548	9.6	530	0.0065	195,161	255	0.0066	0.066	2.9	0.81	1.6	1,171	148	27	161,637
2085	272,007	178,451	3,178	18	0.48	0.36	0.42	145	0.0081	310	0.16	0.79	2.3	8.1	0.7	80	8,453	3.3	0.00081	9.2	2.6	51	4,548	9.7	530	0.0064	195,547	255	0.0065	0.065	2.9	0.81	1.6	1,198	151	28	161,890
2086	274,151	180,017	3,178	18	0.48	0.37	0.43	145	0.0081	317	0.16	0.81	2.4	8.1	0.72	80	8,558	3.3	0.00081	9.2	2.6	51	4,548	9.8	530	0.0065	197,076	255	0.0066	0.066	2.9	0.81	1.6	1,170	148	27	162,778
2087	274,417	181,762	3,178	17	0.48	0.37	0.43	145	0.0082	322	0.16	0.8	2.4	8.2	0.72	80	8,648	3.3	0.00082	9.2	2.6	51	4,548	9.8	530	0.0065	197,831	255	0.0066	0.066	2.9	0.82	1.6	1,182	149	27	163,470
2088	278,238	184,154	3,178	19	0.49	0.37	0.43	145	0.0082	308	0.16	0.81	2.4	8.2	0.73	80	8,795	3.4	0.00082	9.4	2.6	51	4,548	9.9	530	0.0066	200,479	255	0.0067	0.067	3.0	0.82	1.7	1,114	141	26	164,570
2089	278,070	188,038	3,178	22	0.49	0.37	0.44	145	0.0082	278	0.16	0.81	2.4	8.2	0.72	80	8,919	3.3	0.00082	9.4	2.6	51	4,548	9.8	530	0.0066	201,978	255	0.0067	0.067	3.0	0.82	1.7	1,110	140	26	164,772
2090	277,778	191,572	3,178	22	0.49	0.37	0.44	145	0.0083	272	0.17	0.81	2.4	8.3	0.73	80	9,044	3.3	0.00083	9.3	2.6	51	4,549	9.7	530	0.0066	203,237	255	0.0067	0.067	3.0	0.83	1.7	1,042	132	24	165,462
2091	278,395	193,905	3,178	22	0.49	0.37	0.45	145	0.0083	273	0.17	0.81	2.4	8.3	0.72	80	9,165	3.3	0.00083	9.4	2.6	51	4,549	9.7	530	0.0066	204,381	255	0.0067	0.067	3.0	0.83	1.7	1,058	134	24	166,285
2092	280,457	196,798	3,178	22	0.49	0.37	0.45	145	0.0084	275	0.17	0.81	2.4	8.4	0.73	80	9,323	3.3	0.00084	9.4	2.6	51	4,549	9.8	530	0.0067	206,401	255	0.0067	0.067	3.0	0.84	1.7	1,046	132	24	167,587
2093	278,867	200,885	3,178	23	0.49	0.37	0.46	145	0.0084	266	0.17	0.8	2.4	8.4

Table A10. Annual loads of the NAG backfill for the high nitrogen scenario.

Model Year	SO4	Alkalinity	Cl	Al	Sb	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	U	V	Zn	NO3	NH3	NO2	Seepage Rate
	kg/year	kg/year as CaCO3	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	kg/year	m^3/year
2135	293,380	298,007	3,182	43	0.52	0.42	0.59	145	0.0093	180	0.19	0.89	2.8	9.3	0.82	80	14,476	3.6	0.00093	9.9	2.9	51	4,554	11	531	0.0071	249,369	256	0.0071	0.071	3.1	0.93	1.9	729	92	17	186,569
2136	294,116	300,087	3,182	44	0.52	0.42	0.59	145	0.0094	180	0.19	0.88	2.8	9.4	0.82	80	14,627	3.6	0.00094	9.9	2.9	51	4,554	10	531	0.0071	250,409	256	0.0071	0.071	3.1	0.94	1.9	720	91	17	187,180
2137	294,526	299,791	3,182	43	0.52	0.42	0.59	145	0.0093	180	0.19	0.89	2.8	9.3	0.82	80	14,660	3.6	0.00093	9.9	2.9	51	4,554	11	531	0.0071	250,386	256	0.0071	0.071	3.1	0.93	1.9	719	91	17	186,716
2138	292,307	302,917	3,182	45	0.52	0.41	0.59	145	0.0093	175	0.19	0.88	2.8	9.3	0.81	80	14,758	3.6	0.00093	9.8	2.9	51	4,554	10	531	0.007	250,579	256	0.007	0.07	3.1	0.93	1.9	718	91	17	186,790
2139	289,713	306,716	3,182	46	0.51	0.41	0.6	145	0.0094	171	0.19	0.87	2.8	9.4	0.8	80	14,875	3.5	0.00094	9.7	2.9	51	4,554	10	531	0.007	250,880	256	0.007	0.07	3.1	0.94	1.9	719	91	17	187,056
2140	288,790	309,416	3,182	47	0.51	0.41	0.61	145	0.0094	170	0.19	0.86	2.8	9.4	0.79	80	15,004	3.5	0.00094	9.7	2.8	51	4,554	10	531	0.007	251,418	256	0.0069	0.069	3.1	0.94	1.9	722	91	17	187,514
2141	285,594	310,955	3,182	48	0.5	0.4	0.61	145	0.0093	167	0.19	0.84	2.7	9.3	0.78	80	15,062	3.4	0.00093	9.6	2.8	51	4,554	10	531	0.0069	250,495	256	0.0069	0.069	3.0	0.93	1.9	721	91	17	186,895
2142	284,497	312,138	3,182	48	0.5	0.4	0.61	145	0.0093	166	0.19	0.84	2.7	9.3	0.77	80	15,125	3.4	0.00093	9.6	2.8	51	4,555	10	531	0.0068	250,391	256	0.0068	0.068	3.0	0.93	1.9	722	91	17	186,886
2143	282,701	314,516	3,182	48	0.5	0.39	0.62	145	0.0094	164	0.19	0.82	2.7	9.4	0.75	80	15,260	3.3	0.00094	9.5	2.7	51	4,555	10	531	0.0068	250,382	256	0.0068	0.068	3.0	0.94	1.9	724	91	17	187,034
2144	282,564	316,417	3,182	49	0.5	0.39	0.62	145	0.0094	164	0.19	0.81	2.7	9.4	0.75	80	15,365	3.3	0.00094	9.5	2.7	51	4,555	10	531	0.0068	250,980	256	0.0068	0.068	3.0	0.94	1.9	726	92	17	187,551
2145	280,098	317,409	3,183	49	0.49	0.38	0.63	145	0.0094	162	0.19	0.79	2.7	9.4	0.72	80	15,447	3.2	0.00094	9.4	2.6	51	4,555	9	531	0.0067	250,100	256	0.0067	0.067	3.0	0.94	1.9	724	91	17	187,019
2146	279,425	318,300	3,183	49	0.49	0.38	0.63	145	0.0094	162	0.19	0.78	2.7	9.4	0.72	80	15,509	3.2	0.00094	9.4	2.6	51	4,555	9.2	531	0.0067	250,071	256	0.0067	0.067	3.0	0.94	1.9	723	91	17	187,081
2147	278,254	320,021	3,183	49	0.49	0.38	0.63	145	0.0094	161	0.19	0.76	2.7	9.4	0.7	80	15,631	3.1	0.00094	9.4	2.5	51	4,555	9.0	531	0.0067	250,059	256	0.0067	0.067	3.0	0.94	1.9	716	91	16	187,212
2148	278,291	321,567	3,183	50	0.49	0.37	0.64	145	0.0094	161	0.19	0.75	2.7	9.4	0.69	80	15,727	3.1	0.00094	9.4	2.5	51	4,555	8.9	531	0.0067	250,610	256	0.0067	0.067	3.0	0.94	1.9	712	90	16	187,667
2149	276,225	321,860	3,183	50	0.49	0.37	0.64	145	0.0094	159	0.19	0.73	2.6	9.4	0.67	80	15,781	3.0	0.00094	9.3	2.4	51	4,555	8.7	531	0.0066	249,667	256	0.0066	0.066	2.9	0.94	1.9	687	87	16	187,030
2150	275,653	322,343	3,183	50	0.49	0.36	0.64	145	0.0093	159	0.19	0.72	2.6	9.3	0.66	80	15,824	2.9	0.00093	9.3	2.4	51	4,555	8.6	531	0.0066	249,532	256	0.0066	0.066	2.9	0.93	1.9	669	85	15	186,985

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APPENDIX 6: TENAS PROJECT INFORMATION REQUEST RESPONSES RELATED TO SURFACE WATER VALUED COMPONENT, SRK

APPENDIX 7: WATER AND WASTEWATER TREATMENT DESIGN REPORT AND BIONEST ASSURANCE LETTER, RADLOFF

APPENDIX 8: TENAS PROJECT, HYDROGEOLOGY TECHNICAL REPORT, SRK

APPENDIX 9: EVALUATION OF ACUTE DAPHNIA MAGNA AND RAINBOW TROUT LC50 TOXICITY SUPPORTING TENAS PROJECT BEST AVAILABLE TECHNOLOGY ASSESSMENT STUDY – PARAMETERS OF CONCERN: NITRITE, IRON (TOTAL) AND IRON (DISSOLVED)

APPENDIX 10: EFFECT OF MITIGATION CONTROLS ON WATER QUALITY AND QUANTITY OF THE TENAS PROJECT, SRK

APPENDIX 11: TENAS PROJECT BEST ACHIEVABLE TECHNOLOGY ASSESSMENT UPDATED, SRK

APPENDIX 12: ENVIRONMENTAL EFFECTS ASSESSMENT - SURFACE WATER VALUED COMPONENT

APPENDIX 13: TENAS PROJECT, INITIAL DILUTION ZONE ASSESSMENT, SRK

APPENDIX 14: TENAS COAL MINE INFORMATION REQUEST # 498, 500-504, AND 520 - EXPERT ADVICE REGARDING FISH AND FISH HABITAT WITHIN THE PROJECT AREA, PALMER ENVIRONMENTAL

APPENDIX 15: TENAS PROJECT, MINE MATERIAL MANAGEMENT BASED ON AN NPR CUT-OFF OF 2.0, 1.80, 1.60, AND 1.20, TELKWA MINING

APPENDIX 16: TELKWA COAL TENAS PROJECT ENVIRONMENTAL ASSESSMENT APPLICATION – RESPONSES TO 2022 SUPPLEMENTAL GEOCHEMISTRY INFORMATION REQUESTS FROM THE MINISTRY OF ENERGY, MINES AND LOW CARBON INNOVATION, SRK

APPENDIX 17: METAL LEACHING/ACID ROCK DRAINAGE MANAGEMENT PLAN, SRK

APPENDIX 18: TENAS PROJECT INFORMATION REQUEST RESPONSES RELATED TO GEOTECHNICAL ASPECTS, SRK

APPENDIX 19: TENAS PROJECT DAM BREACH ASSESSMENT REPORT, SRK

APPENDIX 20: PAG MANAGEMENT ALTERNATIVES ASSESSMENT, SRK

APPENDIX 21: TENAS PROJECT POTENTIAL ACID GENERATING MATERIAL STORAGE ALTERNATIVES ASSESSMENT, SRK

APPENDIX 22: TENAS PROJECT INFORMATION REQUEST RESPONSES FROM OFFICE OF THE WET'SUWET'EN – FINAL, SRK

Attachment B: Telkwa Mining Response to the follow up information requests from MENV on April 15, 2026

Attachment C: Telkwa Mining Response to the follow up information requests from MCMM on May 15, 2026

Attachment D: Telkwa Mining Response to the follow up information requests 8 and 9 from MENV on May 22, 2026

Attachment E: Telkwa Mining Response to the follow up information request 8 from MENV and MCMM on June 25, 2026