



BC EAO EAC Application – Tenas Project

Section 13.0 Management Plans

Chapter 15.0 Reclamation and Closure Plan

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Tenas Project

Section 13.0 Management Plans

Chapter 15.0 Reclamation and Closure Plan

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ABBREVIATIONS AND ACRONYMS

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
ALC	Agricultural Land Commission
ALR	Agricultural Land Reserve
A&P	Arya and Paris
ASMR	absolute soil moisture regime
AWSC	available water-storage capacity
BC	British Columbia
BCCL	Bulkley Valley Collieries Ltd.
BEC	biogeoclimatic ecosystem classification
BGC	biogeoclimatic
BC EAO	British Columbia Environmental Assessment Office
BC MECCS	British Columbia Ministry of Environment and Climate Change Strategy
BC MEM	British Columbia Ministry of Energy and Mines
BC MEMLI	British Columbia Ministry of Energy, Mines and Low Carbon Innovation
BMPs	best management practices
C	Chapter
CCME	Canadian Council of Ministers of the Environment
CMER	Coal Mine Effluent Regulations
CNR	Canadian National Railway
Code	Health, Safety and Reclamation Code for Mines in British Columbia (British Columbia Ministry of Energy, Mines and Low Carbon Innovation [BC MEMLI] 2021) (Code)
CPP	Coal Processing Plant
CEMP	Construction Environmental Management Plan (S13.0-C4)
CMSTHP	Chemicals and Materials, Storage, Transfer, and Handling Plan (S13.0-C3)
DMP	Discharge Management Plan (S13.0-C5)
EA	environmental assessment
EAC	Environmental Assessment Certificate
EC	electric conductivity
EMP	Explosives Management Plan (S13.0-C6)
EDI	Environmental Dynamics Inc.
EMS	Environmental Management System (S13.0-C1)
FMSCP	Fuel Management and Spill Control Plan (S13.0-C7)
GovCan	Government of Canada
HRMP	Heritage Resources Management Plan (S13.0-C8)

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
ICHmc2	Hazleton Moist Cold Interior Cedar Hemlock biogeoclimatic unit
IDFmw2	Thompson Moist Warm Interior Douglas-Fir biogeoclimatic unit
IEG	Integral Ecology Group
IPCC	Intergovernmental Panel on Climate Change
JAIR	Joint Application Information Requirements for <i>Mines Act</i> and <i>Environmental Management Act</i> Permits (British Columbia Ministry of Energy, Mines and Petroleum Resources [BC MEMPR] and British Columbia Ministry of Environment and Climate Change Strategy [BC MECCS] 2019)
LMH	land management handbook
JAIR	Joint Application Information Requirements
LFH	organic soil layers developed under well- to imperfectly drained conditions
LOM	life of mine
ML/ARD	metal leaching/acid rock drainage
MMER	Metal Mine Effluent Regulations
MWMP	Minesite Water Management Plan (S13.0-C11).
NAG	non-acid generating
OVb	overburden
OW	Office of the Wet'suwet'en
PAMP	Public Access Management Plan (S13.0-C14)
PET	potential evapotranspiration values
pH	parts hydrogen
POPC/COPC	Parameters of Potential Concern/Contaminants of Potential Concern
POC/COC	Parameters of Concern/Contaminants of Concern
Project	Tenas Project
PSD	particle-size distribution
PSP	permanent sample plot
QEA	quantitative ecohydrological analysis
QP	qualified professional
RCP	Reclamation and Closure Plan
RSMR	relative soil moisture regime
S	Section
SBS	Sub-Boreal Spruce
SBSdk	Sub-Boreal Spruce Dry Cool biogeoclimatic unit
SBSmc2	Babine Moist Cold Sub-Boreal Spruce biogeoclimatic unit
SMR	soil moisture regime
SNR	soil nutrient regime
SMU	soil management unit

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
S&R	Saxton and Rawls
TAC	Tenas Access Corridor
TCL	Telkwa Coal Limited
TCP	Tenas Control Pond
TEM	terrestrial ecosystem mapping
Tfc	field capacity tension
TN	total nitrogen
TSS	total suspended solids
WRC	water retention curves
VMP	Vegetation Management Plan (S13.0-C18)
VRMP	Visual Resources Management Plan (S13.0-C19)
WCP	Water Control Pond
WMP	Wildlife Management Plan (S13.0-C21)

UNITS OF MEASURE

Abbreviation or Acronym	Long Form of Abbreviation or Acronym
μ	micron
%	percent
cm	centimetre
dS/m	decisiemens per metre
EC	electrical conductivity
ha	hectare
km	kilometre
LCM	loose cubic metre
m	metre
MLCM	million loose cubic metres
mtpa	metric tonnes per annum
mm	millimetre
Mm ³	million cubic metres

EXECUTIVE SUMMARY

Telkwa Coal Limited (TCL) is proposing to develop the Tenas Project (Project), which is an open-pit surface metallurgical coal mine with an anticipated mine life of approximately 26.5 years and a footprint of 830.1 hectares (ha). The Project will require the following elements over the course of all phases:

- ▶ a soil-salvage program to provide materials for use in reclamation;
- ▶ progressive-reclamation activities while the Project is in operation; and
- ▶ reclamation planning, implementation, and management that allows for land affected by the Project to be fully and successfully reclaimed.

The closure goal for the Project is the return of local ecosystems through reclamation; therefore, the overarching land-capability objective is, to the extent possible, to return the pre-existing ecosystems in the proportion that they existed prior to the Project, and to achieve an average land capability no less than the average that existed prior to mining. This goal and objective is supported by this Reclamation and Closure Plan (RCP), which provides guidance, prescriptions, and best practices to minimize potential Project effects on existing vegetation and ecosystems, and to ensure that mitigation efforts are successful and remain so throughout all phases of the Project.

To develop this reclamation plan, modelling was applied to compare projected post-closure ecosystems based on the RCP to pre-mine conditions. This approach was intended to minimize ecosystem differences between pre-mine and post-closure states, and to generate reclamation-cover and revegetation designs to guide reclamation at a site-wide level with consideration for ecosystem shifts due to climate change and other important aspects of closure (i.e., water management). The RCP provides information on key assumptions and uncertainties in this process, and will guide reclamation research and monitoring and maintenance programs implemented or planned to test these assumptions and reduce uncertainties.

As part of the reclamation-cover design process, suitability of available reclamation materials (i.e., surface soil and overburden [OVB]) was assessed to enable incorporation of suitability considerations into calculations of reclamation-material supply. Suitability was evaluated using the soil management units (SMUs) defined in the Tenas Project Terrain and Soil Baseline Report. Available water-storage capacity (AWSC) was used as the primary suitability criterion because soil water supply is a dominant control on the characteristics of an ecosystem, including its nutrient regime. The SMUs were grouped into suitability classes based on AWSC (i.e., low-AWSC mineral, high-AWSC mineral, and organic) and operational salvage constraints (steep slopes and shallow surface-soil thicknesses).

All surface soil that is sufficiently deep and operationally accessible is categorised as suitable for salvage, as all surface-soil types can support ecosystems on the pre-Project landscape. Design of reclamation covers for the Project is therefore based on two (2) fundamental approaches/conditions:

1. salvage, storage, and replacement of surface soils throughout the Project footprint; and
2. the abundant (non-constrained) supply of suitable morainal OVB available for use as a subsurface lift underlying surface-soil layers in reclamation covers.

These approaches and conditions are unusual in reclamation in BC, as it is rare to (1) salvage virtually all surface soils, (2) segregate surface soil into multiple suitability classes, and (3) construct two-lift cover systems (surface soil over overburden) with OVB depths of at least one metre (m) across the majority of a Project footprint. Thus, the design of reclamation covers for the Project represents industry-leading practices and is based on an unconstrained supply of cover resources.

Achievement of this cover system requires 4.41 Mm³ of overburden and 2.14 Mm³ of surface soil, consisting of 1.80 Mm³ of high-AWSC mineral surface soil, 0.27 Mm³ of low-AWSC mineral surface soil; and 0.07 Mm³ of organic-mineral mix surface soil. Materials that are available for the design of reclamation covers currently offer a surplus.

The RCP has been developed following review of Project-specific baseline studies and the environmental assessment of the Terrain and Soils, Vegetation, and Wildlife VCs. The RCP is intended to be a living document; the information provided in the RCP is initial and is based on the best information available at this time. As such, the RCP will be refined throughout the mine life through progressive reclamation, adaptive management, and reclamation research.

1. INTRODUCTION

The nature of mining activities has effects within the Project Area as well as the surrounding environment. Telkwa Coal Limited (TCL) strives to mitigate these effects and is committed to minimizing the terrestrial footprint of the Tenas Project (Project), and to prevent significant permanent residual effects on terrestrial and aquatic biota. Project reclamation and closure planning has therefore been integrated with overall mine planning and design. The overarching objective of the Reclamation and Closure Plan (RCP) is to reclaim ecosystems after Project development to be like those that would be present in the area and to achieve an average land capability in these areas not less than the existing land productivity if the Project did not occur.

A portion of the Project Components (49.1 hectares [ha], representing approximately 2.5 percent [%] of the total Project Area and 5.9% of the Project footprint) are situated within the BC Agricultural Land Reserve (ALR). This RCP will provide guidance and best practices to inform the conservation of the agricultural capability of affected lands to achieve an equivalent land capability in the Post-closure Phase of the Project. Please see attached **Appendix 13.15-A** for a separate but related reclamation and closure plan that was developed specifically for lands within the ALR.

The Project will require a surface soil salvage program during the Construction, and Operation phases to provide materials for use in reclamation in subsequent phases, progressive-reclamation activities during the Operation, Decommissioning and Reclamation, and Post-closure phases to allow for mine affected lands to be fully and successfully reclaimed. This RCP describes the management processes and procedures associated with all Phases to allow the Project to be developed and reclaimed in a safe and environmentally responsible manner.

2. PURPOSE AND OBJECTIVES

The purpose of this RCP is to develop a Five (5) Year Detailed reclamation plan and an overarching conceptual reclamation and closure plan for the end of the Operation Phase to ensure that efforts to mitigate the Project's effects are successful and remain so through the life of the Project including Post-closure Phase. To accomplish this, the primary objectives of the RCP are:

- ▶ to identify specific practices with respect to mitigation strategies identified in this RCP to maximize reclamation effectiveness, and
- ▶ to develop a system to evaluate and report on the Project's ongoing effects on the environment and the effectiveness of the mitigation and reclamation strategies.

3. SCOPE AND SCALE

The scope of this RCP is defined within the Project Area. The RCP applies to all Project activities and associated infrastructure occurring within the footprint of the Project (major Project components are presented in subsection 6 by **Figure 6.1-1** and **Figure 6.1-2**. The RCP is in effect during Construction, Operation, Decommissioning and Reclamation, and Post-closure phase activities and ceases to be in force at the final closure of the Project as approved by regulatory authorities.

4. COMPLIANCE OBLIGATIONS

4.1 Regulatory Requirements

Provincial legislation, regulations, policy, and guidance documents applicable to the Project and relevant to this RCP are described in **Table 4.1-1**. This summary includes legislative requirements that are directly applicable to reclamation and closure in the RCP.

Table 4.1-1: Legislation and Guidelines Relevant to the Reclamation and Closure Plan (RCP)

Legislation, Regulations, and Guidelines	Applicable Information
Bulkley Land and Resource Management Plan (LRMP) (Government of British Columbia [GovBC] 1998)	The Bulkley LRMP identifies visual quality as an important consideration for all resource development projects and as such, this relates to reclamation and closure management. The LRMP also has management objectives regarding planning to sustain a viable caribou population and manage caribou habitat.
<i>Forest and Range Practices Act</i> RSBC 2002, c 69 (GovBC 2002) (<i>FRPA</i>)	<i>FRPA</i> assesses the effectiveness of maintaining wildlife habitat and species across their natural ranges and over time in British Columbia (BC).
Health, Safety and Reclamation Code for Mines in British Columbia (British Columbia Ministry of Energy, Mines and Low Carbon Innovation [BC MEMLI] 2021) (Code)	The Code stipulates the permitting, reclamation, and closure requirements for mines in BC and the reclamation standards within Part 10 of the Code.
Joint Application Information Requirements for <i>Mines Act</i> and <i>Environmental Management Act</i> permits (BC MEMLI and British Columbia Ministry of Environment and Climate Change Strategy [BC MECCS] 2019)	Provides direction for what is to be included in Reclamation and Closure chapters and environmental management plans.
<i>Mines Act</i> (1996) (GovBC 1996)	The Act requires that mining operations comply with the Code.

The Joint Application Information Requirements for *Mines Act* and *Environmental Management Act* Permits (British Columbia Ministry of Energy, Mines and Low Carbon Innovation [BC MEMLI] and British Columbia Ministry of Environment and Climate Change Strategy [BC MECCS] 2019) (JAIR) provides direction in developing plans in Chapter 4, Reclamation and Closure Plans (11 components), including scheduling and costs, and in Section 9.3 of the JAIR respecting Soil Management Plans (Appendix 1-B attached), which were utilized in the development of this RCP. The RCP is designed to fulfill the requirements of *Mines Act*, RSBC 1996, c 293 and *Environmental Management Act*, SBC 2003, c 53 (*MA/EMA*) permits for British Columbia (BC).

Furthermore, specific to the regulatory requirements of the *Mines Act*, RSBC 1996, c 293 and Code, Section 10.7.4 (Land Use) of the Code, requires that:

The land surface shall be reclaimed to an end land use approved by the chief permitting officer that considers previous and potential uses.

Section 10.7.5 (Capability) of the Code requires:

Excluding lands that are not to be reclaimed, the average land capability to be achieved on the remaining lands shall not be less than the average that existed prior to mining, unless the land capability is not consistent with the approved end land use or compromises long-term physical and/or geochemical stability.

This RCP describes how end land use and land capability objectives will be achieved to the extent feasible by the end of the Project's Post-closure Phase.

5. RELATIONSHIP TO OTHER MANAGEMENT PLANS

The Project is governed by an **Environmental Management System (Section [S] 13.0-C1) (EMS)**, an overarching management plan strategy comprising a set of processes and practices which enable TCL to manage its environmental and safety performance in a holistic way, within an integrated framework. While the management plans are part of the **EMS**, the **EMS** is not just a collection of management plans.

In addition to the overall guidance of the **EMS**, this RCP has a relationship with other management plans that also present mitigation measures. Those management plans and their relationship to this RCP are listed in **Table 5-1**.

Table 5-1: Management Plans with a Relationship to the Reclamation and Closure Plan (RCP)

Management Plans	Nature of Relationship
Environmental Management System (S13.0-C1) (EMS)	All management plans are part of the EMS, including this RCP.
Air Quality Management Plan (S13.0-C2) (AQMP)	The AQMP provides dust mitigation measures which will be monitored under this RCP by way of sampling programs to monitor trace element (metals) uptake in soils and vegetation.
Chemical and Materials Storage, Transfer, and Handling Plan (S13.0-C3) (CMSTH)	This plan will apply to these items being used during the progressive reclamation phase in the Operation and the Decommissioning and Reclamation phases of the Project and into Post-closure Phase, if required.
Construction Environmental Management Plan (S13.0-C4) (CEMP)	This plan applies to soil salvage and storage activities during the Construction and Operation phases of the Project and regarding the Soil Management Plan in Appendix 1-B attached.
Fuel Management and Spill Control Plan (S13.0-C7) (FMSCP)	This plan will apply to these items being used during all phases including the Decommissioning and Reclamation Phase of the Project and into the Post-closure Phase, if required.
Public Access Management Plan (S13.0-C14) (PAMP)	This plan will apply to public access during progressive reclamation activities in the Operation and the Decommissioning and Reclamation phases of the Project and into the Post-closure Phase, if required.
Soil Management Plan (Appendix 13.15-A-B) (SMP)	The SMP is an Appendix to the RCP, and informs the RCP by detailing a reclamation-materials balance based on soils and overburden (OVB) available for salvage and projected demands for these materials to achieve similar land ecosystems that would exist if the Project did not occur. The SMP guides the salvage, storage, and placement of soil materials to maximize the retention and benefit of soil resources for reclamation and to provide a consistent approach to site-specific soil management.
Surface Erosion Prevention and Sediment Control (S13.0-C17) (SEPSCP)	The relevant aspects of this plan will be applied during the Decommissioning and Reclamation Phase of the Project and the Post-closure Phase, if required.
Vegetation Management Plan (S13.0-C18) (VMP)	The VMP informs this RCP by indicating measures for vegetation retention strategies and use of invasive plant control.
Visual Resources Management Plan (S13.0-19) (VRMP)	The VRMP provides a plan to ensure that efforts to mitigate the Project's effects on Visual Resources are effective and remain so through the life of the Project, including monitoring from set

Management Plans	Nature of Relationship
	viewpoints. Vegetation visual screening is also prescribed in this plan at the Rail Infrastructure and is part of the RCP.
Wildlife Management Plan (S13.0-C21) (WMP)	The WMP outlines the regulatory obligations and commitments to avoid or minimize effects on wildlife and wildlife habitat which are part of the RCP.
Minesite Traffic Control Plan (MTCP) (S13.0-C10)	This plan will apply to traffic patterns and rules during progressive reclamation activities in the Operation and the Decommissioning and Reclamation phases of the Project.

5.1 Standard Practices and Procedures (SPPs)

All TCL Standard Practices and Procedures (SPPs) will conform to the Code.

In addition to regulatory requirements, the Project will implement SPPs that meet or exceed the required laws and regulations.

6. DETAILS OF THE CONCEPTUAL RECLAMATION AND CLOSURE PLAN END OF OPERATION PHASE

This subsection provides the details of the current RCP for the Project. A project description is available as part of EAC Application submission (**S1.0 Overview of Project Proponent Description**), and includes a regional overview, a Project overview, history, geology, Project phases and activity, life-of-mine (LOM) description, detailed Five (5) Year mine plan, Project components, scheduling, and regulatory context.

This RCP is intended to be a living document that will guide the management processes and procedures associated with developing and reclaiming the Project area in a safe and environmentally responsible manner, including the development of reclamation and closure prescriptions, and monitoring and maintenance programs designed to meet approved end land uses and provide an average land capability not less than the average that existed prior to mining. This will be an iterative process; the information provided in the RCP is preliminary and is based on the best information available at this time, and will be refined throughout the mine life through progressive reclamation and reclamation research designed to address potential uncertainties and investigate opportunities to improve the RCP.

6.1 Summary of Reclamation and Development Activities Over the Project's Life

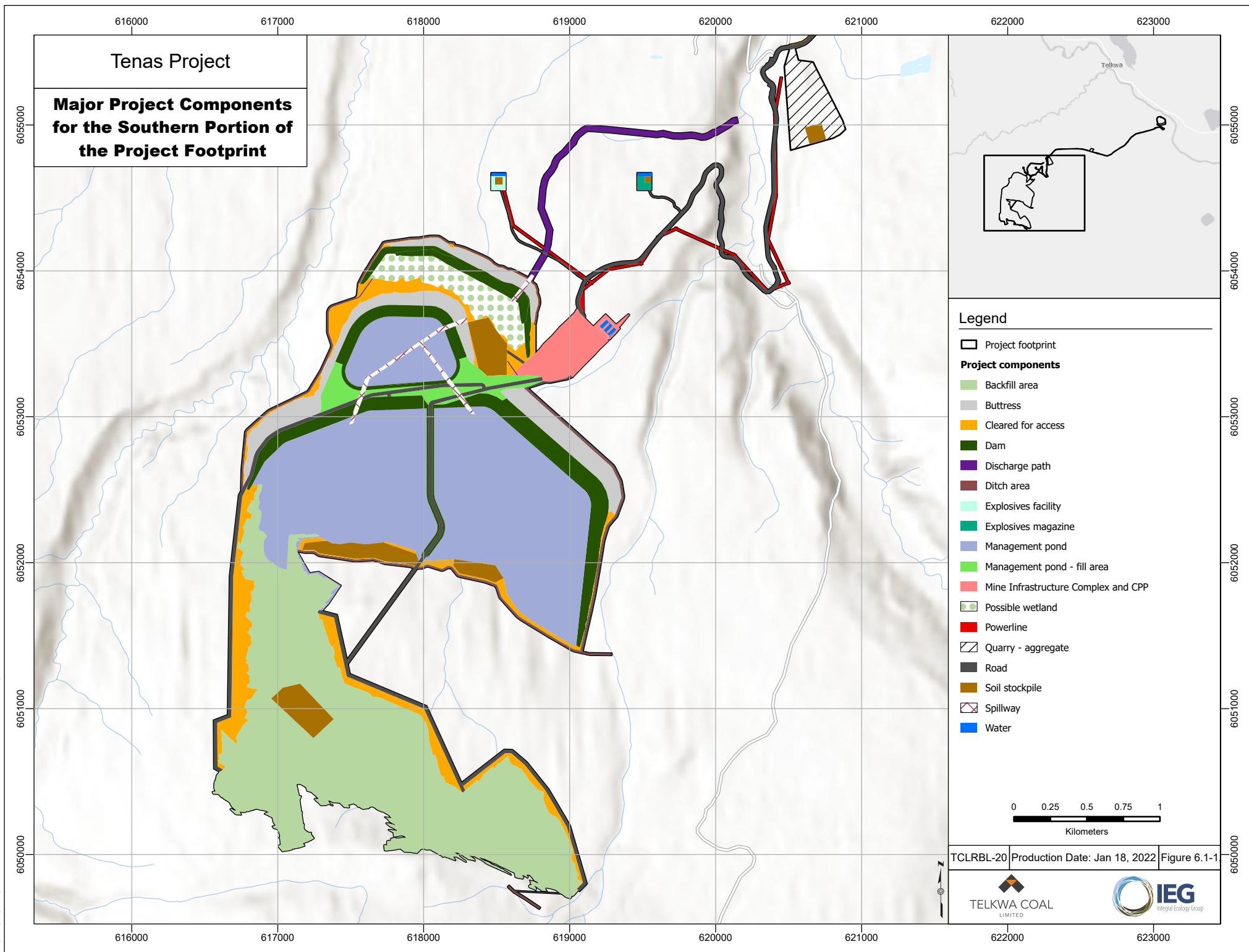
Table 6.1-1 below provides a summary of the reclamation and development activities completed over the Construction, Operation, Decommissioning and Reclamation, and Post-closure phases for the Project. **Figure 6.1-1** and **6.1-2** show the major project components for the southern and northern areas of the Project respectively.

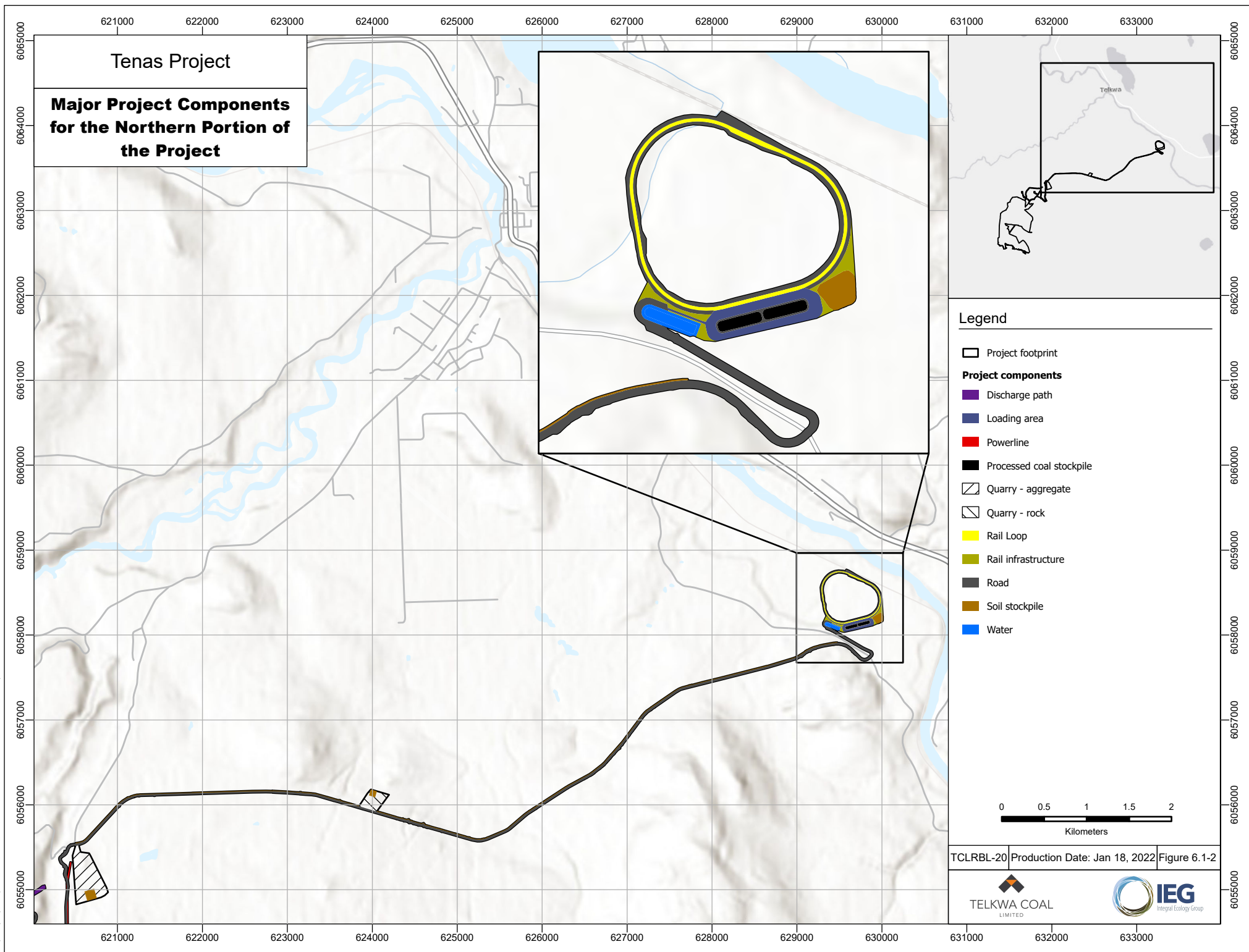
Table 6.1-1: Summary of Reclamation and Development Activities During the Construction, Operation, and Decommissioning and Reclamation Phases of the Project

Year	Logging and Clearing (ha)	Surface Soil Salvage Areas (ha)	Surface Soil Salvage Volumes (m ³)	Surface Soil Placement Volumes Including Direct Placement (m ³)	Direct Placement Volumes of Surface Soils (m ³)	Surface Soil Remaining in Stockpiles (m ³)	Surface Soil Placement Areas (ha)	Revegetation and Fertilizer Treatment Areas (ha)
-0.5	313	284	797,257	-	-	797,257	-	-
0	32	20	83,283	-	-	880,540	-	-
1	48	47	140,186	96,062	96,062	924,665	18	18
2	136	134	365,868	76,503	76,503	1,214,030	26	26
3	42	42	139,931	69,052	69,052	1,284,909	14	14
4	10	9	28,295	67,614	28,295	1,245,590	23	23
5	8	8	24,096	88,211	24,096	1,181,475	29	29
6-10	70	66	194,239	557,579	194,239	818,134	186	189
11-15	104	103	292,059	189,622	189,622	920,571	63	63
16-20	67	66	198,658	175,897	175,897	943,333	59	59
21-25	-	-	-	820,575	-	122,757	263	309
TOTAL	830.1	779.0	2,263,873	2,141,116***	853,766	122,757*	679.3	729.3

Notes: ha=hectare; m³=cubic metres

- Some Project component footprints have already been disturbed so no surface soil remaining to salvage has been assumed for these areas while in the field there might be some surface soil recovered during salvage operation.
- Any excess surface soils present will be used in the Decommissioning and Reclamation Phase to provide additional diversity and final landform configuration and micro ecosystems
- The area for surface soil placement does not match the surface soil salvage areas as some portions of the Project footprint are not reclaimed including the water effluent channel, portions of the Tenas Access Corridor (TAC), spillway for management ponds, and areas that are planned as open water such as the end pit lakes and infiltration channels within the management pond covers
- There are areas of the Project footprint that do not have surface soil salvaged from but do require revegetation for example surface soil stockpiles, and powerline right-of-way (ROW)





6.2 End Land Use Capability and Objectives

The Post-closure goal for the Project is the return of local ecosystems through reclamation; therefore, the overarching land-capability objective is, to the extent possible, to return the Project footprint to climate shifted pre-Project ecosystems in the proportion that they existed prior to the development of the Project. To meet this goal, the following end land use objectives are proposed:

- ▶ **Objective 1:** Re-establish during the Decommissioning and Reclamation Phase multiple-use forest ecosystems that support wildlife habitat, recreation, the potential for forest harvest in appropriate areas, and traditional land uses such as plant and animal harvest and feasting ceremonies;
- ▶ **Objective 2:** Re-establish during the Decommissioning and Reclamation Phase conifer-dominated ecosystems that will support pine marten habitat. Pine marten is the primary focal species for habitat reclamation, as it is a habitat generalist, has cultural and socio-economical importance as a furbearer, and is an indicator for a broader suite of species that utilize mature conifer forests. An additional goal of habitat reclamation will be the avoidance of revegetation strategies that include broad introduction of deciduous browse species favoured by moose, due to the implications on caribou through facilitated predation;¹ and
- ▶ **Objective 3:** Re-establish during the Decommissioning and Reclamation Phase self-sustaining vegetation that will progress to plant communities like the Pre-Project ecosystems as supported by the results of ecohydrological modelling.

Several factors add complexity to these land use objectives:

- ▶ mining activities will make changes to the topography, drainage, and surficial materials of the Project footprint, and thus the post-Project landscape will be different than the one that supported pre-development ecosystems; and
- ▶ the local and regional climate is changing and will continue to change over the period of Project development, including the Post-closure Phase.

To understand the targets for the Decommissioning and Reclamation Phase, and to set capability objectives, provincial regulatory requirements were reviewed, and information was generated on pre-development ecosystems within the RCP for the Project footprint and on Post-closure ecosystems predicted to occur within the Project's footprint in the Post-closure Phase. The following subsections describe the methods used to assess the pre- and post-Project land capability, and a summary of the changes to landscape capability following the Decommissioning and Reclamation Phase.

6.2.1 Pre- and Post-Project Land Capability Assessment

Reclamation objectives for the Project are based on the approximate return of climate shifted pre-Project ecosystems to the post-Project landscape. Because of this, British Columbia's biogeoclimatic ecosystem classification (BEC) system is used as the basis for both planning and accounting for changes in land capability due to the Project. To assess land capability, the pre-Project distribution of ecosystems (i.e., biogeoclimatic [BGC] units and site series) was compared to the projected distribution of ecosystems after Project reclamation is completed, accounting for climate change. The major steps in this workflow included:

¹ Increased moose abundance can increase risk of predation on caribou due to sustaining a common predator (i.e., wolves).

- ▶ determining pre-development capability through Terrestrial Ecosystem Mapping (TEM) of the pre-development study area at a scale of 1:5,000 for the open pit and related component areas (such as Mine Infrastructure Complex (MIC), Explosive Facility, and Explosive Magazine pads) and Rail Infrastructure, and a scale of 1:10,000 for portions of the Tenas Access Corridor (TAC) (Tenas Project Terrain and Soil Baseline Report [Ardea 2021b]);
- ▶ modelling shifts in BGC subzone variants due to a changing climate based on Wang et al. (2016)² to generate a pre-mine ecosystem map that reflects a “climate-shifted baseline”, which is a modelled inventory of the ecosystems that would be projected to occur in the study-area landscape in the post-closure period if the Project had not occurred, given the changes that are occurring to local and regional climate;
- ▶ using a quantitative ecohydrological analysis (QEA) model³ to predict the occurrence of post-closure ecosystems generated by reclamation on the post-mining landscape; and
- ▶ compiling this information in mapped and tabular forms to allow comparisons between the pre-development and post-closure ecosystems, and to evaluate any opportunities to reduce differences in these comparisons through adjusted mine planning and/or reclamation treatments.

The information generated from this process provides end land use and capability targets in the inventory of post-closure ecosystems and allows for the evaluation of capability changes through a comparison of these post-closure ecosystems and the climate-shifted baseline. Detailed methods for the Ecohydrological Modelling Methods are presented in **Appendix 1-C** attached. Modelled local climate and occurrence of BGC zones for the 2050s period⁴ (Wang et al. 2016) was used for both the climate-shifted baseline and projection of post-closure ecosystems.⁵

Reclamation guided by the above principles will not produce a post-mining landscape or ecosystems identical to climate shifted pre-mining conditions, due to the changes to topography and surficial materials made throughout the mining process. However, an iterative process of adjusting modelled reclamation-cover materials and depths was used to minimize the differences in ecosystem distribution between the climate shifted pre- and the anticipated post-Project landscapes, as described in **6.3.1.3 Design of Reclamation Covers**. The QEA model will continue to be updated to reflect any changes to the mine plan and incorporate results from ongoing reclamation monitoring and research. Opportunities for increasing similarity of post-closure ecosystem distribution to climate shifted pre-Project conditions will be reviewed on a periodic basis. Updates will coincide with the Five (5) Year Mine Plan and Reclamation and Closure Plant updates (please note the Reclamation Program provided in the code has been defined as the Reclamation Program for the remainder of this report), with available interim updates presented in Annual Reclamation Reports (**9. Reporting**).

² <http://www.climatewna.com/>

³ The QEA model employed for Project reclamation planning uses three principal inputs: (i) available water storage capacity (AWSC) based on particle size distribution (PSD), organic matter content and bulk density in the upper metre (m) of soil; (ii) post-closure topography (i.e., slope and aspect); and (iii) climatic information (regional climate as characterized by the BGC unit) (Straker et al. 2014; Straker et al. 2015; Baker et al. 2020).

⁴ This period is a 30-year period centered on the 2050s (i.e., 2040-2070), which coincides with the timing of closure and reclamation for the Project.

⁵ It is recognized that there is substantial uncertainty in future climate modelling, but the uncertainties involved in using this modelling for reclamation planning introduce less error than adopting the assumption that historical climatic conditions and their associated ecosystems will still be dominant during the closure period for the Project.

Note the existing road between the Gravel Quarry and the existing washed bridge location on Goathorn Creek is shown as not being reclaimed at this stage due to uncertainty associated with this section of road being required to be kept for recreational access requirements. Currently the Project assumes this road will have to be left open. Furthermore, the plan show some access roads remaining at the end of the Decommissioning and Reclamation Phase which are reclaimed in the passive portion of the Post-closure stage.

6.2.2 Summary of Changes to Landscape Capability

Table 6.2-1 provides an inventory of climate-shifted pre-development ecosystems and anticipated Post-closure ecosystems projected to the 2050s. These data are shown spatially in and Figure 6.2-2 (climate shifted pre-mine ecosystems), and **Figure 6.2-3** and **Figure 6.2-4** (anticipated Post-closure ecosystems⁶).

The results of QEA modelling indicate that the post-mine ecosystems and land capability will shift towards zonal (mesic) site series of the ICHmc2 (Hazelton Moist Cold Interior Cedar Hemlock), SBSmc2 (Babine Moist Cold Sub-Boreal Spruce), and IDFmw2 (Thompson Moist Warm Interior Douglas-Fir) compared to the climate-shifted pre-Project conditions, with an overall loss of wetter (subhygric and wetter) and drier (subxeric and drier) site series. While iterative modeling and design of reclamation covers was conducted to reduce differences between the climate shifted pre- and anticipated post-Project ecosystem distributions, a foundation of the reclamation program is that although the climate shifted pre-development landscape informs reclamation targets, the post-mining landscape will not be identical to this climate shifted pre-development landscape. As part of the ongoing mine planning tasks that are completed annually and submitted every five years, attempts will be made to minimize the differences noted. The largest shifts in ecosystem occurrence resulting from mining and reclamation, which correspond to an overall increase in zonal (mesic) site series and a loss of drier and wetter site series, are:

- ▶ Reclamation covers that use both morainal overburden (OVB) and salvaged surface soils to replace deep (>1.0 m) rooting zones across much of the Project footprint (**6.3.1.3 Design of Reclamation Covers**) are projected to create mesic site series. This cover design, which incorporates a sublayer of OVB, is not conducive to producing drier (e.g., xeric to subxeric) site series, but is a conservative design (i.e., attempts to ensure adequate storage of water for plant use) that is intended to reduce the risk of reclamation under-performance;
- ▶ Wetter site series, including wetlands (fens, bogs, and swamps), floodplains, low-lying ecosystems, and ecosystems with fluctuating water tables will generally not be replaced through reclamation due to the fundamental alterations to surficial materials and water movement resulting from mining in the Project footprint. The topography and substrates of the post-Project landscape will not be conducive to replacement or maintenance of wetter, richer soils, which generally rely on shallow groundwater inputs; and
- ▶ An overall loss of natural terrestrial and aquatic ecosystems is projected due to conversion of these ecosystems to anthropogenic features such as: constructed waterbodies (e.g., water portions of the Water Control Ponds [WCP]); roads and infrastructure that will remain for post-closure monitoring and maintenance; and the WCP dams, which will not be reclaimed to local forested ecosystems for geotechnical reasons.

It is important to note that while large contiguous areas of the post-closure landscape are projected to be a single site series or group based on modelled ecohydrological conditions, it is anticipated that reclamation

⁶ Site series groupings in the post-closure map occur when a secondary site series is projected to account for 20% or greater of the total ecosystem area.

in practice will result in more diversity and heterogeneity. This will occur through the differential timing of reclamation and revegetation programs, natural variation in cover-material properties and thicknesses, patterns in wind and snow redistribution, and variation in reclamation prescriptions (e.g., use of diverse planting treatments to break up large polygons with similar ecohydrological characteristics). This process will be guided and refined by reclamation research conducted throughout the mine life, as described in **6.3.3 Reclamation Research**. Additionally, variation in reclamation-cover materials (**6.3.1.3 Design of Reclamation Covers**) did not always result in different site series being projected by the QEA model. However, differences in properties of the reclamation materials (overburden, surface soils and woody debris) will generate additional heterogeneity not depicted in the projected post-closure ecosystems shown in **Figure 6.2-1** and **Figure 6.2-2**, even if that heterogeneity is within the soil moisture regimes (SMR) bounds of a site series.

The projected vegetation types in this RCP reflect the best estimate of Post-closure edaphic conditions, particularly with respect to soil water, and the natural vegetation types associated with these conditions. The projections should not be taken as implying that these specific vegetation types and/or communities will be returned in the short-term, or that reclaimed ecosystems will be like and/or indistinguishable from natural ecosystems in the foreseeable future as it will take many years before the site reaches a mature state likely at the end of the Post-closure Phase. The focus of reclamation treatments will be on establishing plant species that are appropriate to edaphic conditions and that are adapted to early successional environments (rather than fully mature and long established ecosystems).

Table 6.2-1: Summary of Pre-Project and Post-closure Ecosystems Projected to the 2050s to Account for the Climate Shift Arranged by Biogeoclimatic (BGC) Unit and Post-closure Abundance

BGC	Site Series	SMR	Vegetation Description	Pre-Project Climate Adjusted			Anticipated Post-closure			Difference between Post-closure and Pre-Project Climate Adjusted		
				Area (ha)	%		Area (ha)	%		Area (ha)	%	
					BGC*	Mine**		BGC*	Mine**		BGC*	Mine**
ICHmc2	01-52	3-5	Western hemlock - step moss	184.3	31.1	22.2	318.1	56.1	38.3	133.8	25.0	16.1
	Mine Water	NA	Ponds	0.0	0.0	0.0	63.7	11.2	7.7	63.7	11.2	7.7
	01-52 - No trees	3-5	Dams in 01-52 - no trees permitted	0.0	0.0	0.0	46.3	8.2	5.6	46.3	8.2	5.6
	Permanent infrastructure	NA	Retained roads and water management infrastructure	0.0	0.0	0.0	37.3	6.6	4.5	37.3	6.6	4.5
	51	3	Lodgepole pine / western hemlock - Feathermoss (seral)	120.3	20.3	14.5	34.7	6.1	4.2	-85.6	-14.2	-10.3
	02	1-2	Western hemlock / lodgepole pine - Kinnikinnick - Cladonia	138.6	23.4	16.7	28.9	5.1	3.5	-109.7	-18.3	-13.2
	03-53	4-5	Western hemlock / western redcedar - Oak fern	58.0	9.8	7.0	28.1	4.9	3.4	-29.9	-4.8	-3.6
	03-53 - No trees	4-5	Dams in 03-53 - no trees permitted	0.0	0.0	0.0	5.0	0.9	0.6	5.0	0.9	0.6
	02 - No trees	1-2	Dams in 02 - no trees permitted	0.0	0.0	0.0	1.6	0.3	0.2	1.6	0.3	0.2
	51 - No trees	3	Dams in 51 - no trees permitted	0.0	0.0	0.0	0.9	0.2	0.1	0.9	0.2	0.1
	06	4-6	Black cottonwood / hybrid spruce - Dogwood	18.0	3.0	2.2	0.7	0.1	0.1	-17.3	-2.9	-2.1
	Pre-Project disturbance	NA	Rural, cultivated field, gravel pit	4.3	0.7	0.5	0.5	0.1	0.1	-3.7	-0.6	-0.4
	Wetland	7	Bogs, fens, swamps	5.7	1.0	0.7	0.3	0.1	0.0	-5.3	-0.9	-0.6
	05	6	Hybrid spruce / paper birch – Devil's club - Lady fern	5.6	0.9	0.7	0.3	0.0	0.0	-5.4	-0.9	-0.6
	04-54	5	Western redcedar / western hemlock - Devil's club - Oak fern	0.8	0.1	0.1	0.2	0.0	0.0	-0.6	-0.1	-0.1

BGC	Site Series	SMR	Vegetation Description	Pre-Project Climate Adjusted			Anticipated Post-closure			Difference between Post-closure and Pre-Project Climate Adjusted		
				Area (ha)	%		Area (ha)	%		Area (ha)	%	
					BGC*	Mine**		BGC*	Mine**		BGC*	Mine**
	07	6-7	Western redcedar / hybrid spruce - Horsetail - Skunk cabbage	24.1	4.1	2.9	0.1	0.0	0.0	-24.0	-4.0	-2.9
	31	7	Non-forested bog	28.1	4.7	3.4	0.1	0.0	0.0	-28.1	-4.7	-3.4
	Atha	4-6	Trembling aspen / Hardhack	3.4	0.6	0.4	<0.1	<0.1	<0.1	-3.4	-0.6	-0.4
	SD	4-5	Hybrid white spruce - Devil's club	1.7	0.3	0.2	<0.1	<0.1	<0.1	-1.7	-0.3	-0.2
			<i>Subtotal</i>	592.8	100.0	71.4	566.8	100	68.3	-26.0	0.0	-3.1
IDFmw2	01	3-5	Douglas-fir / western redcedar - Falsebox - Prince's pine	20.4	46.2	2.5	23.6	52.7	2.8	3.2	6.5	0.4
	03	1-3	Douglas-fir - Pinegrass - Feathermoss	4.5	10.1	0.5	12.1	27.2	1.5	7.7	17.1	0.9
	02	0-2	Douglas-fir - Snowberry - Bluebunch wheatgrass	1.9	4.3	0.2	7.0	15.6	0.8	5.1	11.3	0.6
	04	4-6	Western redcedar / hybrid white spruce - Oak fern	11.8	26.8	1.4	1.6	3.5	0.2	-10.3	-23.3	-1.2
	Pre-Project disturbance	NA	Pasture, transmission line, rural, cultivated field, railway	5.1	11.5	0.6	0.4	0.8	0.0	-4.7	-10.7	-0.6
	SD	4-5	Hybrid white spruce - Devil's club	0.4	0.9	0.0	0.1	0.1	0.0	-0.3	-0.8	-<0.1
	Wetland	NA	Swamps	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0
	05	4-5	Dogwood - Sedge	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			<i>Subtotal</i>	44.1	100.0	5.3	44.7	100.0	5.4	0.6	0.0	0.1
SBSmc 2	01	3-4	Hybrid white spruce - Huckleberry	108.7	56.2	13.1	206.4	94.4	24.9	97.8	38.2	11.8
	Mine Water	NA	Ponds	0.0	0.0	0.0	11.3	5.2	1.4	11.3	5.2	1.4
	05-06	4-5	Hybrid white spruce - Twinberry Coltsfoot – Hybrid white spruce - Oak fern	44.2	22.9	5.3	0.6	0.3	0.1	-43.6	-22.6	-5.2
	Permanent infrastructure	NA	Retained water infrastructure	0.0	0.0	0.0	0.3	0.1	0.0	0.3	0.1	0.0

BGC	Site Series	SMR	Vegetation Description	Pre-Project Climate Adjusted			Anticipated Post-closure			Difference between Post-closure and Pre-Project Climate Adjusted		
				Area (ha)	%		Area (ha)	%		Area (ha)	%	
					BGC*	Mine**		BGC*	Mine**		BGC*	Mine**
	02	1-2	Lodgepole pine – Huckleberry - Cladonia	23.4	12.1	2.8	<0.1	<0.1	<0.1	-23.4	-12.1	-2.8
	07	5-6	Hybrid white spruce - Scrub birch - Feathermoss	0.4	0.2	0.0	0.0	0.0	0.0	-0.4	-0.2	0.0
	09	5-6	Hybrid white spruce - Devil's club	3.2	1.7	0.4	0.0	0.0	0.0	-3.2	-1.7	-0.4
	10	6-7	Hybrid white spruce - Horsetail	13.4	7.0	1.6	0.0	0.0	0.0	-13.4	-7.0	-1.6
			<i>Subtotal</i>	193.3	100.0	23.3	218.6	100	26.3	25.4	0.0	3.1
Total				830.1	-	100.0	830.1	-	100.0	0.0	0.0	0.0

Notes: %=percent; BGC=biogeoclimatic; ha=hectare; SMR=soil moisture regime

* Proportion of BGC (biogeoclimatic subzone variant) area

**Proportion of total Project footprint

616000 617000 618000 619000 620000 621000 622000 623000

Tenas Project

**Pre-Development Ecosystems,
Modelled for a 2050s Climate for
the Southern Portion of the
Project Footprint**

6055000

6054000

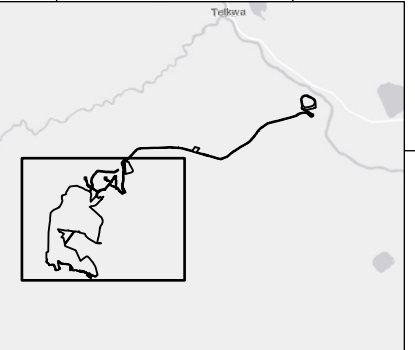
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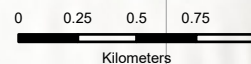
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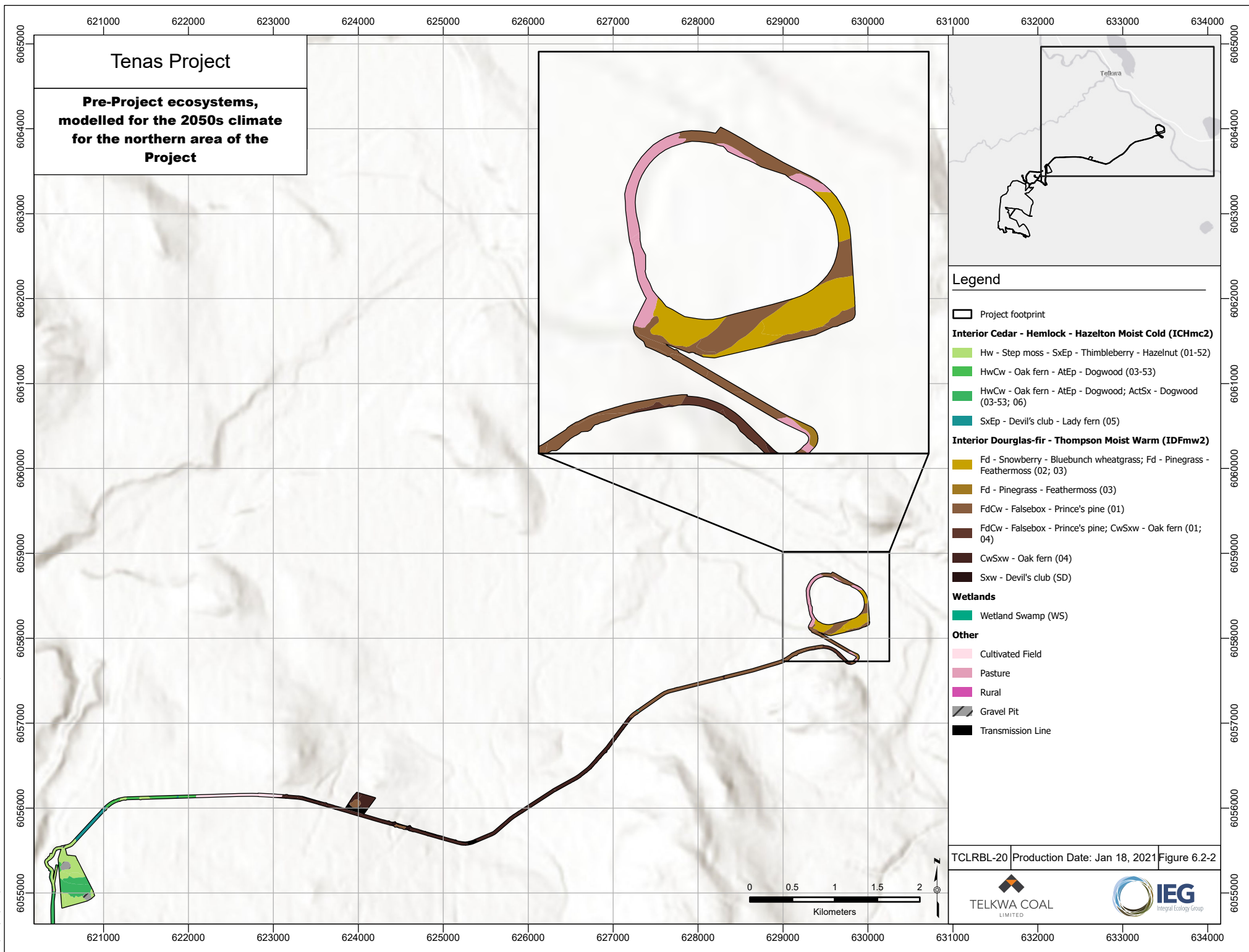
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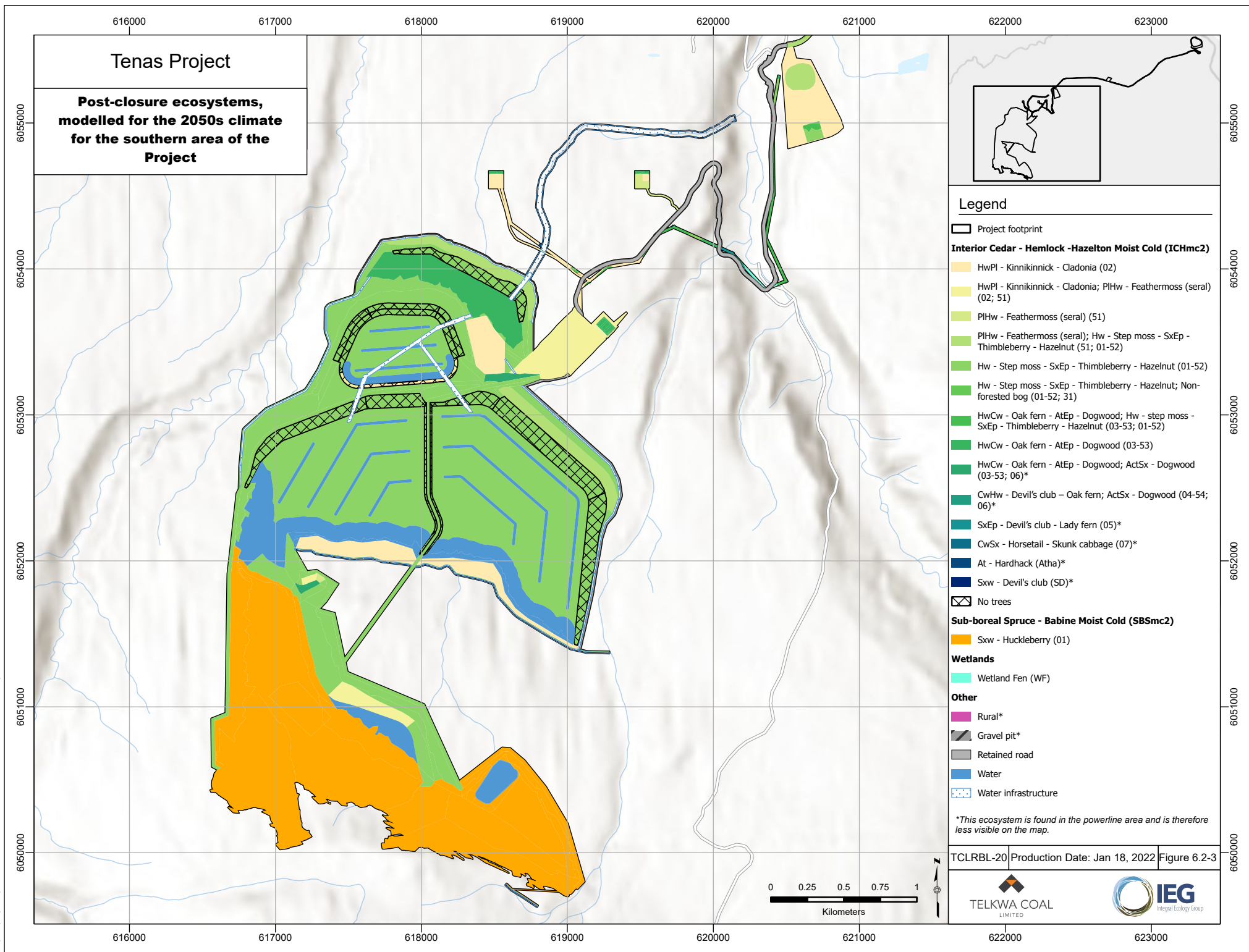
- Project footprint
- Interior Cedar - Hemlock - Hazelton Moist Cold (ICHmc2)**
 - HwPl - Kinnikinnick - Cladonia (02)
 - HwPl - Kinnikinnick - Cladonia; PlHw - Feathermoss (seral) (02; 51)
 - PlHw - Feathermoss (seral); Hw - Step moss - SxEp - Thimbleberry - Hazelnut (51; 01-52)
 - Hw - Step moss - SxEp - Thimbleberry - Hazelnut (01-52)
 - Hw - Step moss - SxEp - Thimbleberry - Hazelnut; Non-forested bog (01-52; 31)
 - Hw - Step moss - SxEp - Thimbleberry - Hazelnut; HwCw - Oak fern (01-52; 03-53)
 - HwCw - Oak fern - AtEp - Dogwood (03-53)
 - HwCw - Oak fern - AtEp - Dogwood; ActSx - Dogwood (03-53; 06)
 - SxEp - Devil's club - Lady fern; ActSx - Dogwood (05; 06)
 - CwHw - Devil's club - Oak fern; ActSx - Dogwood (04-54; 06)
 - SxEp - Devil's club - Lady fern (05)
 - CwSx - Horsetail - Skunk cabbage (07)
 - Atha,At - Hardhack (Atha)
 - Sxw - Devil's club (SD)
- Sub-boreal Spruce - Babine Moist Cold (SBSmc2)**
 - Pl - Huckleberry - Cladonia; Sxw - Huckleberry (02; 01)
 - Sxw - Huckleberry; Sxw - Twinberry - Coltsfoot (01; 05-06)
 - Sxw - Devil's club (09)
 - Sxw - Horsetail (10)
- Wetlands**
 - Wetland Bog (WB)
 - Wetland Fen (WF)
- Other**
 - Rural
 - Gravel Pit

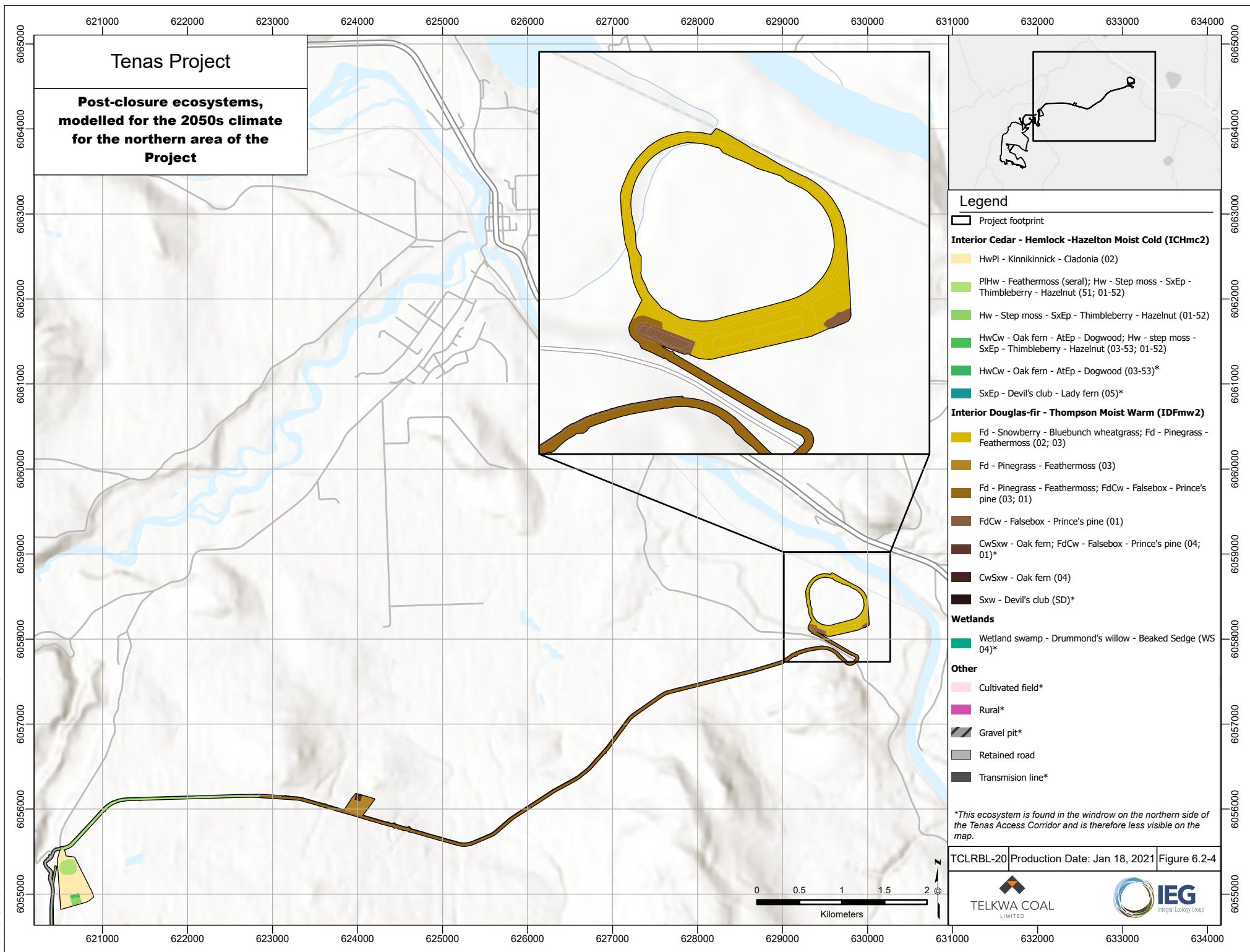


TCLRBL-20 Production Date: Jan 18, 2021 Figure 6.2-1









Further description of Project changes to the existing climate-shifted ecosystem abundance and land capability are provided in the subsections below. Vegetation-community descriptions and SMRs of the BGC units referenced in the subsections are provided in **Table 6.2-1**.

6.2.2.1 *BGC unit: Interior Cedar Hemlock Moist Cool subzone (ICHmc2)*

The most prevalent BGC subzone variant projected in the climate-shifted pre-Project footprint is the ICHmc2. The mesic, zonal 01-52 site series is modeled to be the dominant site series in both the climate shifted pre-Project conditions (184.3 ha) and in the anticipated Post-closure Phase (318.1 ha, plus 46.3 ha of non-treed 01-52 ecosystems on dams, where trees will not be permitted to grow for geotechnical reasons). The increase in area of the 01-52 site series corresponds to a 24.9 ha (43%) loss of the 03-53 site series, which is also mesic but has a richer soil nutrient regime. Losses are also projected for drier site series, including an 84.6 ha (70%) decrease in the submesic 51 site series and a 108.1 ha (78 %) decrease in the xeric to subxeric 02 site series. Wetter (subhygric to subhydryc) site series (04-54, 05, 06, 07, 31, Atha, SD and wetlands), which covered 87.4 ha pre-mine, are projected to be reduced to 1.6 ha. The edatopic grid for this variant is shown in **Figure 6.2-5**.

6.2.2.2 *BGC unit: Sub-boreal Spruce Moist Cool subzone (SBSmc2)*

The SBSmc2 is the second most prevalent BGC subzone variant in the climate-shifted pre-Project landscape. QEA modelling indicates that the mesic, zonal 01 site series will be the dominant site series on the climate shifted pre-Project landscape (108.7 ha), and will increase to 206.4 ha in the anticipated Post-closure Phase. The projected increase in area of the 01-site series corresponds to a decrease in the drier (xeric to subxeric) 02 site series from 23.4 ha in the climate shifted pre-Project conditions to <0.1 ha in the anticipated Post-closure Phase, and a decrease in the wetter (mesic to subhygric) and richer 05-06 site series from 44.2 ha in the climate shifted pre-Project phase to 0.6 ha in the Post-closure Phase. Wetter (subhygric to subhydryc) site series (07, 09 and 10), which constitute 17.0 ha of the climate shifted pre-Project development area, are projected to be lost. The edatopic grid for this variant is shown in **Figure 6.2-6**.

6.2.2.3 *BGC unit: Interior Douglas-fir Moist Warm subzone (IDFmw2)*

The IDFmw2 is a relatively minor component of the climate shifted pre-mine landscape. The dominant climate-shifted site series pre-Project is modeled to be the mesic, zonal 01 site series (20.4 ha), which is projected to occupy a similar area in the anticipated Post-closure Phase (23.6 ha). Drier site series are projected to increase in the Post-closure Phase: the 02 (very xeric to subxeric) site series is projected to increase from 1.9 ha in the climate shifted pre-Project situation to 7.0 ha in the Post-closure Phase, and the 03 (xeric to submesic) site series is projected to increase from 4.5 ha in the climate shifted pre-Project situation to 12.1 ha in the Post-closure Phase. While drier site series are projected to be gained, the mesic to subhygric 04 site series is projected to decrease from 11.8 ha in the climate shifted pre-Project condition to 1.6 ha post-closure. Wetlands and wetter (subhygric/hygric) site series (05, SD) were minimally present on the climate shifted pre-Project landscape(< 0.5 ha) and are not projected to occur in post-closure. The edatopic grid for this variant is shown in **Figure 6.2-7**.

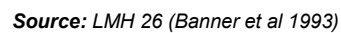
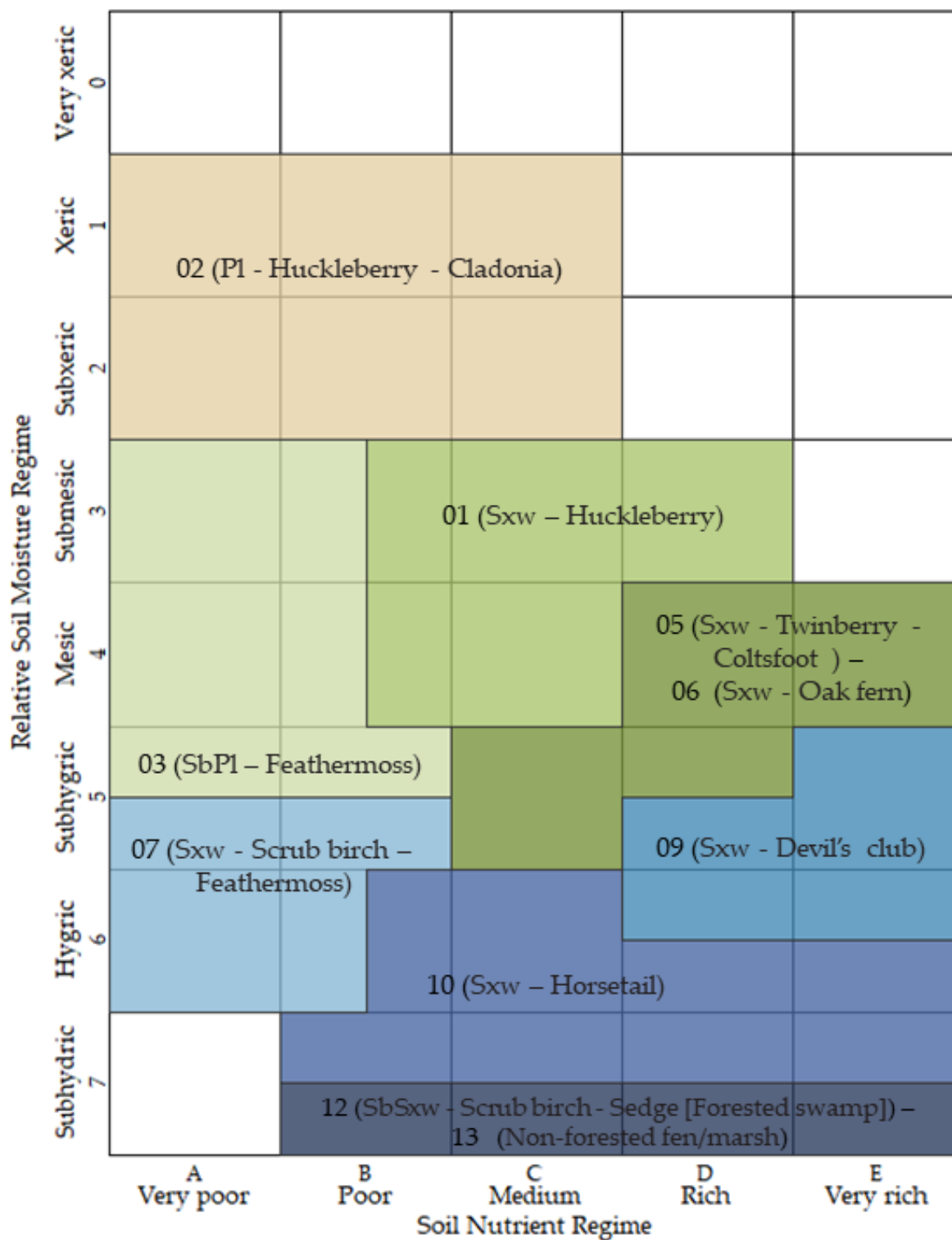
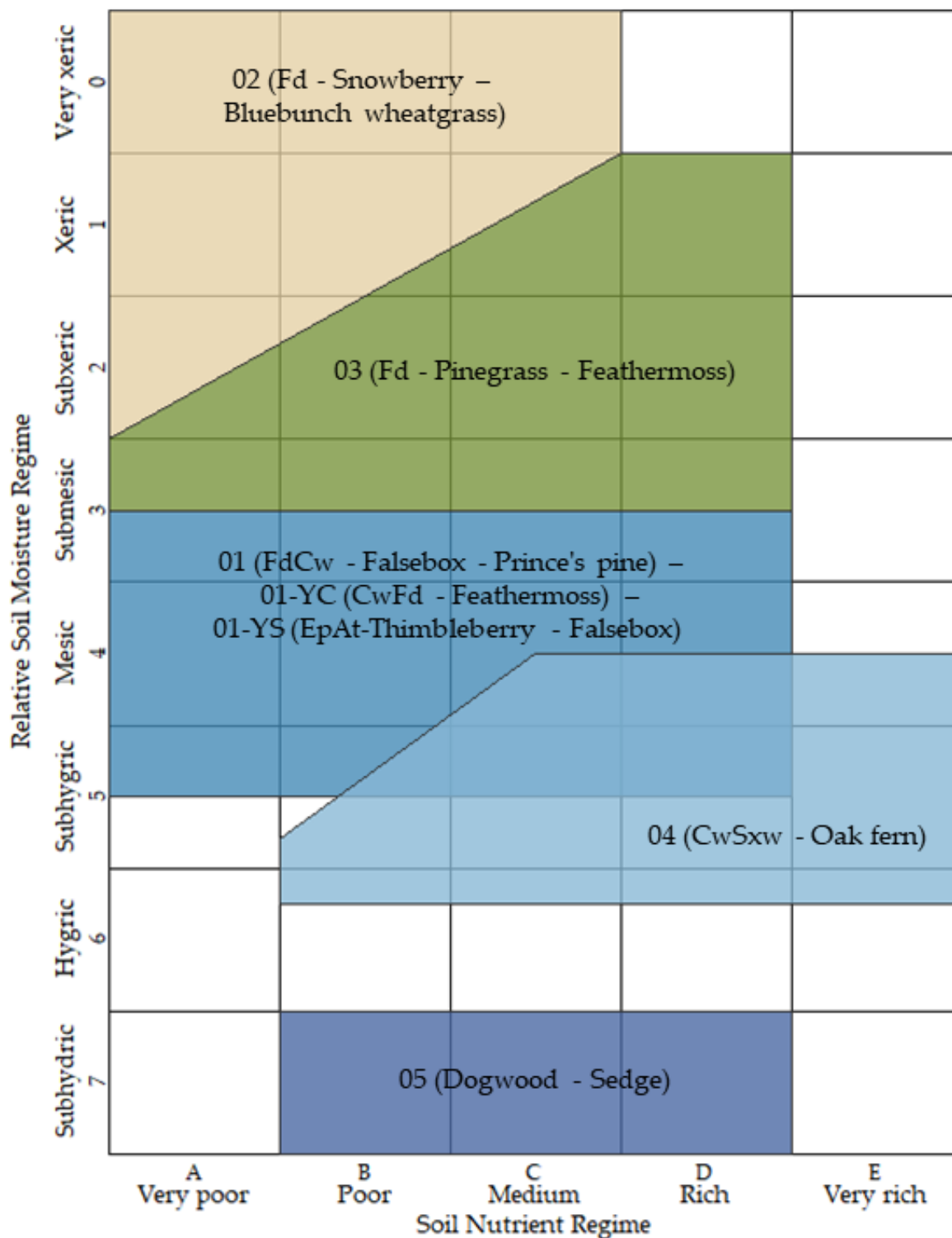


Figure 6.2-5: Edatopic grid for the ICHmc2 biogeoclimatic variant



Source: LMH 26 (Banner et al 1993)

Figure 6.2-6: Edatopic grid for the SBSmc2 biogeoclimatic variant



Source: LMH 23 (Lloyd et al 1990)

Figure 6.2-7: Edatopic grid for the IDfMw2 biogeoclimatic variant

6.3 Reclamation Approaches

Reclamation approaches for the Project are based on the results of QEA modelling (**Appendices 13.15-A and 13.15-C** attached), with ecosystem targets informed by the climate-shifted pre-mine ecosystems on the Project site. Modelling was used to develop reclamation-cover designs to support the targeted balance of ecosystems as closely as possible.

6.3.1 Surface Soil Resources

The following subsections summarize the reclamation-cover designs for the Project and present a reclamation-material balance that confirms that sufficient volumes of reclamation materials (surface soils and overburden) are available to achieve these cover designs. Soil salvage, stockpiling and replacement plans are also presented. These subsections summarize information that is presented in greater detail in the **Soil Management Plan (Appendix 13.15-B) (SMP)** attached).

6.3.1.1 Terminology

Reclamation materials referred to throughout the **SMP in Appendix 13.15-B** and this RCP are defined as follows.

- ▶ **Reclamation materials** – surface soils, woody debris, and OVB that will be salvaged and used in reclamation;
- ▶ **Overburden (OVB)** – OVB is defined as unconsolidated soil that underlies surface soils (greater than [$>$] 0.5 m below the interface between organic and mineral soil horizons). These materials have not undergone pedogenesis⁷, except the uppermost OVB (e.g., 0.5 to 1.0 m below the interface between organic and mineral soil horizons), which has undergone less pedogenesis than surface soil and has lower organic-matter (OM) content. Overburden within the Project Area/footprint consists primarily of morainal deposits. OVB, in the context of reclamation materials and this RCP and the SMP, does not include any mine materials (e.g., mine rock, run-of-mine coal);
- ▶ **Surface soil** – surface soils include organic horizons, if present, and the upper 0.5 m of mineral horizons underlying the organic horizons. Surface soils have undergone pedogenesis, which includes accumulation of OM. For mineral soils, the organic horizons are thin (less than [$<$] 0.1 m), while the organic horizons of organic soils are approximately 1 m deep within the Project Area⁸/footprint; and
- ▶ **Woody debris** - involves larger deadwood such as logs, branches, stumps, roots, and other stems and branches that are not large enough to be merchantable but are too large just to incorporate with surface soil salvage operation. Woody debris is used to encourage revegetation through the creation of microsites.

The following are subcomponents of surface soil that are used as part of the RCP, and SMP:

- ▶ **Organic soil** – soils classified to the Organic soil order. The Organic order comprises soils with greater than 40-centimetre (cm)-deep litter (L), fermentation (F) and/or humic (H) horizons, greater than 40-cm-deep Of horizons, or greater than 60-cm-deep Om or Oh horizons;

⁷ Pedogenesis is the study of the origin/evolution and formation/development of soil.

⁸ Terrain polygons with organic soils either had a surface expression code of veneer (Ov) or blanket (Ob), indicating that the organic horizons of organic soils were either less than 1 m deep or between 1 to 2 m deep, respectively.

- ▶ **Mineral soil** – soils classified to non-organic soil orders (e.g., from colluvial, morainal, and glaciofluvial parent materials). Mineral soil orders may have L, F, and/or H horizons, but these organic horizons will be mixed with the underlying mineral soil during salvage and are grouped under mineral surface soils in this plan; and
- ▶ **Organic-mineral mix** – over-salvaged organic surface soils that are planned to be salvaged. The organic-mineral mix will encompass the organic horizons of organic surface soils in addition to underlying mineral soil, which is likely enriched in fine soil particles due to the landscape position and enriched in organic nutrients due to the overlying organic layers. This mix is estimated to be 50% mineral soil (by volume).

6.3.1.2 *Evaluation of Reclamation Material Suitability*

Suitability of available reclamation materials (surface soil and OVB) was assessed to enable incorporation of suitability considerations into calculations of reclamation-material supply. Suitability was evaluated using the SMUs defined in the Tenas Project Terrain and Soil Baseline Report (Ardea 2021b) and described in the **SMP**. Available water-storage capacity (AWSC) was used as the primary suitability criterion because soil water supply is a dominant control on the characteristics of an ecosystem, including its nutrient regime (Pojar et al. 1987; Baker et al. 2020). The SMUs were grouped into suitability classes based on AWSC (calculated from particle-size distribution [PSD] and OM content) and operational salvage constraints (steep slopes and shallow surface-soil thicknesses) as shown in **Table 6.3-1**.

All surface soil that is sufficiently deep and operationally accessible is categorised as suitable for salvage, as all surface-soil types can support ecosystems on the climate-shifted pre-Project landscape. Suitable surface soils are, however, divided into three classes based on AWSC: low-AWSC mineral, high-AWSC mineral, and organic. Segregation of these classes will enable targeted creation of specific soil moisture regimes (and corresponding ecosystems), as per the ecohydrological modelling in the RCP, to promote heterogeneity on the post-closure landscape. The suitability classes (**Table 6.3-1**) correspond to parent-material types, with high-AWSC mineral surface soils formed from finer-textured parent materials (primarily morainal), and low-AWSC mineral surface soil formed from coarser-textured parent materials (primarily fluvial and glaciofluvial).

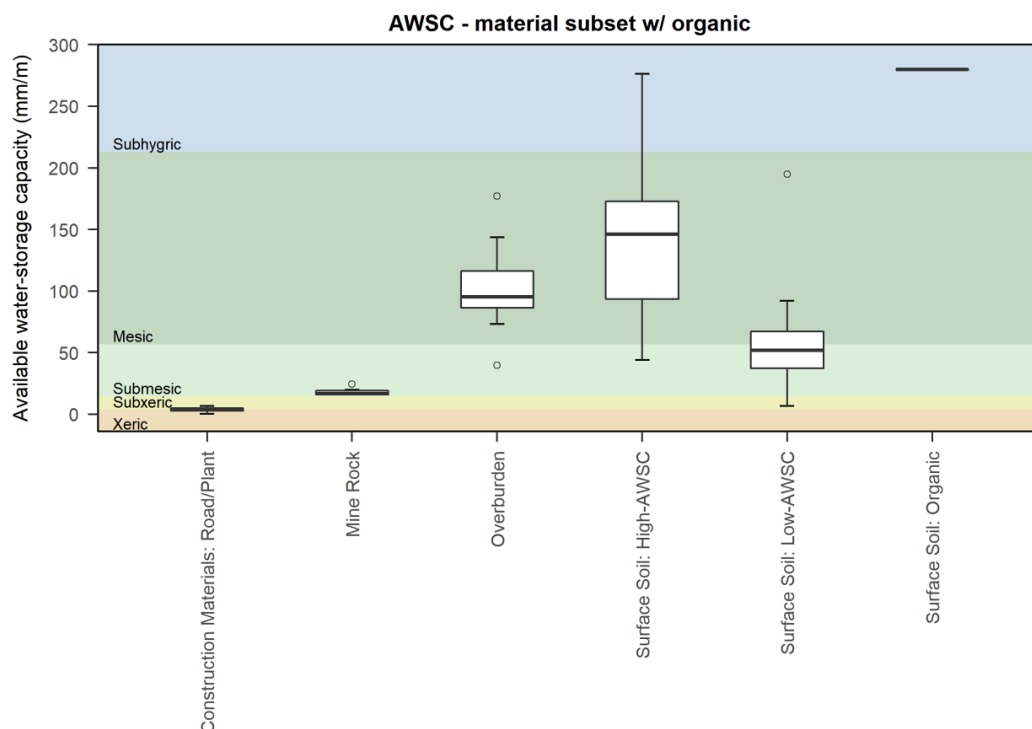
The AWSCs of the low-AWSC, high-AWSC and organic surface soils are shown in **Figure 6.3-1** and compared with the AWSC of OVB and Project materials (mine rock and the material used to represent roads, Coal Processing Plant (CPP) areas, and maintenance areas). All reclamation materials have AWSC values far exceeding mine rock and the projected substrate of haul roads, service roads and pad areas such as where the Coal Processing Plant is located and Maintenance Building, which have negligible water-holding capacity and would be expected to have a limited ability to support vegetation if left uncovered. High-AWSC mineral surface soil has a greater AWSC than OVB, while low-AWSC mineral surface soil has a lower AWSC than OVB.

Criteria to be applied during salvage operations to support delineation reclamation-material types are provided in **6.3.1.2 Evaluation of Reclamation-Material Suitability**. Additional detail on the SMUs and evaluation of soil suitability is provided in the **SMP (Appendix 13.15-B attached)**.

Table 6.3-1: Soil Suitability Classification

Suitability Class	Soil Management Units (SMUs)*	Description
Unsuitable	5, 6, 8.1, 8.2	SMUs were deemed unsuitable due to surface soil is that is too shallow to operationally salvage (SMUs 5 and 6), and terrain that is too steep for salvage (SMUs 8.1 and 8.2).
Low-AWSC mineral	1.3, 2, 4.1, 4.3	Coarse-textured, low-AWSC and low-nutrient surface mineral soils derived from fluvial, glaciofluvial, and ablation-till parent materials. Suitable for reclamation of submesic or drier ecosystems.
High-AWSC mineral	1.1, 1.2, 3.1, 3.2, 4.2	Finer-textured and high-AWSC surface mineral soils with a nutrient-rich Ah (humic) horizon present. Soils are derived from morainal, glaciolacustrine and silty-fluvial parent materials. Suitable for reclamation of mesic ecosystems.
Organic	7	Organic surface soils with high organic-matter content and nutrient availability. Useful as an organic amendment or for reclamation of wetlands and low-lying ecosystems.

* SMUs were defined in the Tenas Project Terrain and Soil Baseline Report (Ardea 2021b), and reflect groupings of soil with related properties, including soil texture, drainage, coarse-fragment content, degree of organic enrichment, slope position, parent materials, aspect, and average rooting depth. Detailed descriptions of SMUs are presented in the SMP.



Notes: The coloured bands represent relative soil moisture regime classes for flat sites without root restriction in the upper metre. The middles of the boxplots represent the 50th percentile, the hinges represent the 25th and 75th percentiles, and the whiskers represent 1.5 x the interquartile range of the hinges.

Figure 6.3-1: Available-water storage capacity of mine materials and overburden compared to surface-soil suitability classes

6.3.1.3 *Design of Reclamation Covers*

Reclamation covers are materials placed on the surface of post-Project landforms (e.g., mine-rock stockpiles). In the context of the Project, these covers have two primary duties:

1. provide a rooting zone for vegetation and a basis for ecosystem re-establishment; and
2. moderate movement of water through the post-mining landscape by storing rain and snowmelt for use by reclaimed ecosystems. Reclamation covers can contribute to the goal of reducing volumes of contact water by allowing for the uptake and release by vegetation through transpiration of a portion of the meteoric waters. This storage and release of a portion of water by reclamation covers reduces the amount of water percolating into the underlying mine materials.

Design of reclamation covers for the Project is based on two (2) fundamental approaches/conditions:

1. salvage, storage, and replacement of surface soils throughout the Project footprint; and
2. the abundant (non-constrained) supply of suitable morainal OVB available for use as a subsurface lift underlying surface-soil layers in reclamation covers.

These approaches and conditions are unusual in reclamation in BC, as it is rare to (1) salvage virtually all surface soils, (2) segregate surface soil into multiple suitability classes, and (3) construct two-lift cover systems (surface soil over OVB) with OVB depths of at least one metre (m) across the majority of a Project footprint.⁹ Thus, the design of reclamation covers for the Project represents industry-leading practices and is based on an unconstrained supply of cover resources. A more conventional reclamation-cover design would involve more limited salvage of surface soils (e.g., within pit stripping limits and other areas of required removal such as dam foundations), use of one-lift cover systems, and overall thinner covers using less volume of both surface soils and OVB.

Project cover designs are directly linked to the projected post-closure ecosystems discussed in **6.2.1 Pre- and Post-Project Land Capability Assessment**, i.e., it is the combination of local climate, post-mining landforms, cover designs (rock, OVB, cover depths, and soil properties) that generates the projected post-closure ecosystems. Reclamation covers have been designed to replace pre-development edaphic conditions to the extent possible, given the material and landform changes necessitated by the mining process. The QEA model (**6.2.1 Pre- and Post-Project Land Capability Assessment** and **Appendix 13.15-C** attached) used to support cover design accounts for properties, depth, and layering of cover and mine materials present in the surface one-metre rooting zone, and for the landform slope angle and aspect. It estimates the available water-storage capacity (AWSC) of reclamation covers, and resulting SMR, and associated ecosystem occurrence.¹⁰

The QEA model can be run in both a constrained/deterministic mode (i.e., cover depths are input as fixed) or in an unconstrained mode. In the unconstrained mode, the model is run using data on characteristics of cover materials, but assuming an unconstrained supply of these materials, with the goal of finding solutions (i.e., depths) that maximize the AWSC of reclamation cover systems. To maximize similarity of climate

⁹ Except for Project facilities that are not proximal to the Minesite, and will not receive OVB: Explosive Facility, Explosive Magazine, Rock Quarry, Aggregate Quarry, Tenas Access Corridor (TAC) and Rail Infrastructure. These areas represent an estimated 58.7 hectare (ha) of the 679.3 ha to be reclaimed.

¹⁰ For additional information on the modelling process and data inputs used for mine materials and cover materials, see Appendix **1.0-C** attached and Baker et al. (2020).

shifted pre- and anticipated post-Project ecosystem distribution, an iterative approach to the QEA modelling was used that involved both modelling methods, as described by the steps below.

- ▶ **Unconstrained model:** A preliminary model was run that maximized AWSC (i.e., created the wettest possible site series) given the site characteristics and available reclamation materials. The results were observed to result in a loss of wetter (subhygric and wetter) and drier (submesic and drier) ecosystems, with zonal (mesic) site series predominating;
- ▶ **Constrained model:** The QEA model was run deterministically, based on a general assumption that reclamation covers will consist of approximately 30 centimetres (cm) of surface soils overlying at least 100 cm of reclamation-suitable morainal OVB. Comparisons of deterministic and unconstrained runs of the QEA model found little benefit to placement of surface-soil depths greater than 30 cm, given the commitment to placing a sub-layer of OVB; however, the projected post-closure ecosystems continued to be dominated by mesic ecosystems, with losses of wetter and drier site series;
- ▶ **Increased ecosystem heterogeneity:** QEA model revisions were made to address the projected loss of wetter and drier site series. To better mimic the heterogeneity of parent materials on the climate shifted pre-Project ecosystem in the planned reclamation covers, surface soil was segregated into low-AWSC, high-AWSC, and organic-mineral-mix suitability classes. Multiple modeling scenarios were evaluated to identify suitable locations for placement of surface soils from the different suitability classes. Modeling considerations included:
 - ▶ Selecting areas of the Post-reclamation landscape with mining substrates/materials and topography that align with the typical location of the prescribed reclamation material in undisturbed ecosystems. For example, organic-mineral mix is planned to be applied in low-lying or depressional areas that are more likely to accumulate water and support development of wetter, richer ecosystems over time;
 - ▶ Avoiding placing low-AWSC surface soil on steeper slopes because (1) these fluvial/glaciofluvial soils are typically present on flat or gently sloping topography in the pre-mine landscape, and (2) low-AWSC surface soil may revegetate more slowly, so avoiding placement on slopes reduces risk of erosion; and
 - ▶ Creating edaphic conditions comparable to adjacent ecosystems, where possible, to improve integration of the reclaimed mine with the surrounding landscape. For example, low-AWSC soil is primarily planned to be placed in reclamation areas adjacent to undisturbed areas classified as drier site series (e.g., 02 in ICHmc2). This was primarily done by targeting replacement of low-AWSC soils in areas from which it was salvaged.

The planned cover design includes a minimum of 1.0 m of OVB placed over most post-Project substrates (e.g., mine rock stockpiles, roads, and CPP areas) except for:

- ▶ areas where OVB will already be present as the substrate, including dams, buttresses, the Mine Infrastructure Complex footprint, cleared areas adjacent to dams and areas cleared for access;
- ▶ areas that are not close to any existing sources of OVB, including the two (2) quarries, the Explosive Facility, the Explosive magazine, the Rail Infrastructure area, and the portion of the TAC scheduled to be reclaimed. To remain conservative in post-closure projections for these areas (i.e., to avoid overestimating available soil water and nutrients in reclamation covers) in the QEA model, rock materials were assumed to contain negligible organic matter and nutrients and contribute very little to soil-profile AWSC values;
- ▶ A 30-cm layer of surface soil will be placed over OVB (or other material where OVB is not placed). This depth of surface soil will provide benefits of topsoil beyond water-holding capacity, such as

the presence of nutrients and vegetation, and biological propagules (MacKenzie and Renkema 2013). The exceptions to the 30-cm surface soil depths for this Project are as follows:

- ▶ The portion of the TAC being reclaimed, and the Rail Infrastructure will have a 40-cm and 35-cm soil covers, respectively, to help compensate for the absence of an OVB sublayer;
- ▶ On the buttresses where low-AWSC surface soil will be placed over OVB, surface soil will be placed at a 50 cm thickness such that the coarser surface soil constitutes most of the primary rooting zone (i.e., the area most accessed by plant roots);
- ▶ Organic-mineral mix surface soil will be placed at 70 cm in a depressional area of the Backfill to provide greater AWSC and promote initial formation of a wetter, richer ecosystem; and
- ▶ Areas where soil is not planned to be stripped and will remain in place, such as soil stockpile pads, the powerline access route and select areas cleared for access, are not scheduled to receive a reclamation cover as the existing soil is already in place.

Cover designs for each Project component are presented in **Table 6.3-2**. Reclamation covers were not prescribed for:

- ▶ areas projected to have a water cover in closure;
- ▶ facilities and infrastructure that will be maintained post-closure, including water infrastructure (e.g., ditches, spillways, discharge right-of-way (ROW), roads required for maintenance and monitoring, and any retained buildings within the Project footprint; and
- ▶ project components for which salvage of soil is not required and the existing soils will remain in place, including the powerline ROW and surface-soil stockpile footprints.

As mine development, material salvage, and detailed reclamation designs progress, the QEA model and corresponding designs of reclamation covers will be refined using data collected in the reclamation research program (**6.3.3 Reclamation Research**) and reclamation-material monitoring program (**7.1 Reclamation Monitoring**).

Table 6.3-2: Cover Designs and Reclamation Material Requirements by Project Component

Project Component	Area (ha)	OVb Depth Required for Reclamation (m)	OVb Volume Requirements (m³)	Surface Soil Types Present	Surface Soil Depth Required for Reclamation (m)	Surface Soil Volume Requirements for Reclamation (m³)
Gravel Quarry	16.4	0	0	Low-AWSC mineral	0.30	49,075
Backfill Area	213.2	1	2,131,761	High-AWSC mineral	0.30	639,528
Backfill Area	0.7	1	6,956	Organic-mineral mix	0.70	4,869
Buttress - East MP	13.6	1*	136,172	Low-AWSC mineral	0.50	68,086
Buttress - North MP, West MP	20.2	1*	201,819	High-AWSC mineral	0.30	60,546
Buttress - TCP	7.4	1*	73,513	Low-AWSC mineral	0.50	36,757
Cleared Areas for Access	44.6	0	0	High-AWSC mineral	0.30	133,818
Cleared Areas for Access	0.9	1	9,027	High-AWSC mineral	0.30	2,708
CPP Pond	1.0	0	0	Low-AWSC mineral	0.50	5,163
Dams	53.9	1*	538,501	High-AWSC mineral	0.30	161,550
Explosives Facility	1.6	0	0	Low-AWSC mineral	0.30	4,897
Explosives Magazine	1.1	0	0	High-AWSC mineral	0.30	3,253
Haul Roads	24.8	1	248,455	High-AWSC mineral	0.30	74,537
Management Ponds	192.9	1	1,929,304	High-AWSC mineral	0.30	578,791
Mine Infrastructure Complex	15.2	0	0	Low-AWSC mineral	0.45	68,237
Rail Infrastructure	11.8	0	0	Low-AWSC mineral	0.35	41,143
Rock Quarry	4.6	0	0	High-AWSC mineral	0.30	13,863
Service Roads	2.6	1	26,309	High-AWSC mineral	0.30	7,893
TCP - Dam footprint	3.9	0	0	High-AWSC mineral	0.30	11,563
TCP - Pond	21.1	0	0	Organic-mineral mix	0.30	63,402
Tenas Access Corridor	27.9	0	0	High-AWSC mineral	0.40	111,437
Total High AWSC Areas	590.5	0 to 1	5,085,176	High-AWSC mineral	0.30 to 0.40	1,799,487

Project Component	Area (ha)	OV B Depth Required for Reclamation (m)	OV B Volume Requirements (m ³)	Surface Soil Types Present	Surface Soil Depth Required for Reclamation (m)	Surface Soil Volume Requirements for Reclamation (m ³)
Total Low AWSC Areas	66.9	0 to 1	209,685	Low-AWSC mineral	0.30 to 0.50	273,357
Total Organic Soil Areas	21.8	0 to 1	6,956	Organic-mineral mix	0.30 to 0.70	68,271
Project Component footprint Area not requiring cover designs	150.8	-	-	N/A	-	-
Grand Total	830.1	-	5,301,817**	-	-	2,141,116

Notes: AWSC=available water-storage capacity; ha=hectare; m=metre; m³=cubic metre; OV B=overburden; TAC=Tenas Access Corridor; TCP=Tenas Control Pond; MP=management pond

* Assumed to be already present on surface of dam and buttress (final lift of construction)

The volume demands for surface soils and OVB were calculated by spatially applying the cover designs developed with the QEA model, as described in **6.3.1.3 Design of Reclamation Covers**, to the post-Decommissioning and Reclamation Phase landscape and converting depths to volume based on the areas of Project components. It is estimated that 2.14 Mm³ of surface soil will be required for reclamation, as follows:

- ▶ 1.80 Mm³ of high-AWSC mineral surface soil;
- ▶ 0.27 Mm³ of low-AWSC mineral surface soil; and
- ▶ 0.07 Mm³ of organic-mineral mix surface soil.

A total of 5.3 Mm³ of OVB is projected to be required for reclamation covers for Project components.

6.3.1.4 Available Volumes of Reclamation Materials

Reclamation-material supply was evaluated to support development of a reclamation-materials balance and confirm that sufficient reclamation materials are available to meet demands for implementing the designed reclamation covers.

6.3.1.4.1 Surface Soils

Areas of surface soil available for salvage were delineated by applying the surface-soil suitability class groupings to polygons of SMUs delineated in the baseline bioterrain mapping (Ardea 2021b), with the following exclusions:

- ▶ areas of existing Pre-Project disturbance;
- ▶ Project components for which salvage of soil is not required, including the powerline right-of-way (ROW) and the footprints of surface soil stockpiles; and
- ▶ Project components that will be maintained after the Decommissioning and Reclamation Phase and beyond the Post-closure Phase (i.e., not reclaimed) and are not proximal to the Minesite (i.e., primary mining area), including the effluent channel and the portion of the TAC between the Mine Infrastructure Complex (MIC) and the Gravel Quarry, which is the current condition.

Surface soil volumes were calculated from salvage areas using salvage depths of 0.30 m for high-AWSC mineral surface soil areas and 0.15 m for low-AWSC mineral surface soil areas. The exception to these depths is that greater salvage depths are recommended for portions of the TAC and Rail Infrastructure areas that are far away from the Minesite where no OVB is available to supplement surface soil with. For the TAC, Gravel and Rock Quarries, Explosive Facility and Explosive Magazine, the recommended salvage depth is 0.40 m for all mineral surface soil areas (low- and high-AWSC). For the Rail Infrastructure area, the recommended salvage depth is 0.40 m for high-AWSC mineral surface soil areas and 0.35 m for low-AWSC surface soil areas.

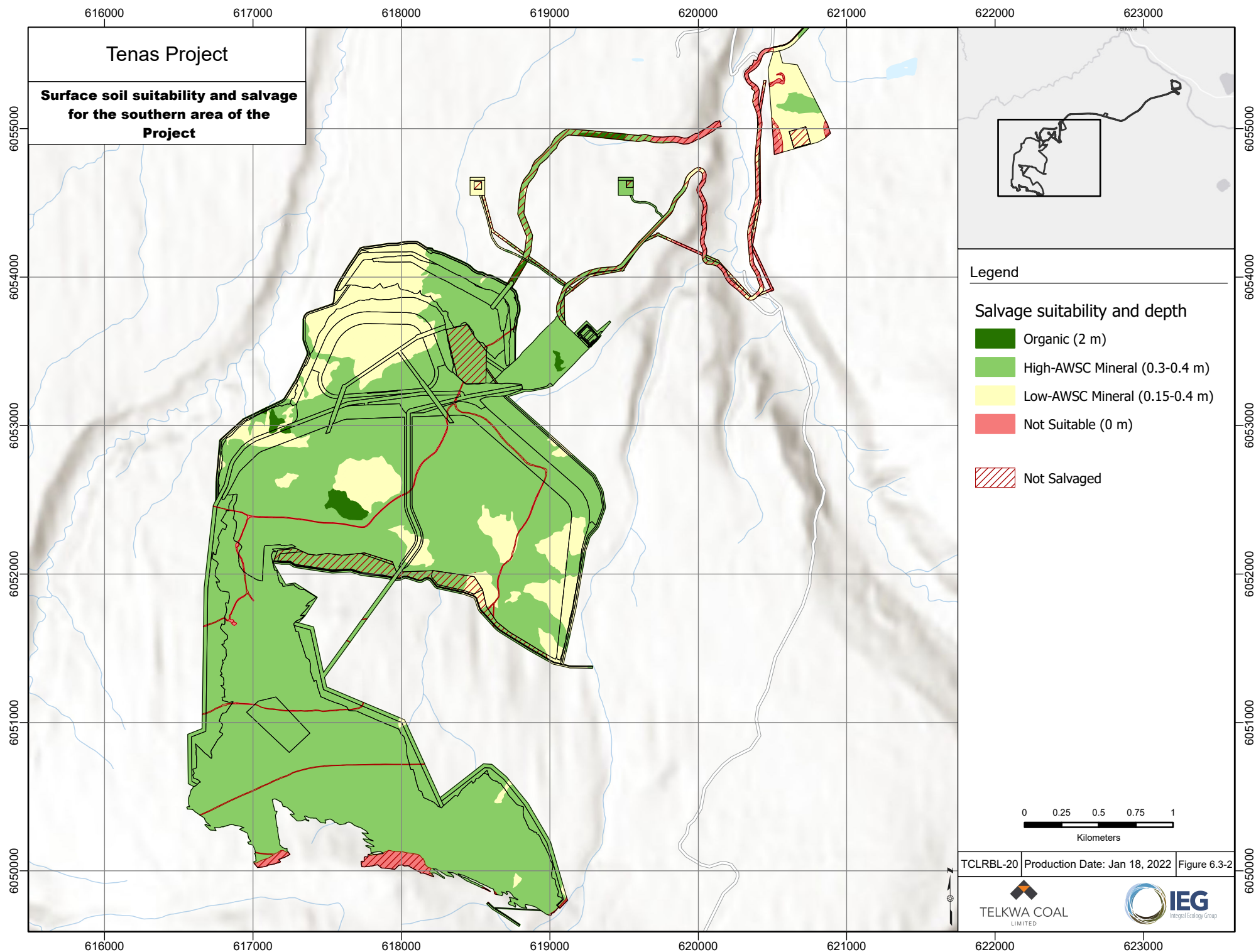
Organic soil areas within the Project footprint are, on average, approximately 1.0 m deep (TCL 2021).¹¹ Therefore, an average salvage depth of 2.0 m is recommended to capture the organic materials plus an additional 1.0 m to include the underlying mineral soil, which is likely enriched in fine soil particles due to the landscape position and enriched in organic nutrients due to the thickness of the overlying organic

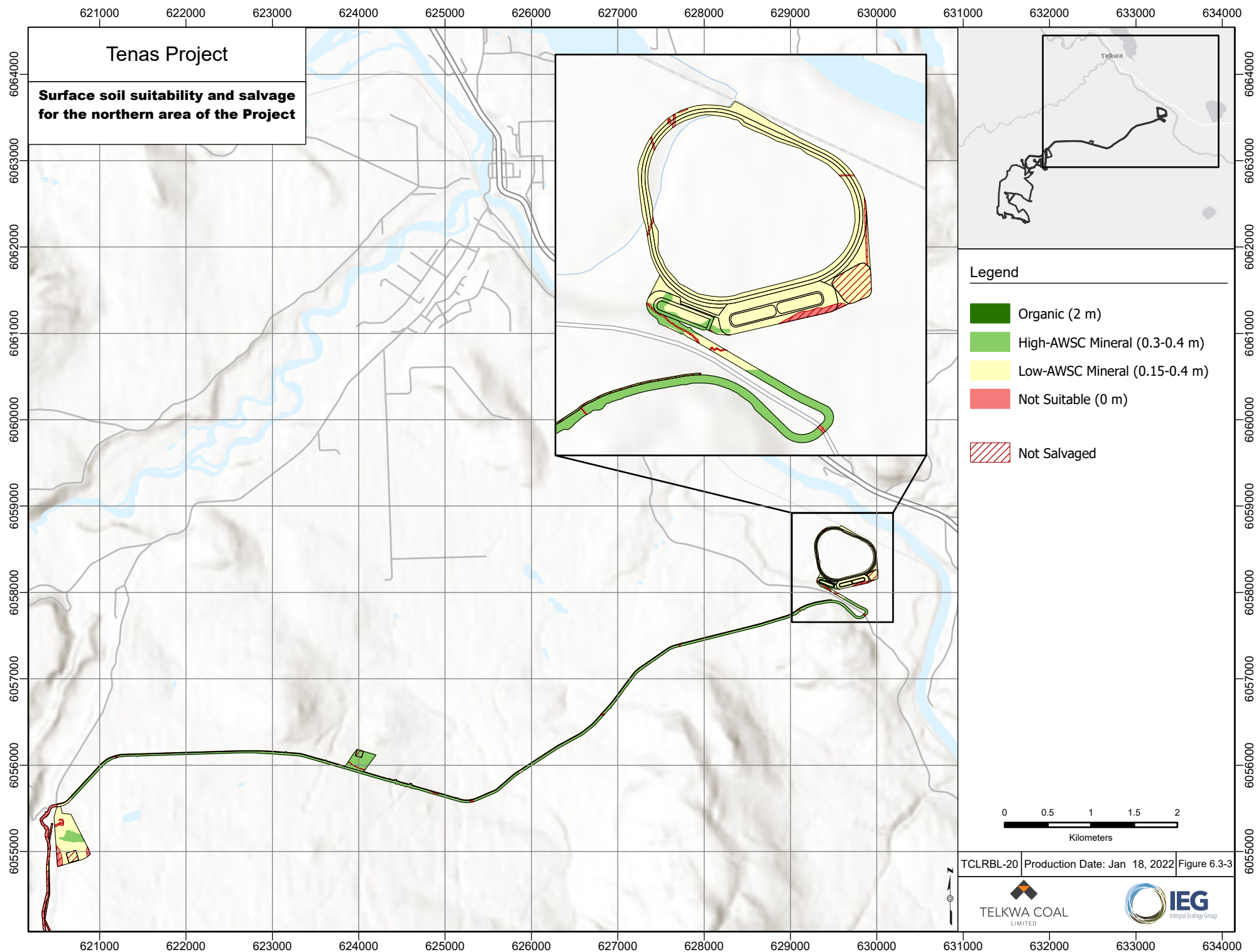
¹¹ Terrain polygons with organic soils either had a surface expression code of veneer (Ov) or blanket (Ob), indicating that the organic horizons of organic soils were either less than 1 m deep or between 1 to 2 m deep, respectively.

layers.¹² These “over-salvaged” organic soils are more useful and feasible to use in reclamation than pure organic material.

These salvage depths are in accordance with recommended soil salvage depths in the mine reclamation literature, which range from 0.15 to 0.80 m (MacKenzie 2011; Paquin and Brinker 2011). The upper 0.50 m of mineral soils plus the overlying organic layers is typically the portion of the surface soil profile where the majority of biotic activity occurs, and concentrations of organic materials and nutrients are highest. Subsurface soil (0.5 to 1.0+ m of depth) is minimally influenced by biotic activity and soil processes and are expected to have material properties more like reclamation suitable OVB. **Figure 6.3-2** and **Figure 6.3-3** show the reclamation-suitability of soils in the Project footprint and planned areas of surface soil salvage with the Project footprint. A total of 1.87 million cubic metres (Mm³) of high-AWSC mineral surface soil, 0.27 Mm³ of low-AWSC mineral surface soil, and 0.12 Mm³ of suitable over salvaged organic surface soil mixes (50% of which is estimated to be underlying suitable mineral soil) are projected to be available for salvage, giving a total of 2.26 Mm³ of salvaged surface soil. The LFH (forest floor) portion of mineral surface soils was conservatively not included in these volumes, as these organic horizons commonly compress with handling and mixing during the surface soil salvage process. A more detailed breakdown of projected surface soil salvage volumes by Project component footprints is presented in the reclamation materials balance in **Table 6.3-4**.

¹² Salvage depths should be confirmed and adjusted during salvage operations, as overseen by a Qualified Professional (QP) with appropriate training.





6.3.1.4.1.1 Overburden

A total of 26.76 loose (swelled at 20%) Mm³ of OVB is available from open pit excavation. Of this total amount available, 14.50 Mm³ will be used in dams and buttresses, leaving 12.26 Mm³ available for reclamation (see **S1.0 Overview of Project Proponent Description**).

6.3.1.4.1.2 Woody Debris

It is estimated that there is approximately 2 million m³ of woody debris that will be placed into stockpiles collated with surface soil stockpiles and on top of the embankments and buttresses constructed for the management ponds

6.3.1.5 Reclamation Materials Material Balance

Table 6.3-3 summarizes the required and available volumes of reclamation materials based on **6.3.1.4** to generate a reclamation materials balance. Sufficient volumes of surface soil and OVB are anticipated to be salvaged during the Construction and Operation phases to meet the reclamation needs of the Project with a surplus of reclamation material types projected to be available as a contingency. Woody debris is not included in this material balance as it is not technically required for successful reclamation.

While the organic mineral mix surface soil is only currently scheduled to be applied at two (2) locations, the surplus will be used opportunistically to reclaim low-lying areas and potential wetlands, or as an organic soil amendment.

Since the Project includes several satellite areas, including the Rock Quarry, Gravel Quarry, Explosive Facility, Explosive Magazine, TAC and the Rail Infrastructure area, a more detailed materials balance for surface soil is presented in **Table 6.3-4**, showing required and available surface soil volumes broken down by surface soil stockpile and Project Component. Surface soils salvaged at satellite areas (TAC, Explosive Facility, Explosive Magazine, and Rail Infrastructure) will be stockpiled at each location and replaced following the Operation Phase. This approach is efficient for minimizing hauling of surface soils and allows for the surface soil types present in these pre-Project locations to be replaced back to the same location.

Table 6.3-3: Reclamation Materials Material Balance

Reclamation Materials	Available Reclamation Material for Reclamation (Mm ³)	Required Reclamation Material for Reclamation (Mm ³)	Surplus (+Mm ³) or Deficit (-Mm ³) of Reclamation Material for Reclamation	Surplus (+%) or Deficit (-%) of Reclamation Material for Reclamation
High-AWSC mineral surface soil	1.87	1.80	+0.07	+4
Low-AWSC mineral surface soil	0.27	0.27	+<0.01	+<1
Organic-mineral mix surface soil	0.12	0.07	+0.05	+71
Total surface soils	2.26	2.14	+0.12	+6
Overburden	12.26	4.35	+7.91	+182

Notes: <=less than; %=percent; AWSC=available water storage capacity; Mm³=million cubic metres

Table 6.3-4: Surface Soil Material Balance by Identified Stockpile

Surface Soil Stockpile Identifications	Surface Soil Suitability Class	Availability by Surface Soil Suitability Class (m³)	Total Available Surface Soils for Reclamation (m³)	Surface Soils Required for Reclamation (m³)*	Surplus (+m³) or Deficit (-m³) of Surface Soils Required for Reclamation	Surplus(+) or Deficit (-%) of Surface Soils Required for Reclamation	Notes
Pit #1, #2, #3 and #4	High-AWSC mineral	1,729,457	2,022,062	1,917,448	104,614	5.5	Will be separated into four stockpiles with sub material portions or stockpiles.
	Low-AWSC mineral	175,077					
	Organic-mineral mix	117,528					
Explosive Magazine	High-AWSC mineral	3,790	3,790	2,392	1,397	58.4	Only one stockpile required.
Explosive Facility	High-AWSC mineral	156	5,345	3,784	1,561	41.3	71% low-AWSC surface soil. Reclamation surface soils will be like pre-Project surface soils. Ecohydrological modeling assumed use of low-AWSC mineral surface soil in reclamation.
	Low-AWSC mineral	5,189					
Rock Quarry	High-AWSC mineral	17,994	17,994	13,863	4,132	29.8	Only one stockpile required.
Gravel Quarry	High-AWSC mineral	11,720	58,541	49,075	9,466	19.3	80% low-AWSC surface soil. Reclamation surface soils will be like pre-Project surface soils. Ecohydrological modeling assumed use of low-AWSC mineral surface soil in reclamation.
	Low-AWSC mineral	46,821					
Tenas Access Corridor #1 and #2	High-AWSC mineral	106,734	113,416	113,411	6	0.0	5% low-AWSC surface soil. Reclamation surface soils will be like pre-Project surface soils. Ecohydrological modeling assumed use of high-AWSC mineral surface soil in reclamation.
	Low-AWSC mineral	5,868					
	Organic-mineral mix	814					

Surface Soil Stockpile Identifications	Surface Soil Suitability Class	Availability by Surface Soil Suitability Class (m ³)	Total Available Surface Soils for Reclamation (m ³)	Surface Soils Required for Reclamation (m ³)*	Surplus (+m ³) or Deficit (-m ³) of Surface Soils Required for Reclamation	Surplus(+) or Deficit (-%) of Surface Soils Required for Reclamation	Notes
Rail Infrastructure	High-AWSC mineral	1,763	42,725	41,144	1,581	3.8	92% low-AWSC surface soil. Reclamation surface soils will be like pre-Project surface soils. Ecohydrological modeling assumed use of low-AWSC mineral surface soil in reclamation.
	Low-AWSC mineral	40,962					
Total	High-AWSC mineral	1,871,614	2,263,873	2,141,116	122,757*	5.7*	
	Low-AWSC mineral	273,916					
	Organic-mineral mix	118,342					

Notes: %=percent; AWSC=available water-storage capacity; cm=centimetres; m³=cubic metre

*Any surplus reclamation materials will be used to increase diversity of the final reclaimed landform

6.3.1.6 *Salvage of Reclamation Materials*

The **SMP (Appendix 13.15-B)** attached) describes the equipment to be used for salvage, guidelines for supervision of salvage operations by trained personnel and Qualified Professionals (QPs), and best management practices to be implemented to maintain the quality of reclamation materials and protect the adjacent environment. Additional relevant information is also presented in the **Construction Environmental Management Plan (CEMP) (S13.0-C4)**, as salvage operations will primarily occur during Construction Phase of the Project.

Areas with shallow surface soils thicknesses above bedrock (less than [$<$] 50 cm) or steep areas (greater than [$>$] 26° or slopes exceeding operational safety protocols) will not be salvaged. Supervising personnel will be responsible for applying the suitability criteria outlined in the following subsections to delineate suitable materials for use in reclamation. Suitability criteria are also summarized in **6.3.1.2 Evaluation of Reclamation-Material Suitability**, which provides additional recommendations for sampling intensity and analytical parameters to be measured prior to final salvage activities. Monitoring programs will provide data to support ongoing refinement of surface soil suitability criteria; in particular, proposed coarse-fragment thresholds and ranges of natural variation for pH, electrical conductivity, and element concentrations. New data collected from these programs will be used to refine surface soil suitability evaluations and QEA modelling. Updates will be presented in the Five Year Mine Plan and Reclamation Program updates, with interim information presented in the Annual Reclamation Reports. An overview of compliance reporting required for the Project is provided in **9.2 Compliance Reporting**.

6.3.1.6.1 *Surface Soil*

For surface soil salvage, supervising QPs will delineate suitable surface soils based on parent-material type as per Key 9.13 in the British Columbia Field Manual for Describing Terrestrial Ecosystems (BC MOF and BC MOE 2015) and SMU definitions in the Tenas Project Terrain and Soil Baseline Report (Ardea 2021b). Key parameters and associated criteria from these sources are summarized in the **SMP (Appendix 13.15-B)** attached).

Data available from 55 samples from baseline surveys indicated occasional elevated concentrations of arsenic and frequently-elevated concentrations of boron in comparison to the Canadian Council of Ministers of the Environment (CCME) agricultural guidelines (Ardea 2021b)¹³. Elevated boron was identified in the Rail Infrastructure and Bypass Road areas, while elevated arsenic was identified in the open pit, Rail Infrastructure and Bypass Road areas. All other CCME agricultural guidelines were met (Ardea 2021b). Given that Pre-Project disturbance levels are low in baseline conditions in the Project Area/footprint, these elevated concentrations should be interpreted as reflecting natural mineralization of surficial materials rather than contamination, and do not affect suitability ratings for reclamation. Samples of surface soil will be taken during salvage to further verify and augment baseline element concentrations, to identify any materials with consistently elevated levels, and to build on the existing dataset (**7.1.3.1 Baseline Data**). Surface soil pH and electrical conductivity criteria have not been proposed for salvaged surface soils because the surface soils within the Project Area are currently supporting healthy forests that are like those being proposed for revegetation in the Decommissioning and Reclamation Phase of the Project.

¹³ Agricultural guidelines apply to the ALR portion of the Project footprint and were used for the remaining Project footprint to be conservative.

6.3.1.6.1.1 Overburden

For OVB to be used as rooting-zone material (i.e., in the uppermost 1.0 m of reclamation covers) to meet the specifications used in the QEA modelling, it must be as fine or finer than the samples in the modelled dataset. For operational purposes, these thresholds have been set using coarse-fragment sizes that can be visually identified in the field. Namely, the volume of coarse fragments larger than 100 millimetres (mm) in diameter must be less than 10% of the total bulk material volume. Furthermore, the OVB must appear to be morainal in origin, as identified by predominance of sub-rounded and sub-angular coarse fragments (typically silty clay loam, silt loam, loam, sandy loam, or clay loam fine-fraction [$< 2\text{-mm}$] textures in the Project Area/footprint; BC MOF and BC MOE 2015).

Preliminary suitability criteria for selection of OVB that is appropriate for use as a reclamation medium are:

- ▶ Volume of coarse fragments larger than 100 mm is $<10\%$ of the total bulk material volume (i.e., surface soil plus voids);
- ▶ must appear to be morainal in origin, as identified by predominance of sub-rounded and sub-angular coarse fragments and silty clay loam, silt loam, loam, sandy loam, or clay loam fine-fraction ($< 2\text{-mm}$) textures;
- ▶ element concentrations are below CCME thresholds for agricultural soils (or alternate Project-specific criteria);¹⁴
- ▶ pH is between 4.5 and 8; and
- ▶ electrical conductivity is <1 decisiemens per metre (dS/m).¹⁵

6.3.1.7 **Stockpiling of Reclamation Materials**

6.3.1.7.1 *Surface Soil*

Throughout the Construction, and Operation phases of the Project, opportunities will be pursued for direct placement of salvaged surface soils and overburden on newly completed areas for reclamation research and progressive reclamation. During the Operation and Construction Phases, a total of 0.85 Mm^3 of surface soil is directly placed from surface soil salvage activities while an additional 0.47 Mm^3 will be reclaimed from surface soil stockpiles (**Table 6.3-5**) for a total of 1.32 Mm^3 being placed during the Operation Phase (approximately 62% progressive reclamation), leaving only 0.82 Mm^3 to be placed during the Decommissioning and Reclamation Phase (**Table 6.3-5**).

Surface soil stockpiles will be in place for up to 25 years (except for the Pit #4 surface soil stockpile, which will be in place for 15 years), but the majority of the surface soils will be directly placed or stockpiled for shorter periods. This represents a significant reduction in reclamation liability costs and will reduce the degradation of surface soil quality due to long term storage in stockpiles.

¹⁴ Element concentration thresholds should be evaluated relative to ranges of natural variation in surface soils within the Project Area/footprint as surface-soil samples are collected during salvage. In cases where baseline conditions exceed Canadian Council of Ministers of the Environment (CCME) guidelines, use of Project-specific criteria may be appropriate, as designated by a Qualified Person (QP).

¹⁵ The proposed thresholds for pH and electrical conductivity in overburden (OVB) should be evaluated relative to the baseline range of natural variation to be assessed as samples of salvaged soil and OVB samples are sent for laboratory testing.

6.3.1.7.2 *Overburden*

Salvaged OVB will be used directly to build dams and buttresses as well as for progressive reclamation requirements; therefore, dedicated OVB stockpiles are not currently required for the Project. If OVB stockpiles are required during the Operation Phase due to capacity issues and/or sequencing requirements, they will be added in as needed in field-fit locations and configurations that are appropriate for the current stage of mining and will be within previously and/or future disturbed areas for the Project Area.

Table 6.3-5: Surface Soil Stockpiling and Direct Placement Sequencing for the Project Footprint

Year	Surface Soil Salvage Volumes (m ³)	Cumulative Proportion of Surface Soils Salvaged (%)	Volumes of Direct Placed Surface Soils (m ³)	Volume of Surface Soil Rehandled from Surface Soil Stockpiles (m ³)	Total Volume of Surface Soils placed (m ³)	Volume of Surface Soils Remaining in Stockpiles (m ³)
-0.5	797,257	35	-	-	-	797,257
0	83,283	39	-	-	-	880,540
1	140,186	45	96,062	-	96,062	924,665
2	365,868	61	76,503	-	76,503	1,214,030
3	139,931	67	69,052	-	69,052	1,284,909
4	28,295	69	28,295	39,319	67,614	1,245,590
5	24,096	70	24,096	64,115	88,211	1,181,475
6-10	194,239	78	194,239	363,341	557,579	818,134
11-15	292,059	91	189,622	-	189,622	920,571
16-20	198,658	100	175,897	-	175,897	943,333
21-25	-	100	-	820,575	820,575	122,757
Totals	2,263,873	100	853,766	1,287,350	2,141,116	122,757*

Notes: %=percent; m³=cubic metres

* this is not a total and if there is actual surface soils left in stockpile at the end of the Decommissioning and Reclamation Phase, it will be used for additional topographic diversity

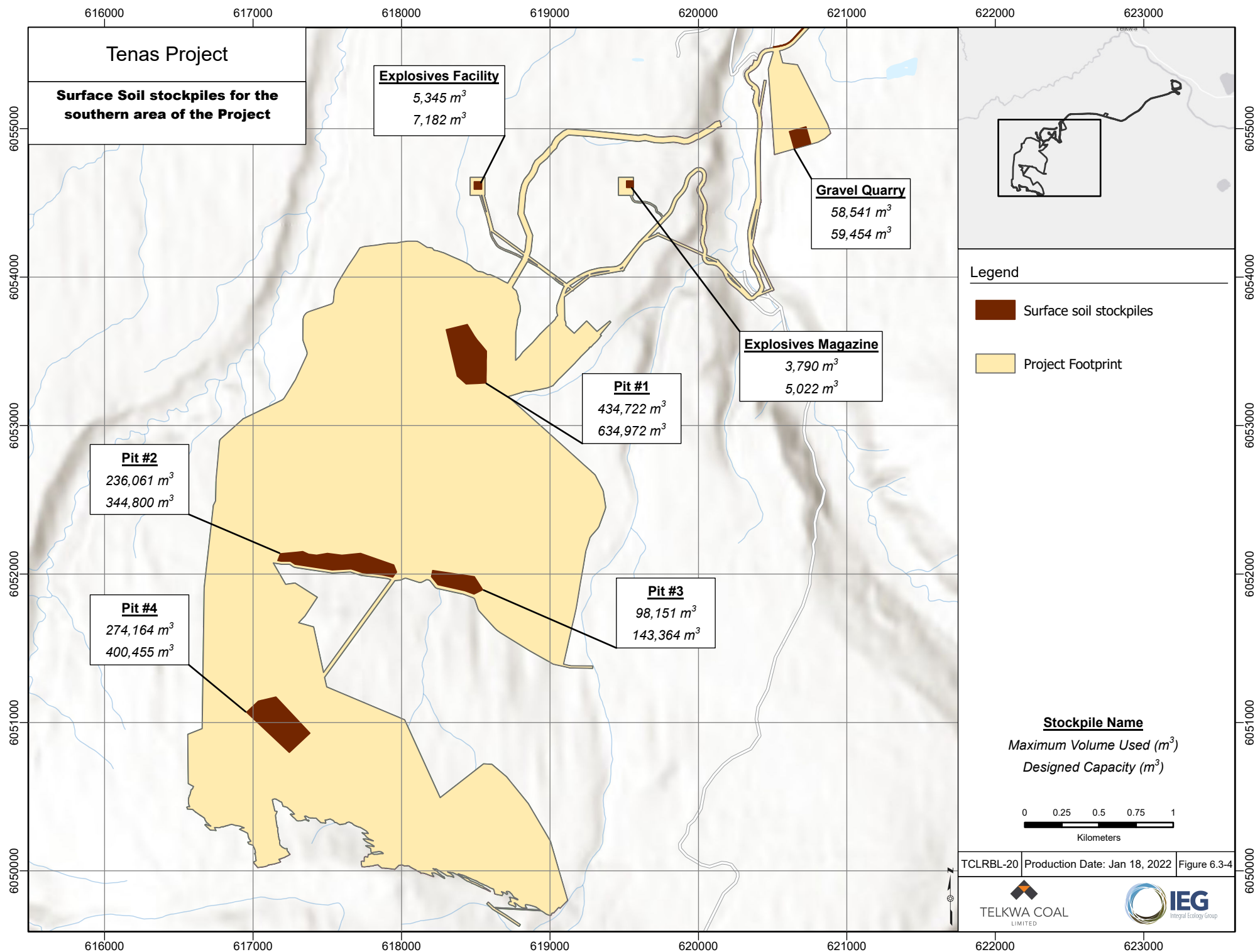
Stockpile locations for salvaged surficial soils are shown in **Figure 6.3-4** and **Figure 6.3-5**, and include four stockpiles in the Minesite area of the Project, along with satellite stockpiles for more remote areas (Rail Infrastructure, quarries, Explosives Magazine and Explosives Facility). Windrows will be used to store surface soil salvaged along the TAC. Note that while stockpile locations are shown in place in **Figure 6.3-4** and **Figure 6.3-5**, the creation and depletion of surface soil stockpiles will be temporally staggered throughout the Operation Phase as mine development and progressive reclamation is carried out (**6.3.2.2 Progressive Reclamation/Sequencing**). Additional information on surface soil stockpile material sources, volumes, dimensions and designs is presented in the SMP.

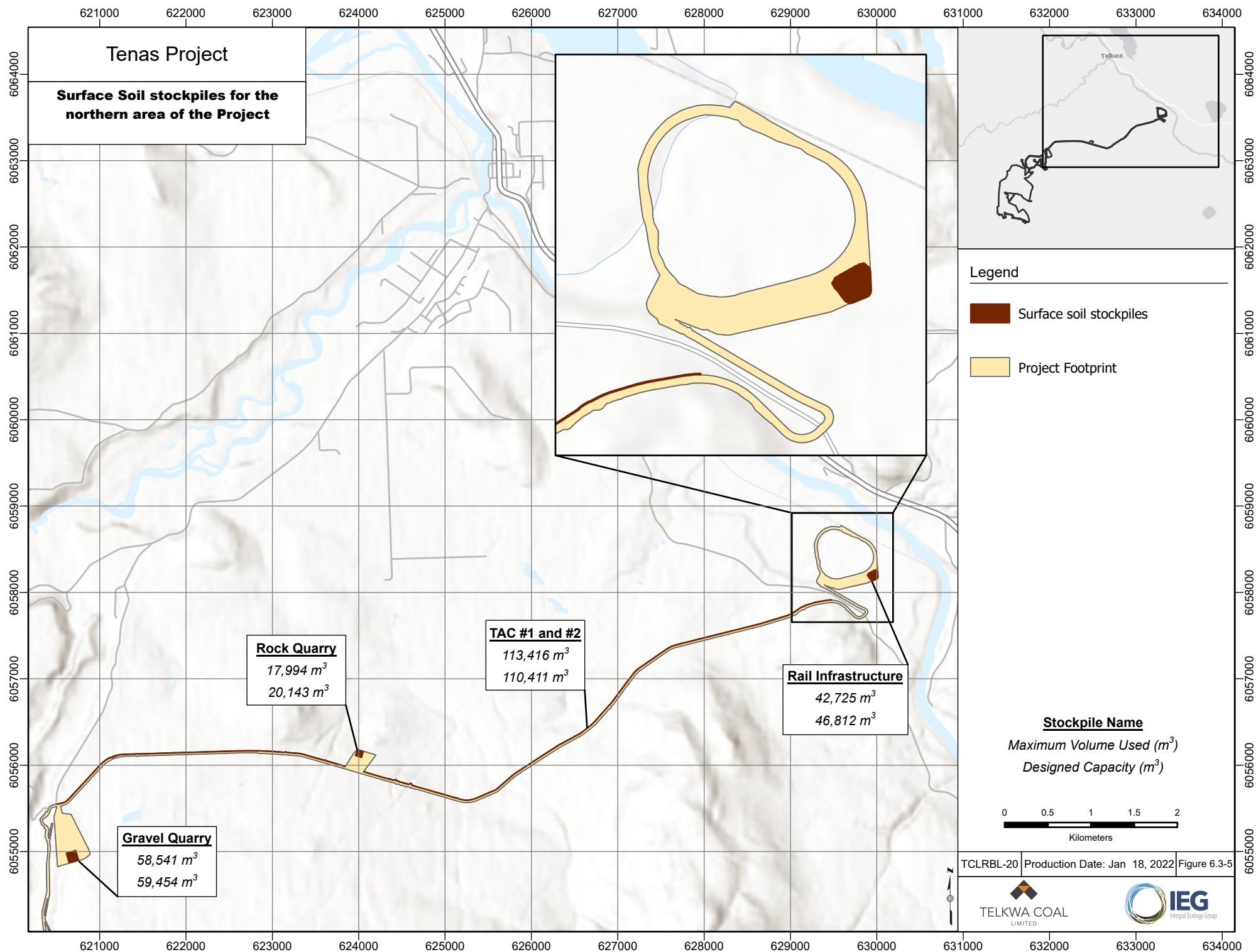
For surface soil stockpiles at the Explosive Facility, Gravel Quarry and Rail Infrastructure area, surface soils of different suitability classes will be stockpiled within one stockpile area, but at different ends of stockpiles to limit mixing and dilution of specific properties which is anticipated to be feasible given the small size of these stockpiles. Signage will be put in place to indicate the location of soil suitability classes within stockpiles, and corresponding labels will be incorporated into site maps and photographs. Stockpiles at the Rock Quarry and Explosives Magazine will only contain surface soil from one suitability class. Surface soil salvaged from the TAC will be windrowed adjacent to where it is salvaged and contain multiple suitability classes if they are present, thus surface soil that is replaced in reclamation from the TAC surface soil windrows will maintain the pre-development heterogeneity and distribution of surface soil suitability classes.

Salvaged OVB from the Construction, and Operation phases will be used directly to build dams and buttresses as well as for progressive reclamation, therefore dedicated OVB stockpiles are not currently planned. If OVB stockpiles are required during the Operation Phase due to capacity issues and/or sequencing requirements, they will be added in as needed in field-fit locations and configurations that are appropriate to the current stage of mining and matching stability design guidelines provided in **1.0 Overview of Project Proponent Description** of the EAC Application. These overburden stockpiles will be within the Project Area assessed if they are required but might be outside of the Project footprint.

Large volumes of large woody debris will be encountered during site clearing and pre-surface soil salvage tasks, some representing large pieces of vegetation (logs, root wads). These materials can represent valuable biotic material for reclamation and surface micro-habitat creation. Under the direction of a QP, opportunities for salvage of woody debris will be identified and will be salvaged and stored for future use in stockpiles that are co-located with surface soil stockpiles. Large woody debris is planned to be stored within the surface soil stockpile footprints if possible, depending on its diameter and nature of these woody debris materials. Large woody debris will also be stored adjacent to surface soil stockpile footprints as mixing it in with the surface soil stockpiles may become operationally challenging for managing the size of the stockpiles. Small woody debris, and other vegetation will be salvaged concurrently with soil salvage.

Regular inspections and updates to stockpile volumes and location tracking will be carried out during active stockpiling operations. Stockpiling best practices, including practices to reduce erosion and the establishment of invasive plants, will be implemented, and are further detailed in the **SMP (Appendix 13.15-B attached)**; the **CEMP**, which includes measures for sediment control and erosion protection; and the **Vegetation Management Plan (S13.0-C18) (VMP)** that includes invasive plant management. Signage will be installed to mark stockpiles and prevent inadvertent contamination, burial, or removal, and temporary fencing or other type of visual barrier will be erected if required. Regular inspections of stockpiles will be conducted to assess revegetation status, presence of invasive or non-desirable species and evidence of erosion, as well as to confirm that signage is intact, and stockpiles are accurate.





6.3.1.8 *Replacement of Reclamation Materials*

Reclamation materials will be placed as the post-Project landform acquires its final topography through deposition and landform grading. Placement of surface soils within +/- 20 cm of target depths is acceptable; achievement of target ecosystems is not expected to be compromised if the overall average placement depths for surface soils for each hectare meet depth specifications. To the maximum extent practicable, placement operations will avoid placement during excessively dry and windy conditions to reduce dust generation and excessively wet conditions to reduce the risk of erosion and compaction.

Placement of reclamation materials will be accomplished using mine style equipment, primarily bulldozers, excavators and trucks in a manner that generates microtopography to improve microsites for plants, capture of seeds, and reduces erosion. Woody debris will be incorporated to create microhabitats and improve water and snow retention. Equipment operators should not seek to create planar surfaces with exact material depths, rather it is preferable to have surface roughness and undulations. Dozer and/or excavator ripping, surface loosening and/or mounding with an excavator bucket, or other means of site preparation may be applied if additional decompaction is necessary or further creation of microtopography is desired. The following considerations will inform selection of appropriate decompaction and site preparation techniques:

- ▶ Excess water is removed from a site through infiltration or surface flow. While surface flow may cause erosion, as forced infiltration into underlying rock materials is not desirable. Risks and trade-offs of runoff versus infiltration will be evaluated in a site-specific context;
- ▶ Site preparation techniques that create large microtopography (e.g., large mounds) may reduce accessibility for wildlife and/or land users in some situations, thus end land use objectives will inform methods; and
- ▶ The risk of larger-scale cover system failures caused by pooling water (e.g., cascading failures from larger depressions) will be considered in a site-specific context.

Additional best practices that will be implemented during placement of reclamation material, including management of erosion and considerations for operating under varying weather conditions, are detailed in the **SMP (Appendix 13.15-B attached)**.

6.3.2 Landform Design and Erosion Control

6.3.2.1 *Revegetation Strategy*

The proposed revegetation strategy is based on projected post-closure ecosystems and corresponding cover designs identified using ecohydrological modelling (described in **Appendix 13.15-C attached**). Each post-closure ecosystem has an associated suite of plant species that are adapted to its climatic and edaphic conditions, and thus there are specific revegetation strategies linked to each post-closure ecosystem.

Revegetation will be guided by ecosystem and revegetation fact sheets summarizing conditions and revegetation strategies for each Post-closure ecosystem. An example fact sheet for the dominant reclamation ecosystem, the ICHmc2 zonal 01-52 site series, is presented by **Figure 6.3-6**. Additional fact sheets for the zonal IDFmw2-01 and SBSmc2-01 ecosystems are presented in **Appendix 13.15-D attached**. Fact sheets for the smaller-component ecosystems will be developed as reclamation research advances; fact sheets are intended to be living documents and records of knowledge that will be updated for each Post-closure ecosystem as reclamation research, monitoring, and planning evolve over Operation Phase.

Revegetation for the Project footprint is based on the return of locally common native plants. A particular focus will be the creation of closed-canopy coniferous forests, as this aligns with the end land use objectives to:

- ▶ create wildlife habitat that favours pine marten, the primary focal species for habitat reclamation, and avoids the intentional introduction of broadleaf species that will favour moose and associated predators;
- ▶ reclaim forest habitat that, in addition to creating wildlife habitat, will support uses such as recreation, forest harvest (community forest), and traditional land uses, for instance, plant and animal harvesting; and feasting ceremonies; and
- ▶ re-establish self-sustaining vegetation that will progress to plant communities like pre-Project development ecosystems (as defined by the results of ecohydrological modelling).

The cover designs presented in **6.3.1.3** along with projected Post-closure ecosystems (**6.2.2**) and associated reclamation fact sheets will be used as overall guidance for Project specific and polygon specific reclamation design. These Project/polygon designs will be more detailed than the overarching reclamation program presented in this document, based on the evolving state of site-specific knowledge and reclamation research, and will be developed approximately three to four years in advance of reclamation-readiness of the Project. This sequencing allows designs to be completed prior to the need to start acquiring plant materials (e.g., seedlings) for revegetation.

The most likely method based on current knowledge for establishing most plants included in reclamation fact sheets is planting of propagated container seedlings from appropriate seed provenances. Some species may be established through broadcast seeding (or potentially hydroseeding in special cases), but in general, seed for most target species is not readily available commercially, and cost effectiveness for establishing most species is higher through planting of container seedlings than through direct seeding.

Fertilization for the purposes of revegetation will likely be accomplished through spot fertilization of planted stems (i.e., in-hole slow-release fertilizer bags). Local native plant species targeted in revegetation planning are generally not nitrophilic, and thus broadcast fertilization tends to favour establishment of weedy or non-target species over target species, which can compete with target species and inhibit their establishment. The only locations that are scheduled to receive broadcast fertilization will be dam slopes, which require quick revegetation for erosion control. Since dam slopes will not have trees in Post-closure for geotechnical reasons, competition from fertilization is not expected to be a concern.

A critical task for more detailed revegetation planning (and overall reclamation planning) relates to the fact that one of the primary end land use objectives involves the goal of returning the capability to support traditional Indigenous land uses. As reclamation planning progresses, collaborative involvement of the Office of the Wet'suwet'en (OW) is needed to support more detailed planning of how reclamation can be designed and implemented to support these land uses.

Biogeoclimatic unit		Site Series	Site information	
ICHmc2		01/52	<u>Cover type:</u>	Overburden with topsoil cover
Vegetation Association 01: Western hemlock—Step moss 52: Hybrid spruce / paper birch—Thimbleberry—Hazelnut			<u>Cover depth:</u>	100-cm OB, 30-cm topsoil
Edatopic grid			<u>SMR:</u>	3-5
			<u>Landscape position (Aspect/ Slope):</u>	01: 0-90% slopes 52: 0-45% slopes
			<u>Elevation:</u>	100-750 masl
Seral ecosite functions				
- Supporting wildlife habitat, and recreation. - Supporting traditional land uses including plant and animal harvest.				
Climax vegetation species			Climax ecosite functions	
<u>Trees</u>	<u>Shrubs</u>	<u>Herbs</u>	<u>Moss/Lichen</u>	- Supporting wildlife habitat, recreation, and forest harvest in appropriate areas - Supporting traditional land uses including plant and animal harvest.
Western hemlock	Thimbleberry	Purple peavine	Red-stemmed feathermoss	
Western redcedar	Highbush cranberry	Wild sarsaparilla	Step moss	
Lodgepole pine	Falsebox	Bunchberry		
Hybrid spruce	Red-osier dogwood	Queen's cup		
Paper birch				

Recommended site preparation			
- Site preparation to produce microtopography and fine-fraction densities below 1600 kg/m³ - Placement of woody debris where available			
Recommended species to plant/ seed			
<u>Lifeform</u>	<u>Species</u>	<u>Planting (stems/ha)</u>	<u>Seeding rate (kg/ha)</u>
Trees	Lodgepole pine	1,000-2,000	
	Hybrid spruce	1,000-2,000	
Shrubs	Red-osier dogwood	100-1,000	
	Black huckleberry	100-1,000	
	Black twinberry	100-1,000	
Recommended fertilizer methods and application rates			
<u>Fertilizer method</u>		<u>Application rate</u>	
Slow-release fertilizer “teabags” in planting holes; no broadcast fertilizer		Variable—to be tested.	

Figure 6.3-6: Reclamation fact sheet for ICHmc2 01-52

6.3.2.2 *Progressive Reclamation and Sequencing*

TCL is planning to conduct progressive reclamation during the post-Construction and the Operation Phases of the Project where area is available and/or to reduce erosion. In the first five (5) years of operation, progressive reclamation will mainly be focused on the embankments and buttresses of the TCP, EMP, and revegetation of the North Management Pond cover, buttress, and embankments (**6.4 Detailed Five-Year Mine and Reclamation Plan**). As detailed in the **Visual Resource Management Plan (S13.0-C19) (VRMP)**, visual screening will also be completed in Year -0.5 for the Rail Infrastructure area. Furthermore, once the TAC is constructed and in use, it is planned to start reclaiming the cut and fill slopes for this Corridor in Year 1 with completion planned for the end of Year 2. After the first five (5) years of the Operation Phase, progressive reclamation will be accelerated as backfilling of the open pit are completed and the East and West Management Ponds near their completion. Progressive reclamation will not be conducted in locations where future mining activity may occur. **Table 6.3-6** below provides a summary of reclamation activities completed in the Construction Phase (Years -0.5 to 0) and the first five (5) years of Operation (Years 1 to 5).

Table 6.3-6: Summary of Reclamation and Development Activities during the Construction Phase and First Five (5) Years of Operation Phase

Year	Logging and Clearing (ha)	Surface Soil Salvage Areas (ha)	Surface Soil Salvage Volumes (m ³)	Surface Soil Placement Volumes Including Direct Placement (m ³)	Direct Placement Volumes of Surface Soils (m ³)	Surface Soil Remaining in Stockpiles (m ³)	Surface Soil Placement Areas (ha)	Revegetation and Fertilizer Treatment Areas (ha)
-0.5	313	284	797,257	-	-	797,257	-	-
0	32	20	83,283	-	-	880,540	-	-
1	48	47	140,186	96,062	96,062	924,665	18	18
2	136	134	365,868	76,503	76,503	1,214,030	26	26
3	42	42	139,931	69,052	69,052	1,284,909	14	14
4	10	9	28,295	67,614	28,295	1,245,590	23	23
5	8	8	24,096	88,211	24,096	1,181,475	29	29
TOTAL	589.6	544.2	1,578,917	397,442	294,009	1,181,475*	109.1	109.1

Notes: ha=hectare; m³=cubic metres

* this value is not a total but rather the amount of surface soils currently stockpiled

6.3.3 Reclamation Research

Reclamation research is proposed to both address potential uncertainties and investigate opportunities to improve the RCP. Reclamation research planning and implementation for the Project will be based on the following processes:

1. identify current key uncertainties and assumptions in the reclamation plan;
2. develop research and reclamation monitoring programs (**6.3.3** and **7**) to reduce these uncertainties and test assumptions;
3. interpret research and monitoring results to assess the current state of knowledge;
4. collaborate with local Indigenous groups and regulators to review results on a regular basis;
5. use results to re-evaluate remaining key uncertainties and assumptions, and revise/renew research and monitoring programs; and
6. regularly and formally update and communicate results in the 5-year updates to the Project Mine Plan and Reclamation Program.

Key assumptions and uncertainties for reclamation research and testing are itemized in **Table 6.3-7**. Reclamation-research programs designed to evaluate assumptions and reduce uncertainties will involve establishment of commercial-scale trials in areas eligible for progressive reclamation, with a focus on testing cover depths and placement techniques, and different revegetation strategies and insitu moisture levels.

Table 6.3-7: Key Reclamation Assumptions and Uncertainties

Item Number	Category	Description	Plan to Address	Potential Risks/Repercussions
1	Assumption	Proposed reclamation treatments based on ecohydrological modelling of projected post-closure ecosystems and associated cover designs and revegetation strategies will be effective at establishing native ecosystems on the reclamation landscape.	Reclamation-monitoring programs; operational-scale reclamation-research trials that test cover applications and revegetation strategies.	Reclamation landforms and covers may not support desired communities, and adjustments to cover design will be required to achieve projected Post-closure ecosystems and avoid under-performance.
2	Assumption	Once successfully established, reclaimed ecosystems will proceed on expected trajectories where established woody species persist and define the post-closure community, and new species gradually colonize and shift the community over time.	Reclamation-monitoring programs; reclamation-research trials involving operational-scale revegetation.	Unexpected establishment failures and/or mass colonization by non-target species have the potential to shift conditions to new un-anticipated states.
3	Assumption	Projections of current and future biogeoclimatic variants based on climate-change models are useful in defining ecologically similar areas and in developing revegetation treatments.	Reclamation-monitoring programs; operational-scale reclamation-research trials involving revegetation.	As with all future projections, there is uncertainty in future climate modelling. However, the uncertainties involved in using this modelling for reclamation planning introduce less error than adopting the assumption that historical climatic conditions and their associated ecosystems will still be dominant during the closure period for the Tenas Project (Project).
4	Uncertainty	What is the relationship between cover-material characteristics, cover depth, and ecosystem outcomes? This is currently assessed by the ecohydrological model used to support the Project Plan, which was developed through testing against a large provincial database of ecosystem characteristics, but these relationships have not been demonstrated in the reclamation field setting. The reclamation-materials balance, and its substantial associated efforts and costs, is based on these relationships being correct.	Reclamation-monitoring programs; operational-scale cover-depth and revegetation research trials.	Cover designs and/or post-closure projections may have to be adjusted as this uncertainty is reduced through research and monitoring programs.

Item Number	Category	Description	Plan to Address	Potential Risks/Repercussions
5	Uncertainty	Can reclaimed ecosystems support target end land uses?	Reclamation-monitoring programs and ongoing collaboration with Indigenous groups, regulators, other stakeholders on the Project end-land-use planning process.	Reclamation treatments may need to be adjusted to meet end land-use objectives, based on collaboration with indigenous groups, regulators, other stakeholders, and monitoring programs.
6	Uncertainty	Can the balance of reclaimed ecosystems be shifted towards drier site series that have been lost through Project development?	Reclamation-research trials focussed on re-establishment of drier ecosystems.	It may be difficult to re-establish drier ecosystems on the reclamation landscape, but this is perceived to be a low risk at this time.
7	Uncertainty	In post-closure mapping, many areas are shown as large, homogeneous polygons. These are in fact modelled as heterogeneous polygons with smaller areas of different ecosystems, but there is still a question as to how to construct additional diversity – if needed, on the reclaimed landscape. This could be done by varying revegetation treatments to change species composition, by varying time/year of planting to create different age classes and structural stages, and by building additional diversity into the reclaimed landscape through construction of larger hummocks, and features such as water-conveyance channels. Development of these techniques requires testing on an operational scale.	Operational-scale reclamation research and monitoring programs.	Risk is low—it is likely that heterogeneity will naturally emerge on the post-Project landscape due to variation in cover-material properties and timing of reclamation.

6.3.4 Habitat Compensation Works

The Reclamation and Closure Plan has habitat compensation works consisting of a fish habitat offsetting plan which was developed due to the predicted loss of fish habitat in Four Creek. **Appendix 13.15-E** attached provides the conceptual fishery compensation program that will need to be approved by the Department of Fisheries and Oceans Canada (DFO). TCL is currently in discussions with DFO on this topic with the goal of developing an execution level fishery compensation program and DFO approvals approximately six (6) months prior to the Construction Phase of the Project.

6.3.5 Reclamation and Closure Prescriptions

This subsection describes general prescriptions for reclamation of the following Project components.

6.3.5.1 *Structures and Equipment*

Buildings and other infrastructure on the Minesite, including conveyors, mobile equipment, fixed equipment, sea containers, and clean water pipelines, will be dismantled or demolished and removed from the site. The one exception is the flocculation station and powerlines that will be kept operational to deal with possible sediment levels in the Decommissioning and Reclamation and Post-closure phases. Once the sediment levels reach appropriate levels for an extended period, the powerline, substation, and flocculation stations will be removed from site. Salvageable materials will be reused or recycled or repurposed as much as practical. Material will be disposed of according to applicable legislation and regulations. Contaminated materials, such as soils and/or materials containing hydrocarbons will be disposed of at a suitable offsite hazardous material facility or handled at the Soil Treatment Facility onsite. Once the buildings and infrastructure have been removed, the areas where the infrastructure was situated will have the concrete foundations broken up and the site contoured and revegetated with appropriate plant species for the region.

6.3.5.2 *Material Storage Piles Reclamation*

Surface-soil stockpiles are not scheduled to be stripped or receive additional cover following use of stockpiled material. Site preparation to reduce decompaction and improve microtopography will occur prior to revegetation.

As stated in the Project Description (**S1.0 Overview of Project Proponent Description of the EAC Application**), there are currently no permanent external material storage piles planned for the Project. Material will be placed within the embankments and buttresses of the management ponds, capping the management ponds, saturated underwater within the Management Pond Impoundments, shipped offsite to markets, and/or placed as backfill within the open pit.

However, if at some point external storage piles become necessary, they will be resloped to 2.5H to 1V. If storage piles are composed of rock, a 1.0-m thick layer of OVB will be placed on the slopes and top of the piles. This will be followed by soil placed onto the slopes and top at an approximate thickness of 0.30 meters. Finally, storage piles will be seeded and revegetated.

6.3.5.3 *Management Ponds (Tailings Storage Facility) Reclamation*

Any management pond that has not been capped to have at least 90% coverage during the Operation Phase will have overburden and non-PAG rock rehandled from the Tenas Control Pond's buttress and embankment. The Tenas Control Pond is no longer required in Post-closure for sedimentation purposes. See **Appendix 13.15-F SRK Tenas Project Conceptual Cover Memo**. The embankments and buttresses will be recontoured and have surface soils and vegetation placed on them for reclamation. Water levels and

water quality will be monitored to further confirm the water and load balance model. The dams and buttresses will also be monitored for water levels and potential movement.

6.3.5.4 *Open Pit Reclamation Prescriptions*

The open pit reclamation plan includes a combination of revegetation of backfilled spoils and end-pit lakes. The sequence for mining does not allow the entire open pit to be backfilled to a point where there would be no residual surface water left exposed. Some of the materials that are backfilled within the open pit footprint will be both above and below the final post-closure water elevation. Therefore, some material will be saturated in water even though surface water cannot be visibly seen. In the areas of the open pit where backfill cannot be at an elevation above this water level, end-pit lakes will be left. The open pit walls will be almost entirely covered with non-PAG rock and OVB, so open pit walls can be revegetated and reclaimed.

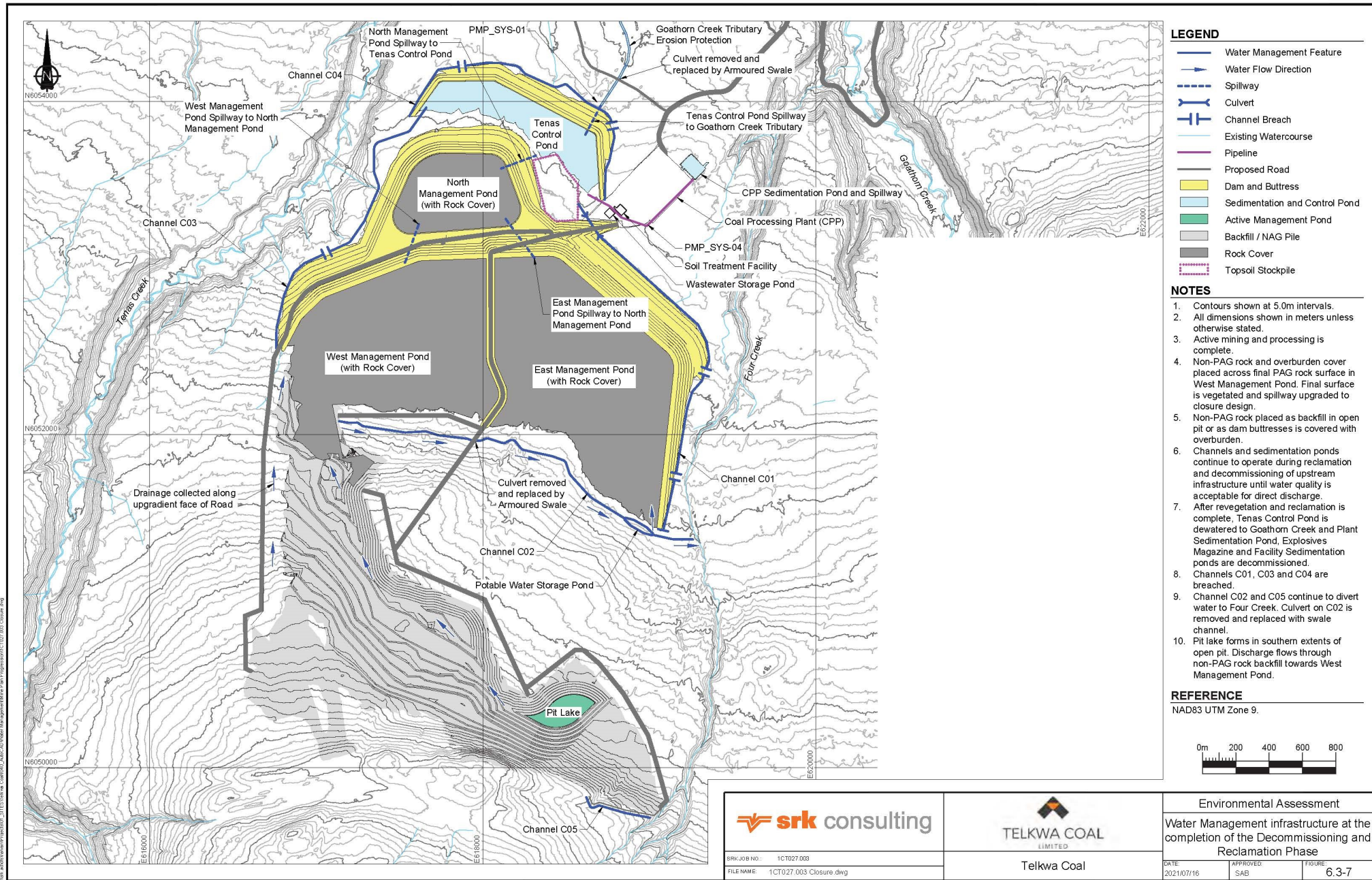
Open pit reclamation will include sloping of the OVB portions of the walls and placing growth medium in the shallow regions of the End Pit lakes. Slopes will be graded to allow the open pit to fill from surface runoff and groundwater inflows into the open pit area. Water will flow from the pit lake through the backfills towards the management ponds to the north. Water quality in the receiving environment will be protective of environmental values and meet permit criteria. Slopes above the final water elevation will be covered in growth media and re-vegetated with appropriate plant species. Prior to the final reclamation of the open pit, the water balance and water quality predictions for closure will be updated for the proposed end pit lakes. Water sampling of the open pit as it fills will also be conducted to verify model accuracy. Sampling of the open pit outflow will also occur on a periodic basis.

6.3.5.5 *Water Management Structure Reclamation Prescriptions*

Water management activities in the Decommissioning and Reclamation Phase include:

- ▶ diverting clean water around working areas and collecting contact water within working areas during Decommissioning;
- ▶ removing culverts in spillways and replace with wide trapezoidal spillway geometry;
- ▶ monitoring water quality during decommissioning of the CPP, explosives area and Rail Infrastructure area in associated sedimentation ponds. After decommissioning of upstream infrastructure is complete, and water quality meets discharge criteria, each sedimentation pond will be breached and backfilled to mimic pre-Project contours and drainage patterns;
- ▶ monitoring water quality in buttress toe collection channels. Once water quality meets discharge criteria, breach collection channels and remove culverts, replacing them with wide swales to facilitate natural drainage patterns;
- ▶ monitoring water cover depths and water quality in covered management ponds to confirm the water and load balance expectations;
- ▶ dewatering the Tenas Control Pond to Goathorn Creek tributary and breaching the dam when upstream decommissioning activities are complete, and
- ▶ decommissioning pumping systems and removing equipment offsite.

Figure 6.3-7 presents an overview of the water management infrastructure present at the end of the Decommissioning and Reclamation Phase. Additional details on water management infrastructure are described in **1.18** of the **Minesite Water Management Plan (S13.0-C11) (MWMP)** and in SRK's water management technical design report, **Appendix 13.15-G SRK Tenas Project Water Management Technical Report**.



6.3.5.6 *Tenas Access Corridor (TAC), Haul and Service Roads Reclamation*

Roads, culverts, and bridges on the Minesite will be reclaimed appropriately. This will include recontouring and establishing natural drainage patterns, removal of stream crossings, and rehabilitation and revegetation of roads, stream banks and riparian areas. This will also include ripping of roads to allow for root penetration and water ingress below the previous road surface. If required, a 1.0-m thick cover of OVB will be placed on haul roads and service roads.

6.3.5.7 *Tenas Access Corridor (TAC)*

The TAC between the Lawson and Telkwa Coalmine Roads will be ripped, recontoured, resloped, covered with surface soils reclaimed from windrows, and revegetated. During the Construction Phase portions of the TAC will be sloped (primarily the cut and fill slopes, and channels), soil placed and revegetated to reduce erosion and promote sediment control. The portion of the TAC between the Telkwa Coalmine Road and the Goathorn Bridge will be turned over to the British Columbia Ministry of Transportation and Infrastructure (BC MOTI), as this section of road is currently used to access recreation areas around the Project and TCL has been told that this access needs to be maintained. The portion of the TAC on the west side of Goathorn Creek past the turnoff to Hunter Basin trail will be reclaimed using the same method for other roads for the Project.

6.3.5.8 *Rail Infrastructure*

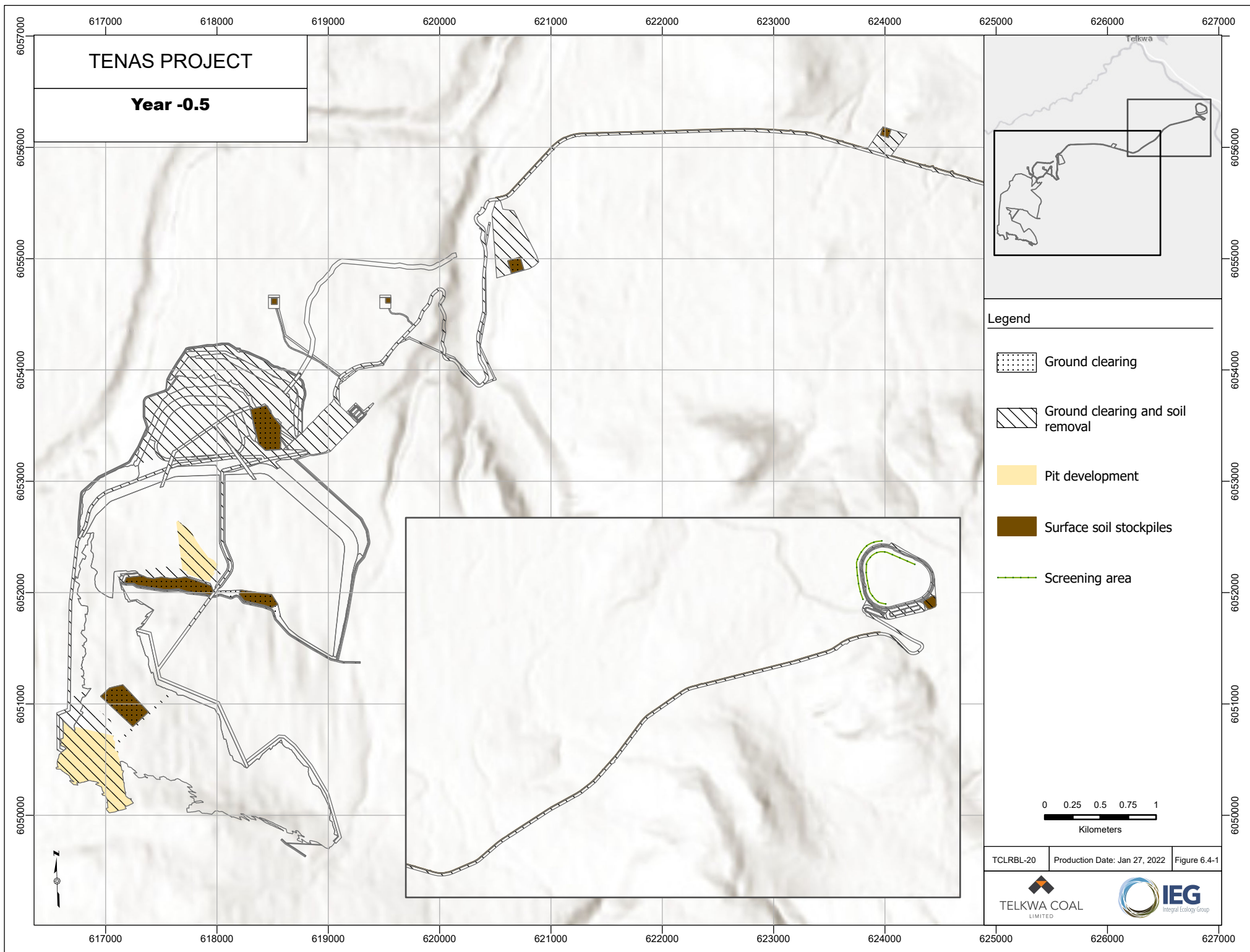
Vegetation screening for visual effect mitigation will be planted by the end of the Construction Phase, as per the **VRMP**.

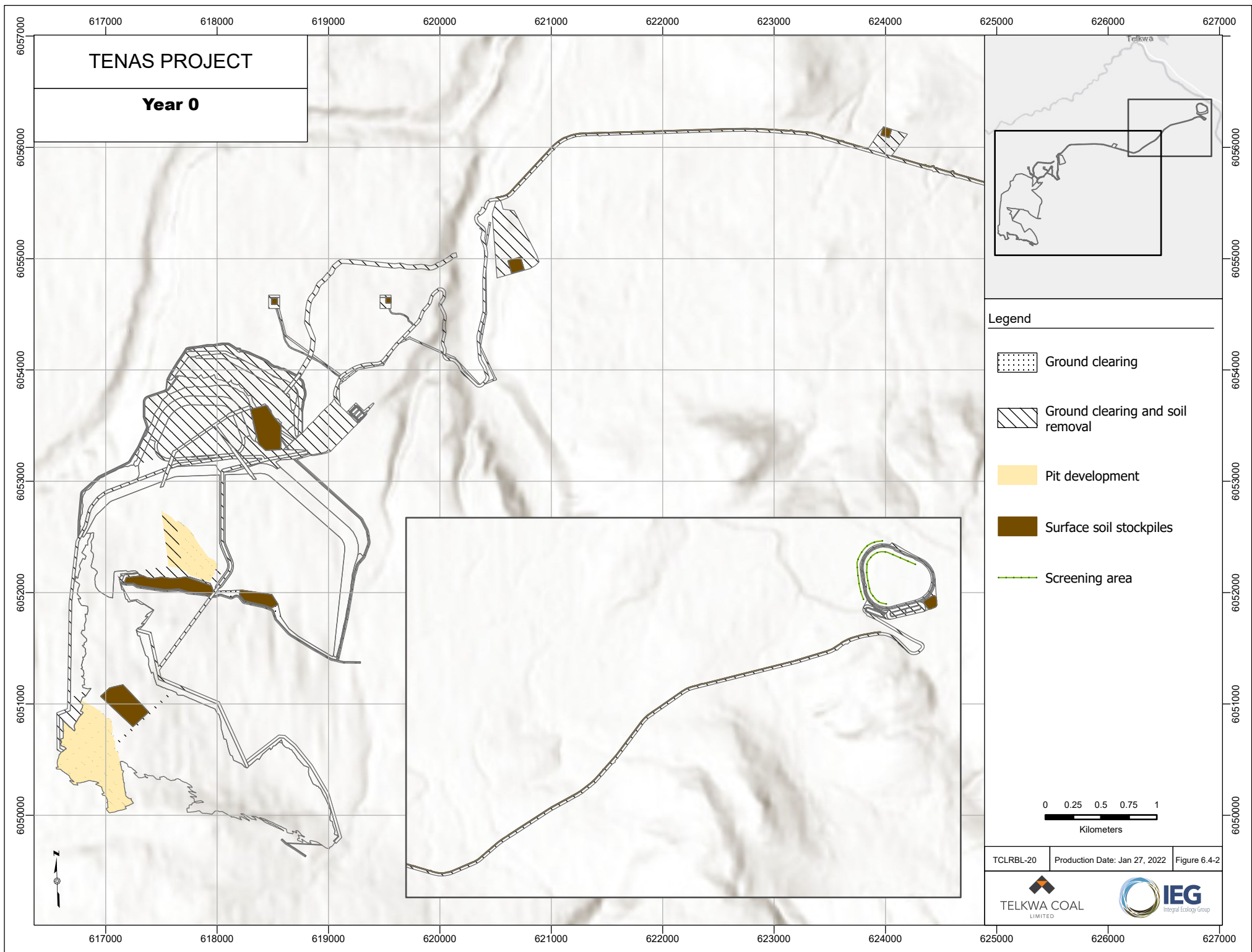
The Rail Infrastructure will be decommissioned and reclaimed, unless there is interest in retaining it from other users in the region, such as Canadian National Railway (CNR). The decommissioning and reclamation plan will involve removing facilities and placing growth media that was salvaged during construction on the disturbed areas. Powerlines will be removed. The Rail Infrastructure Sedimentation Pond will be either be filled in or left as a natural water feature once water quality monitoring shows total suspended solids (TSS) levels meet regulatory requirements.

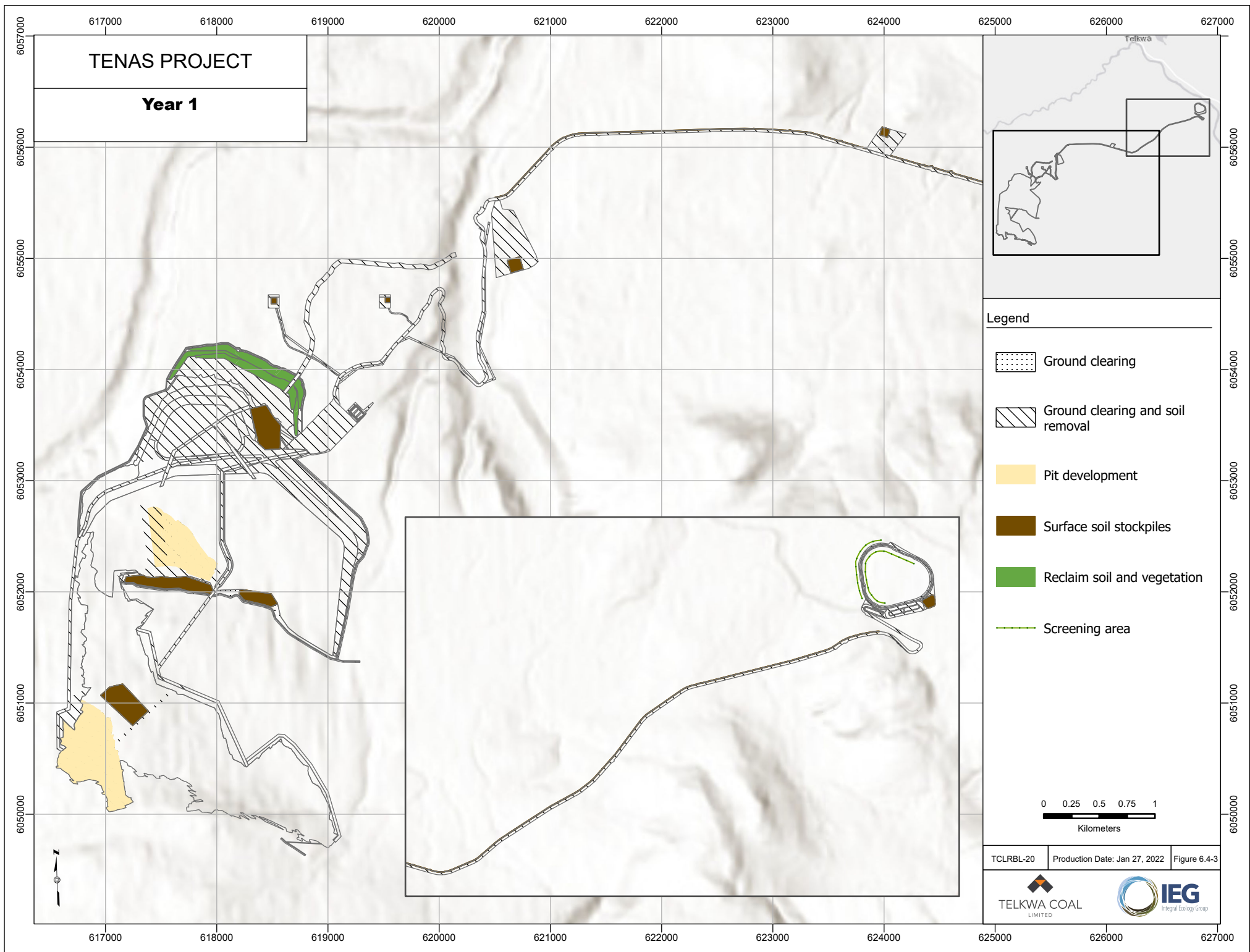
6.4 Detailed Five (5)-Year Reclamation Plan

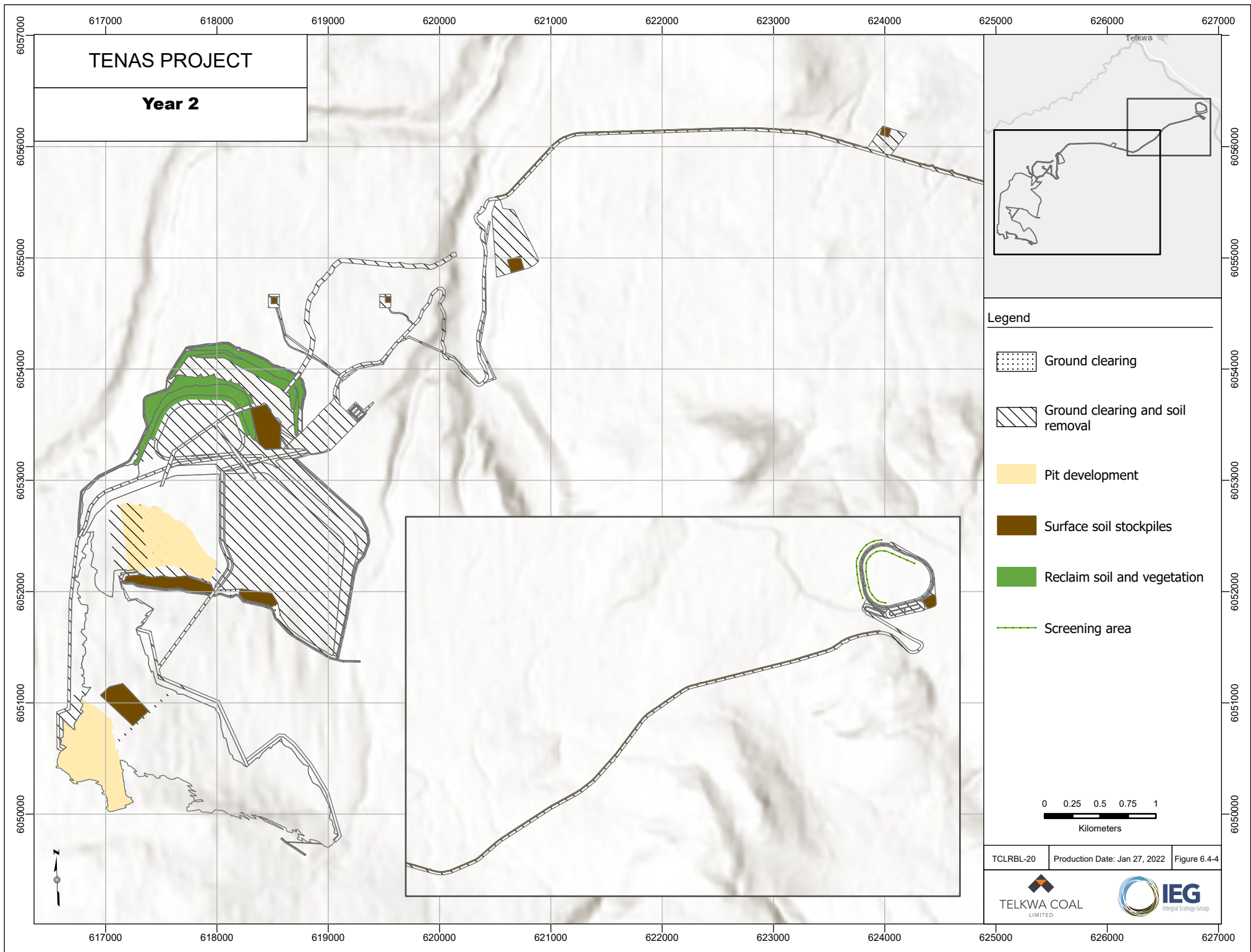
The detailed Five (5)-Year Reclamation Plan draws upon the of the information provided for the Conceptual Reclamation and Closure Plan provided for the end of the Operation Phase. This just provides a year-by-year plan for identifiable reclamation, salvage and clearing activities. The anticipated reclamation plan for the Construction Phase (Years -0.5 and Year 0) and Years 1 to 4 of the Operation Phase are provided in **Figures 6.4-1** through **6.4-6**. **Figure 6.4-7** illustrates the anticipated reclamation plan at the end of Year 5. **Table 6.4-1** provides a summary of the reclamation activities completed by the end of Year 5 of the Operation Phase.

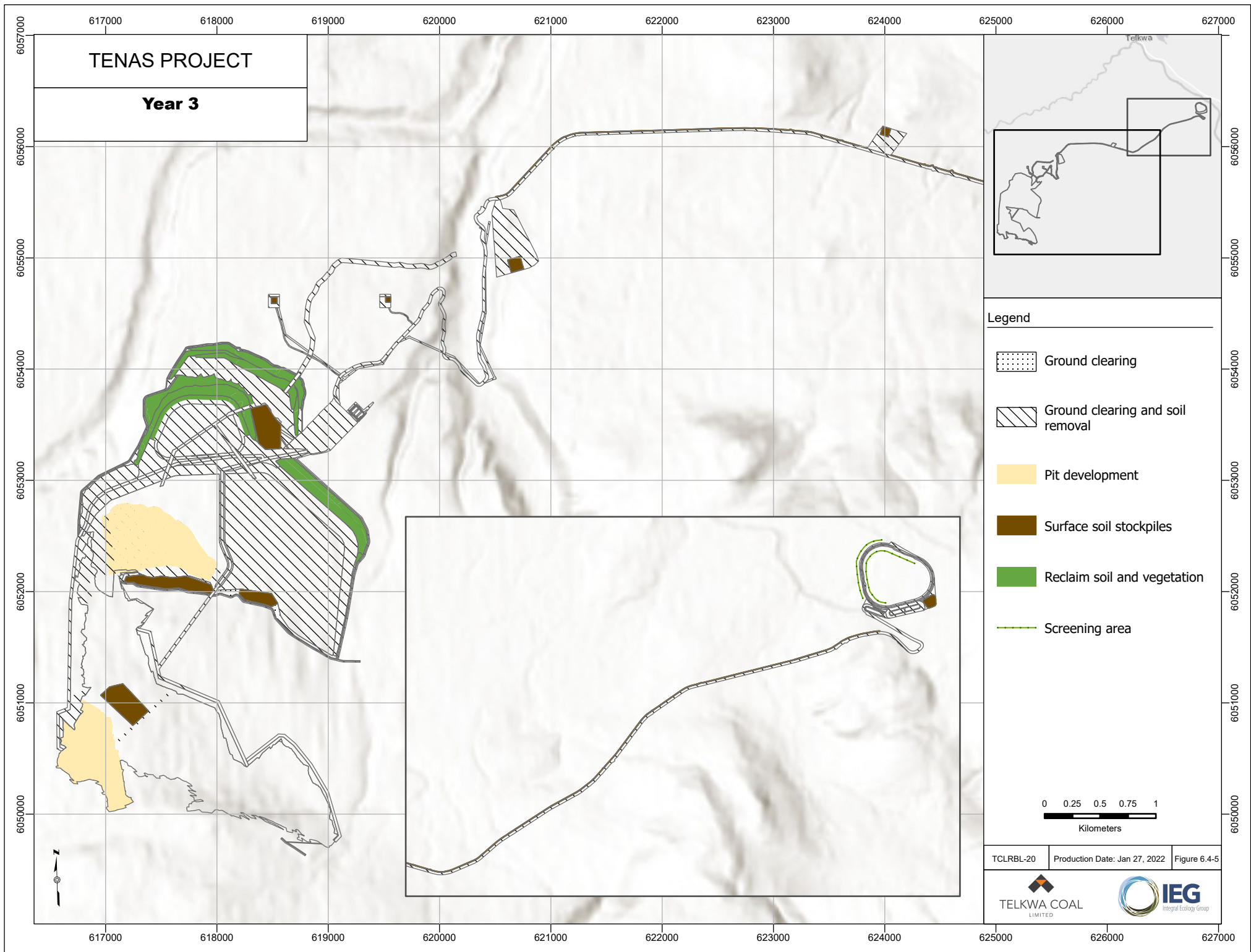
As shown, most of the surface soil salvage and stockpiling occurs between Years -0.5 and Year 1. Progressive reclamation, involving surface soil and overburden placement and revegetation efforts, is anticipated to begin in Year 1 and continue for the remainder of the Operation Phase. During the period between Years 1 and 5, progressive reclamation is focused on the embankments and buttresses of the TCP, and the North Management Pond, and the cover for the North Management Pond. Progressive reclamation will accelerate during the subsequent five (5) years (Years 6 to 10), as the open pit backfills are completed and the East and West Management Ponds near their completion.

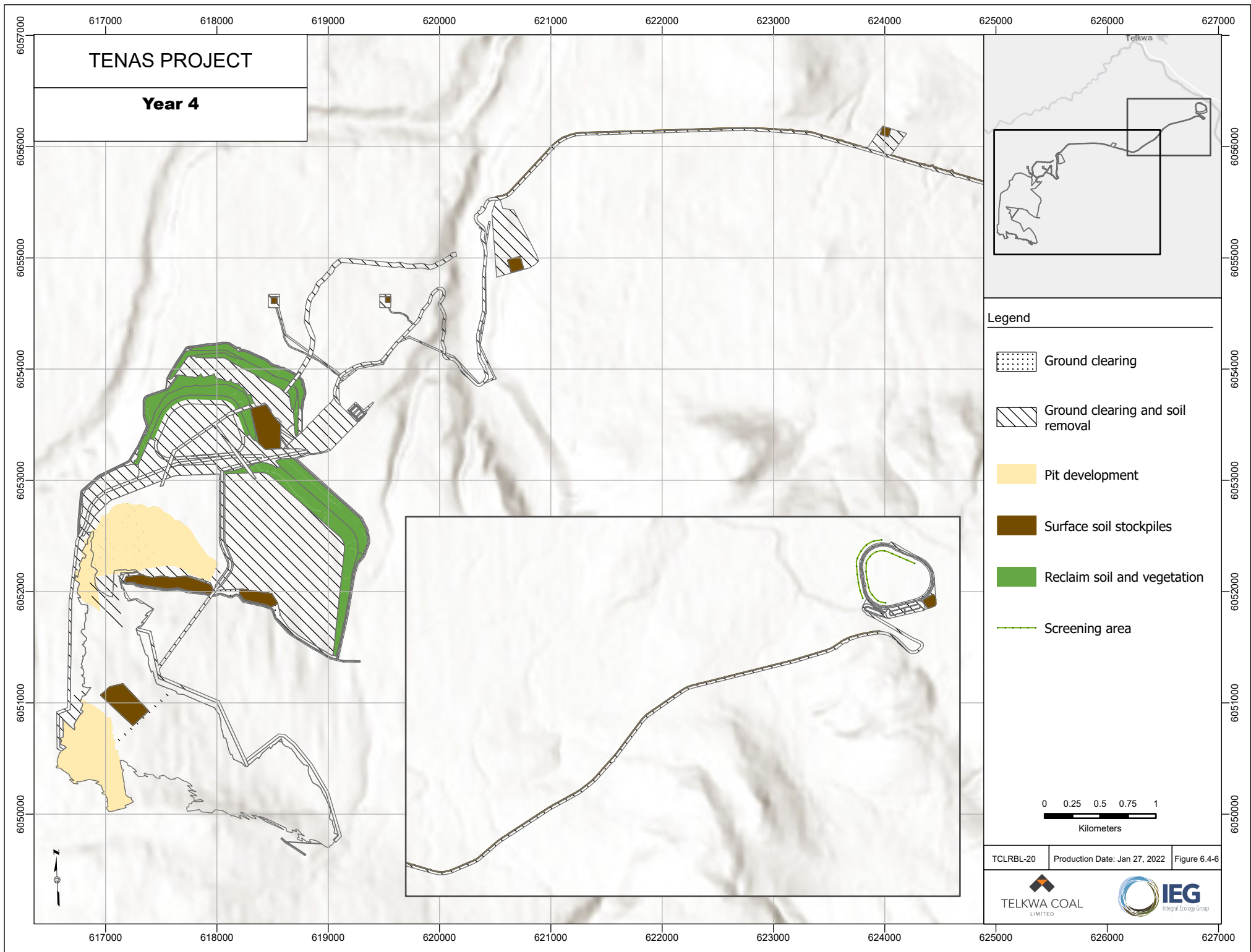












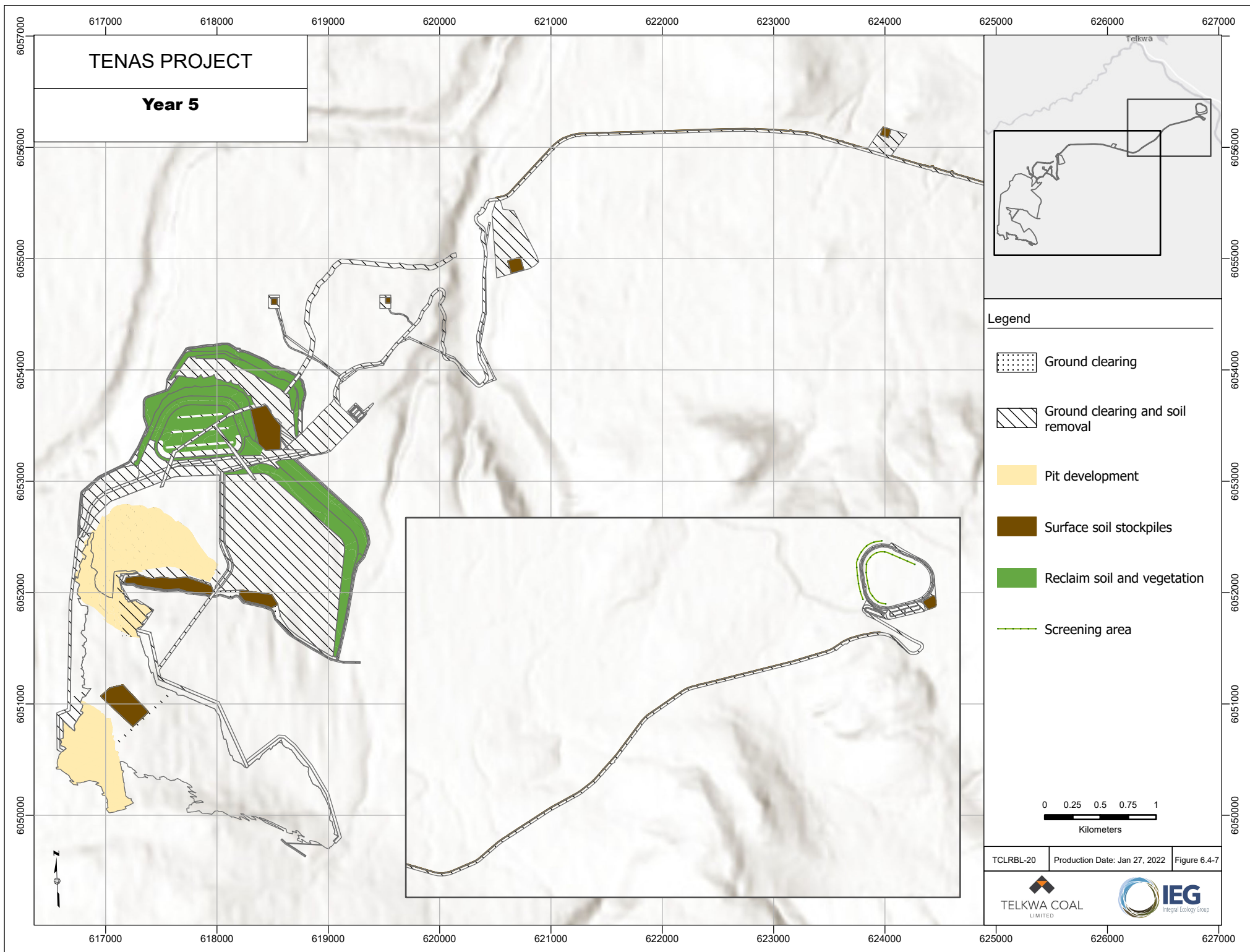


Table 6.4-1: Summary of Reclamation Activities during the Construction Phase (Years -0.5 through 0) and the Operation Phase (Years 1 through 5)

Year	Logging and Clearing (ha)	Surface Soil Salvage Areas (ha)	Surface Soil Salvage Volumes (m ³)	Surface Soil Placement Volumes Including Direct Placement (m ³)	Direct Placement Volumes of Surface Soils (m ³)	Surface Soil Remaining in Stockpiles (m ³)	Surface Soil Placement Areas (ha)	Revegetation and Fertilizer Treatment Areas (ha)
-0.5	313	284	797,257	-	-	797,257	-	-
0	32	20	83,283	-	-	880,540	-	-
1	48	47	140,186	96,062	96,062	924,665	18	18
2	136	134	365,868	76,503	76,503	1,214,030	26	26
3	42	42	139,931	69,052	69,052	1,284,909	14	14
4	10	9	28,295	67,614	28,295	1,245,590	23	23
5	8	8	24,096	88,211	24,096	1,181,475	29	29
TOTAL	589.6	544.2	1,578,917	397,442	294,009	1,181,475*	109.1	109.1

Notes: ha=hectare; m³=cubic metre

* this value is not a total but rather the amount of surface soils currently stockpiles

6.5 Temporary Shutdown Plan

The proposed Project will be one of the lowest cost metallurgical coal Projects on the seaborne market and is being developed by TCL as it is expected to be able to weather the cyclical nature of this commodity. However, TCL has developed a list of activities that will be completed if the Project is put into temporary shutdown or care and maintenance (C&M) status as approved by regulatory authorities. If either should occur, the following activities will be completed by the operation and documentation will be signed off by the Mine Manager upon completion:

- ▶ run-of-mine (ROM) coal in stockpiles and any coal exposed in the open pit is processed through the CPP and processed coal will be hauled to the Rail Infrastructure;
- ▶ processed coal at the CPP and at the Rail Infrastructure is loaded onto unit trains and transported to Ridley terminals for export;
- ▶ drilling patterns are squared up and blasted;
- ▶ management ponds will have current lifts completed;
- ▶ loaded patterns are blasted;
- ▶ any blasted material is excavated and placed in the appropriate permanent storage location;
- ▶ any progressive reclamation that can be completed without impacting future operation is carried out;
- ▶ tanks and lubricant facilities will be drained of hydrocarbons except for minimum levels;
- ▶ explosive materials are removed from site;
- ▶ hazardous materials are removed from site if not required for ongoing water management;
- ▶ equipment will be placed inside the maintenance shop for storage, and any remaining equipment that the maintenance shop cannot accommodate will be drained of fluids and wrapped up with tarps for protective purposes;
- ▶ some of the gates on the TAC will be left open for public access, while others will remain closed for public safety requirements;
- ▶ C&M teams will be appointed to carry out any activities required to keep the Project in a state that will allow for the operation to restart; and
- ▶ if the temporary shut down plan lasts longer than four (4) years, any exposed open pit walls will be covered with overburden in Year 5 that will need to be rehandled to allow the Project to restart sometime in the future unless a written request for change is provided to regulators.

A detailed shut down plan will be developed by TCL, by the end of the Construction Phase in Year 0 by the site team hired for the Project and will be provided to various groups including Indigenous groups, and regulators for feedback and questions before a finalized temporary shut down plan is provided by the end of Year 2.

7. MONITORING

7.1 Reclamation Monitoring

The primary objective of the reclamation monitoring-program is to track reclamation development trajectories over time and compare these trajectories to selected success criteria based on data from reference ecosystems.

Details of the monitoring plan, including criteria and indicators of reclamation success and associated measures and thresholds, will be developed based on ongoing collaboration with Indigenous groups and as more detailed reclamation planning and implementation is conducted. Reclamation monitoring is likely to incorporate elements discussed in the subsections below.

Monitoring of Parameters of Potential Concern/Contaminants of Potential Concern (POPC/COPC) and Parameters of Concern/Contaminants of Concern (POC/COC) identified for aquatic life, wildlife, terrestrial vegetation, human health, and land uses will be conducted for soils, vegetation, sediment, and surface and groundwater.

7.1.1 Permanent Sample Plots

To assess the success of reclamation and compare the trajectory of reclamation relative to baseline conditions, permanent sample plots (PSPs) will be established in onsite reclaimed areas and at offsite reference locations. Reference locations are adjacent areas with ecosystems like those in the Project footprint, but that will be undisturbed by mining.

PSPs will be installed in reclaimed areas as soon as they are established to track ecosystem development over time. Reference plots will be installed early in the Operations Phase to support the development of success criteria to evaluate reclamation on the Minesite. The site series that are projected to occur on the post-closure landscape will be targeted for reference locations. Reference plots will ideally be placed in ecosystems recently initiated by non-mining activities (e.g., forest harvest activity, fire fighting, and/or exploration), so that ages of the forest stand in reference locations are like those of new reclamation areas.

On reclaimed areas, the target plot density will vary over time as reclamation progresses. Beginning at a density of one (1) plot per two (2) ha for a recently initiated reclamation treatment, monitoring plot density will decrease over time to a long-term density of one (1) plot per 20 ha. It is important to have a higher density of plots in early reclamation phases as these early data can help improve practices for later reclamation. Plot densities will be reduced as more area becomes reclaimed, to spread data collection across reclaimed areas and to reduce monitoring effort so that the reclamation-monitoring program does not become unwieldy or overly onerous. Plots can also be dropped from the monitoring schedule as they meet reclamation success criteria.

Onsite plots will be visited following reclamation in Years 1, 2, and 5, and every five (5) years thereafter, to capture potential rapid changes in vegetation during early establishment, allow for early intervention if required, and measure vegetation development trajectories over time. Reference sites will be visited at five-year intervals.

The following data will be collected at each PSP:

- ▶ Site characteristics (elevation, aspect, coordinates, etc.) – Contributes to SMR designations, site notes may offer explanations for the relative success of the site;

- ▶ **Soil profile description and sampling** – Including soil placement depth, particle-size distribution (PSD) and chemistry data required to calculate soil properties (e.g. AWSC, soil moisture and nutrient regimes, soil fertility, and element concentrations). When a PSP is installed, a soil test pit will be dug to 1.0 m, surveyed by standard methods (BC MOF and BC MOE 2015), and sampled for laboratory analysis of PSD, nutrients, and element concentrations. Ongoing monitoring of reclamation soils can be relatively minimal, consisting of observational data collection on the extent of erosion over time, as well as decadal sampling for organic matter content and nutrients at PSP sites. Further soil monitoring is not expected to be necessary except in areas where growth issues are observed or any contamination is suspected, which shall be determined by QPs;
- ▶ **Vegetation cover** – Estimates of percent cover by species to provide information on changing species compositions, proportion of native and exotic species covers, species richness and diversity;
- ▶ **Forest characterisation** – Estimates of tree densities, mensuration, site index to provide information on forest stand development, as appropriate; and
- ▶ **Soil and plant-tissue chemistry** – Plant species potentially consumed by humans and/or other animals will be tested for element concentrations. Soil samples will be collected at the time of plot installation. Additional samples may be collected if there is evidence of deposition of fugitive dust at rates that could be affecting soil element concentrations. Vegetation tissue samples will be collected and tested for element concentrations at each visit. These samples will be used to determine whether any element concentrations present in vegetation are potentially harmful to animals (**7.1.3 Trace Element Uptake in Soils and Vegetation**).

7.1.2 Reclamation Material Monitoring during Salvage, Stockpiling and Placement

Physical properties of mine materials (e.g., processed mine rock, mine rock, coal) and reclamation materials (e.g., salvaged soil and OVB) will be determined through in-situ sampling. Ongoing sampling of reclamation-material stockpiles during salvage will assist in capturing the range of variability in material properties. These data will be used to update ecohydrological modelling and, if necessary, re-evaluate the reclamation targets.

The proposed sampling intensity during soil salvage and stockpiling operations is one sample per 50,000 m³ of salvaged soil or OVB. For OVB, this sampling intensity is only necessary where the intended use of the OVB is for reclamation covers (not for dam or buttress construction). One in five samples should be sent for extra testing as indicated in the ‘subset’ column of **Table 7.1-1**. If potential issues are detected in any of these tests, then sampling intensity may be increased as guided by a QP. A more detailed description of reclamation-suitability criteria and thresholds is provided in the **SMP (Appendix 1.0-B attached)**.

Surface densities of reclamation-cover materials will be assessed following cover placement in reclamation areas to identify any potential issues with fine-fraction densities impeding plant growth (>1,600 kg/m³) and to develop mitigation plans. Use of a nuclear densometer is recommended for this testing, as it is the most efficient and reliable method for taking numerous density measurements in materials with high coarse-fragment contents. The recommended sample intensity is one sample per five (5.0) ha. Placed reclamation materials will also be checked for placement depths and erosion risks.

Table 7.1-1: Physical Properties to be Tested During Surface Soil and Overburden (OVB) Salvage

Surface Soil or OVB Physical Property	Tests to Perform		Thresholds	Notes
	All samples	Subset		
Particle-size distribution	100, 5, 2, 1, 0.5, 0.25, 0.1, 0.05, 0.002 mm	N/A	- Surface Soils: no specific threshold; in-field evaluations will be made based on parent material type, which relates to particle-size distribution. - OVB: coarse fragments > 100 mm will be less than 10% with silty clay loam, silt loam, loam, sandy loam, or clay loam fine-fraction (< 2 mm) textures.	Coarse fragment thresholds should be re-evaluated as data from salvage and mine materials become available.
Organic-matter content	Loss on ignition	N/A	No threshold required, data should be collected for baseline information and to build datasets for ecohydrological modelling.	If inorganic carbon is suspected due to mineralogy, testing should be done by Walkley-Black method.
Nutrients	Total Kjeldahl nitrogen	Olson available phosphorus	No threshold required, data should be collected for baseline information and to build datasets for ecohydrological modelling.	Spot fertilization can supplement low soil nutrients during early establishment (refer to 6.3.2.1 Revegetation Strategy).
Chemistry		pH (in water), electrical conductivity	- OVB pH: 4.5-8 - OVB EC: <1 dS/m	Thresholds apply to OVB only. Soils that are salvaged will have formerly supported local ecosystems and are assumed to be appropriate to support reclaimed ecosystems. OVB thresholds should be re-examined as data from salvaged soils are collected.
Element concentrations ¹	Standard metals (Al, B, Ca, Cu, Fe, K, Mg, Mn, Mo, S, Zn) + trace metals (Ag, As, Ba, Be, Cd, Co, Cr, Hg, Ni, Pb, Se, Sn, Sr, U, V) ¹⁶	Refer to footnote 9	Element concentrations below CCME thresholds for agricultural soils ¹⁷	Element concentration thresholds should be re-evaluated as operational data become available.

Notes: <=less than; %=percent; dS/m= decisiemens per metre; CCME=Canadian Council of Ministers of the Environment; OVB=overburden; mm=millimetres; QP=Qualified Professional

¹⁶ Initially, all samples should be tested for the full suite of metals to determine whether any specific metals are frequently elevated in reclamation materials. As material types (e.g., OVB, salvaged soil) are characterized more thoroughly, the metals analysis can be reduced to standard metals, as well as any trace metals that are frequently elevated, if levels of other trace metals are within CCME acceptable ranges, as guided by QPs.

¹⁷ Element concentration thresholds should be evaluated relative to ranges of natural variation in soils within the Project Area/footprint as soil salvage samples are collected. In cases where baseline conditions exceed CCME guidelines, thresholds may need adjustment.

7.1.3 Trace Element Uptake in Soils and Vegetation

Deposition of fugitive dust (particulate matter) containing potential metals, mine-rock deposition, and spills occurring during mining-related activities are factors that can impact soil element concentrations in the Project footprint. The **Air Quality Management Plan (S13.0-C2) (AQMP)** provides these dust emission mitigation measures, and the **Fuel Management and Spill Control Plan (S13.0-C7) (FMSCP)** provides prevention measures for spills. Element concentrations in plant tissues can be similarly affected by the deposition of dust generated from mining activities, and plants may also accumulate metals from the soil via uptake through their roots.

Sampling programs will be implemented to monitor trace element (metals) uptake in soils and vegetation within the Minesite. The objectives of monitoring trace element concentrations in soils and vegetation are as follows:

- ▶ Establish baseline concentrations of trace elements in cover materials recently placed in reclaimed areas of the Minesite;
- ▶ Monitor potential effects of windblown dust transported from mine-related dust sources on the concentrations of elements in soil and vegetation in reclaimed areas;
- ▶ Determine the degree to which elements accumulate in specific plant species proposed for use in revegetation of reclaimed mine site activity, with the intent to use this data to guide the selection of appropriate species for use in revegetation during reclamation and closure;
- ▶ Determine if the element concentrations measured in soil or vegetation will be suitable for achieving end land use objectives,
- ▶ Monitor POPC/POC related to wildlife, terrestrial vegetation, and people and land uses, and
- ▶ Confirm that element concentrations measured in soil or vegetation tissue will not measurably affect wildlife, aquatic, or human health.

7.1.3.1 *Baseline Data*

Soil and vegetation samples were collected during baseline fieldwork over three (3) consecutive growing seasons (2017-2019) to determine element concentrations. Available data are summarized in the Tenas Project Terrain and Soils Baseline Report (Ardea 2021b).

Forty-two (42) soil samples were collected from a representative cross-section of plots and soil types within the Project Local Study Area (LSA)¹⁸. Element concentrations from these samples were compared with CCME (2007) guidelines for land use categories pertaining to industrial sites and agricultural and residential/parkland areas. Most soil samples collected in the vicinity of the proposed mine footprint had concentrations below thresholds defined by the CCME soil-quality guidelines for industrial sites. Exceptions include one sample that was above the industrial guideline for arsenic. In addition, two (2) samples collected from the Bypass Road and Rail Infrastructure areas were above agricultural guidelines for arsenic.¹⁹ Soil samples from multiple sites indicated exceedances for boron. Selenium levels were low for plots.

¹⁸The LSA as defined in the Terrain and Soils Baseline Report (Ardea 2021b) includes the Minesite and access routes, as well as a 250 m buffer around linear infrastructure (TAC, powerline, etc.) and a 500 m buffer for other infrastructure (open pit, Mine Infrastructure Complex, and Rail infrastructure).

¹⁹ CCME guidelines for agricultural and residential /parkland areas are more stringent than those set for industrial areas (CCME 2007).

A total of 150 vegetation samples collected from 74 sites within the Project LSA were analyzed for element concentrations. Samples were collected from 23 species across 20 genera and included berries (25 samples from eight [8] species), and leaves/stems (125 samples from 17 species). While samples were analyzed for concentrations of 31 elements, eight [8] of these (arsenic, cadmium, chromium, lead, mercury, nickel, copper, and zinc) were identified as metals of environmental interest. While there are no provincial or federal guidelines for vegetation tissue metal concentrations for the protection of wildlife, mineral tolerance limits are available from the National Research Council (NRC; 2005).

7.1.3.2 *Future Sampling*

Soil and vegetation samples will be collected as part of the reclamation monitoring program described in **7.1 Reclamation Monitoring**. PSPs will be installed in reclaimed areas throughout the mine site, spaced at regular distances from each other to ensure that the spatial distribution of plots is random, and the entire Project footprint is sampled. Soil samples will be collected from the surface (0 to 2 cm) and at regular intervals down the soil profile when the sample test pits are initially established. This approach will help address whether elevated element concentrations are a result of dust deposition at the surface, or due to elevated concentrations throughout the reclamation cover.

Vegetation will be sampled from within permanent sample plots in reclaimed and reference ecosystems. During the initial period of reclamation monitoring and plot establishment, species identified as being browsed or otherwise consumed will be targeted for sampling. As more sample plots are assessed, the list of target species will be narrowed down to species that are consistently consumed or of traditional-use interest, and found in most or all plots, to facilitate comparison between reclaimed and reference ecosystems and among reclamation treatments in different areas of the mine site.

7.1.3.3 *Sampling Timing and Frequency*

Vegetation sampling frequency will be consistent with the sampling schedule described in **7.1.1 Permanent Sample Plots**. Reclaimed sites will be sampled in Years 1, 2, and 5, and every five (5) years thereafter, and reference sites will be sampled every five (5) years. As a result of this schedule, there is generally vegetation sampling occurring at a portion of the established plots every year. Soil sampling typically occurs at the time of plot installation. Additional soil sampling may be required at regular intervals (e.g., every five [5] years) in areas of the mine site that experience greater dust deposition compared to other areas of the mine site.

7.1.3.4 *Sampling Methods*

Element concentrations in vegetation and soils will be monitored in paired samples collected from areas adjacent to those disturbed by the Project. Soil samples will be paired with foliage and/or berry samples from plants that are considered important for use by humans or other animals.

7.1.4 Surface Water and Groundwater Monitoring

Details for surface and groundwater monitoring is provided in the **Minesite Water Management Plan (S13.0-C11) (MWMP)** and **Minesite Water Monitoring Program (Appendix 13.11-E of the MWMP)**. **Table 7.1-2** below summarizes the expected monitoring requirements in the Decommissioning and Reclamation Phase.

Table 7.1-2: Water Monitoring Program Requirements during the Decommissioning and Reclamation Phase

Item	Description	Decommissioning and Reclamation Phase
Frequency	n/a	Monthly
Labour	2 field samplers 1 day at site plus travel, sample management	12 trips per year
Field expenses	Vehicle, sampling supplies & rentals, travel expenses	12 trips per year
Analytical costs (surface and groundwater)	Water Quantity Samples	120 samples per year
Reporting	n/a	1 per year

7.1.5 Metal Leaching/Acid Rock (ML/ARD) Drainage

Additional solid-phase metal leaching and acid rock drainage (ML/ARD) monitoring is not required during the Decommissioning and Reclamation Phase as disturbed materials would have been previously characterized during the Construction and Operation Phases as per the **ML/ARD Management Plan (S13.0-C12) (ML/ARDMP)**. Mine rock and coarse and fine processed rock will be submerged under water covers in the Management Ponds constructed for the Project and as such will not need to be monitored for ARD. The management ponds will be maintained with a 1.0 m water cover during their active use and 2.0 m after PAG material disposition is completed. Any materials used for reclamation and construction must be classified as non-PAG with an NPR>2.0.

ML/ARD water monitoring will be covered by the surface and groundwater monitoring programs (**MWMP**) plus visual inspections of reclaimed surfaces for signs of oxidization and ARD generation.

If there are sites for ML/ARD monitoring that must be continued into the Post-closure Phase due to monitoring results in the Construction, and Operation phases, these sites will be covered by (or added to) the **Minesite Water Monitoring Program (Appendix 13.11-E)**, plus visual inspections of reclaimed surfaces for signs of oxidization and seeps.

7.2 Post-closure Monitoring

The Post-closure Phase is separated into an active phase (10 years), and a passive phase (15 years) (TCL 2021). The active phase involves filling the open pit with water, and monitoring vegetation growth and water quality for groundwater, surface water, and wildlife. Control and sedimentation ponds may still be needed for settling of TSS levels, and management ponds are left as dry land reclamation except for portions that will be left as open water to allow for the infiltration of water into the saturated PAG material. During the passive stage, the control and sedimentation ponds are no longer required for settling of total suspended solid (TSS) levels, water filling of the open pit is complete, and TCL is simply monitoring the site.

The Post-closure monitoring program consists of the following components, which are described in the following subsections:

- ▶ revegetation and soil monitoring (including invasive species and metal uptake studies);
- ▶ water monitoring;

- ▶ wildlife monitoring;
- ▶ geotechnical monitoring; and
- ▶ coal mining effluent regulation reporting.

7.2.1 Revegetation and Soil Monitoring

Vegetation and soil monitoring will be conducted in reclaimed areas to track ecosystem development trajectories over time. Key ecosystem parameters identified through the reclamation-monitoring program will be compared to reference ecosystems to evaluate the ability of reclaimed ecosystems to meet the end land-use objectives identified in **6.2 End Land Use Capability and Objectives**. Monitoring will consist of installing permanent sample plots in reclaimed areas across the Project site using a fixed area based intensity. To improve the understanding of reclamation performance prescriptions that were completed during the early stages of operational reclamation (needed during the Decommissioning and Reclamation Phase and subsequent progressive reclamation activities during the Operation Phase), plots will be installed in the first 20.0 ha of a reclamation treatment at a density of one (1) plot per 2.0 ha. As prescriptions that work better in reclaimed plots are identified and successfully applied in other areas, plots will be installed at lower densities of one (1) plot per 8.0 ha for the next 40.0 ha for each reclamation treatment. Beyond 40.0 ha for a given treatment, plots will be installed at their intended long term monitoring density of one (1) plot per 20.0 ha.

Long term reclamation monitoring in the Post-closure Phase will be conducted at a density of one (1) plot per 20.0 ha to measure long-term stability and habitat complexity of reclaimed ecosystems. Plots that are considered successful based on the selected indicators after two (2) consecutive samplings can be removed from the monitoring program to decrease plot densities in heavily sampled early-reclamation areas. Plots will continue to be dropped from the monitoring roster until an evenly spaced density of one (1) per 20.0 ha is reached. Monitoring results will be analyzed and presented in the Annual Reclamation Report.

7.2.2 Surface Water and Groundwater Monitoring

Details for surface and groundwater monitoring is provided in the **MWMP** and the **Minesite Water Monitoring Program (Appendix 13.11-E)**. **Table 7.2-1** below summarizes the expected monitoring requirements in the Post-closure Phase.

7.2.3 Metal Leaching/Acid Rock Drainage (ML/ARD)

As described in **7.1.4**, solid-phase ML/ARD monitoring is not required during the Post-closure Phase as disturbed materials would have been previously characterized during the Construction and Operation Phases. If there are sites for ML/ARD monitoring that must be continued into the Post-closure Phase due to monitoring results in the Construction, and Operation Phases, these sites will be covered by (or added to) the **Minesite Water Monitoring Program (Appendix 13.11-E)**, plus visual inspections of reclaimed surfaces for signs of oxidization and seeps.

Table 7.2-1: Water Monitoring Program Requirements during the Post-closure Phase

Item	Description	Active Post-closure Phase	Passive Post-closure Phase
Frequency	n/a	Quarterly	Semi-annual (low flow and high flow)

Item	Description	Active Post-closure Phase	Passive Post-closure Phase
Labour	2 field samplers 1 day at site plus travel, sample management	4 trips per year	2 trips per year
Field expenses	Vehicle, sampling supplies & rentals, travel expenses	4 trips per year	2 trips per year
Analytical costs (surface and groundwater)	Water Quantity Samples	60 samples per year	20 samples per year
Reporting		1 per year	1 per year

7.2.4 Coal Mining Effluent Monitoring

The proposed federal Coal Mining Effluent Regulation (CMER) has not yet been promulgated and is currently under consultation with the Indigenous nations, Canadian public, provincial governments, stakeholders, and coal mining industry. This Regulation is planned to authorize and monitor coal mine effluent discharges, like the Metal and Diamond Mining Effluent Regulations, SOR/2002-222 (Government of Canada [GovCan] 2002) and it will apply to the Project in relation to discharges from the Project; however, it is currently unknown as to monitoring programs. A post closure monitoring cost estimate for the CMER has been provided in **8. Reclamation Cost Estimate**.

7.2.5 Wildlife Monitoring

The **Wildlife Management Plan (S13.0-C21) (WMP)** describes the monitoring planned during Project phases, including recording and assessment of wildlife use of successfully reclaimed progressive reclamation areas and wildlife use of reclaim areas during the Decommissioning and Reclamation, and Post-closure Phases. The **WMP** includes a Trigger Action Response Plan (TARP) that provides examples of Project activities that may affect wildlife, the trigger, and the appropriate actions and protocols to be followed in response. A comprehensive set of Performance Objectives and Targets to be followed are found in **9.7** of the **WMP**.

Wildlife monitoring has been specifically requested to be considered in recent projects. The program consists of setting up six (6) remote cameras on site that will be downloaded during either the revegetation or water monitoring site visits. An allowance is needed for the review of the data and reporting of the results in the annual reclamation reports.

7.2.6 Geotechnical Stability Monitoring and Maintenance

Up to 10 years following the Decommissioning and Reclamation Phase monitoring to confirm that the closure objectives are met will be based on the following requirements:

- ▶ The site should be visually inspected by a qualified Professional Engineer annually for three (3) consecutive years and less frequently thereafter for up to 10 years to ensure there are no geotechnical concerns on the dams and that erosion prone areas have stabilized; and

- ▶ The soil covers should be regularly inspected by a qualified person to ensure the physical integrity of the cover is maintained. Biannual inspections should be conducted for the first 10 years after construction, and periodically thereafter as needed.

Beyond 10 years after Post-closure, inspections of the dams should be completed every five (5) years or as defined by CDA and maintenance performed on areas that monitoring identifies as needing repairs.

Please refer to **Appendix 1.0-L SRK, Tenas Project Management and Control Pond Stability Assessment in S1.0 Overview of Project Proponent Description.**

7.3 Maintenance Activities during Decommissioning and Reclamation, and Post-closure Phases

The following provides a high-level list of maintenance activities that will need to be undertaken during the phases indicated above but with lessening frequency as time goes on:

- ▶ Ensure spillways, channels are in good working order;
- ▶ Ensure that erosion protection for spillways and channels are effective;
- ▶ Ensure that piezometers, wells, and geotechnical instrumentation is working and replace if required;
- ▶ Ensure electronic monitoring systems are working and replace, update as needed; and
- ▶ If reclamation areas need secondary seeding and fertilizing, carry this out.

A requirement of as-build design reports for Project constructed facilities will be a detailed maintenance program by Project phase and/or by use to sure the constructed infrastructure achieve their intended use and design life.

7.4 Site Access

The **Public Access Management Plan (S13.0-C14) (PAMP)** will remain in effect through the entire Decommissioning and Reclamation Phase for the Project and likely into the active Post-closure Phase. The **PAMP** allows public escorts through the Project to access recreational areas that would normally be used by the public and will continue from the Post-closure Phase.

7.5 Performance Objectives

Performance objectives and targets required to ensure the proper implementation of this RCP are shown in **Table 7.5-1**.

Table 7.5-1: Performance Objectives

Objective	Target
Revegetation and soil monitoring and trace element uptake monitoring at onsite Permanent Sample Plots (PSPs)	Onsite PSPs were visited following reclamation in Years 1, 2, and 5 and every five (5) years thereafter

Objective	Target
In situ sampling of overburden, and reclamation materials	Physical properties of overburden, and reclamation materials were measured during surface soil and overburden salvage and stockpiling operations at a sample intensity of one sample per 50,000 cubic metres (m ³) of these materials.
Surface density monitoring of reclamation-cover materials	Monitoring was conducted after cover placement at a sample intensity of one sample per 5.0 hectare (ha).
Surface and groundwater quality and quantity monitoring	Monitoring programs include monthly sampling during Decommissioning and Reclamation Phase, quarterly sampling during the active Post-closure Phase, and twice annual sampling during the passive Post-closure Phase.
Onsite wildlife monitoring	- Data was collected of the wildlife use of progressive reclamation sites in the Operation Phase and sites reclaimed in the Decommissioning and Reclamation, and Post-closure phases. - Data was collected from onsite remote cameras in conjunction with soils and vegetation and/or water monitoring site visits.
Visual Resource Viewpoint Monitoring	Photographs from set viewpoints were taken every five (5) years to assess reclamation success for screening, reclamation and landscape modification objectives in the Visual Resources Management Plan (S13.0-C19) (VRMP) through to the end of the Post-closure phase.
Onsite geotechnical stability monitoring program	Geotechnical monitoring of management ponds and reclamation works will occur in Post-closure Years 27 to 31, 34, 37, 42, and 52.
Monitoring of coal mining effluent	Comply with <i>Environmental Management Act</i> , SBC 2003, c 53 (Government of British Columbia [GovBC 2003] (<i>EMA</i>) permit limits and proposed Coal Mining Effluent Regulation (CMER) limits, which will be provided with final regulatory approvals.
Mine Planning	Complete an annual updated Five (5)-year Mine Plan every year
Mine Planning and Reclamation Program	Complete an update to the Five (5)-year and life-of-mine (LOM) plan (end of Operation Phase) and reclamation program every five (5) years
Management Plans	Other relevant management plans and associated performance objectives will be followed during Project phases: Environmental Management System (S13.0-C1) (EMS); Air Quality Management Plan (S13.0-C2) (AQMP); Chemical and Materials Storage, Transfer, and Handling Plan (S13.0-C3) (CMSTH); Construction Environmental Management Plan (S13.0-C4) (CEMP); Discharge Management Plan (C13.0-5) (DMP); Explosives Management Plan (S13.0-C6) (EMP); Fuel Management and Spill Control Plan (S13.0-C7) (FMSCP); Heritage Resources Management Plan (S13.0-C8) (HRMP)); Minesite Water Management Plan C13.0-C11) (MWMP); Metal Leaching/Acid Rock Drainage (S13.0-C12) (ML/ARD); Socio-Economic Management Plan (S13.0-C16) (SEMP); Surface Erosion Prevention and Sediment Control Plan (S13.0-C17) (SEPSCP); Vegetation Management Plan (C13.0-18) (VMP); VRMP; Waste Management Plan (S13.0-C20) (WMP); and Wildlife Management Plan (S13.0-21) (WMP).

8. RECLAMATION COST ESTIMATE

An estimate of cost to implement the RCP, including reclamation during the Decommissioning and Reclamation Phase, and Post-closure monitoring and maintenance, is provided in the following sections.

8.1 Decommissioning and Reclamation

An estimate of cost for activities associated with the Decommissioning and Reclamation Phase is summarized in **Table 8.1-1 (8.1.7 Decommissioning and Reclamation Cost Summary)**. A summary of the associated reclamation activities is provided in the list below, and are described in the following subsections:

- ▶ structure and equipment decommissioning and removal;
- ▶ reshaping, resloping, and scarifying;
- ▶ material movement for final reclamation landform;
- ▶ reclamation materials placement;
- ▶ sedimentation and control pond decommissioning and wetland development; and
- ▶ vegetation and fertilizing.

8.1.1 Structure and Equipment Decommissioning and Removal

Buildings will be torn down and transported to scrap dealers in the region for final disposal. All equipment will be removed from the Project for use at other mines or scrapped for metal recovery. No salvage value has been included in the cost estimate for these activities.

8.1.2 Reshaping, Resloping, and Scarifying

Remaining slopes on site will be resloped and flat surfaces will be reshaped to provide necessary diversity and micro-ecosites. Compacted surfaces are ripped to allow vegetation rooting requirements. Some sedimentation ponds will be reshaped to better blend into the final landform. This will conform with the **Visual Resource Management Plan (S13.0-C19) (VRMP)** which includes mitigation and monitoring using the Visual Resources Monitoring Field Sheets to complete photos of Project from identified viewpoints starting at Year 8 and every five (5) years thereafter.

8.1.3 Material Movement for Final Reclamation Landform

The following material will be moved to allow for the final reclamation landform:

- ▶ OVB and non-PAG rock to complete the cover on the West Management Pond and any others required;
- ▶ removal of the embankment and buttress at the TCP to allow for wetland development; and
- ▶ miscellaneous material movement to fill in sedimentation ponds.

8.1.4 Reclamation Materials Placement

Any remaining reclamation materials will be placed on resloped surfaces and existing sloped surfaces at a thickness of approximately 30 cm. This will involve excavating reclamation materials from stockpiles and hauling to the areas that need materials placed. The trucks will dump reclamation materials to dozers on

the top of the slopes and flat areas, and the material will be placed using a rough mounding technique to ensure reclamation materials are not compacted and have a variable thickness for the Decommissioning and Reclamation Phase.

8.1.5 Pond Decommissioning and Wetland development

Once monitoring shows that TSS levels have met regulatory requirement for the required number of years, WCPs will be decommissioned either by filling them in, removing embankments, or reshaping these structures so that wildlife can easily access the ponds.

8.1.6 Vegetation and Fertilizing

The last step in the Decommissioning and Reclamation Phase involves revegetating resloped and recontoured surfaces, followed by fertilizing and maintenance of vegetated areas.

8.2 End of Year 5 of the Operation Phase Reclamation Cost Estimate

The expected cost of reclamation after the Construction Phase the first five (5) years of Operation if the Project were to close is \$23,156,674. Costs associated with reclamation during this period are provided by **Table 8.2-1**.

Table 8.2-1: Expected Reclamation Cost at the End of Construction Phase and Five (5) Years of Operation Phase

Item	Cost (\$)
Equipment removal	443,774
Structure demolishment	2,376,388
Foundation breakup	18,623
Contaminated soil removal and investigation	90,000
Resloping and ripping	430,146
Material movement for final reclamation landform	589,088
Growth medium placement	2,540,078
Woody debris placement	0
Pond decommissioning	60,892
Liner decommissioning	100,000
Water removal	50,000
Sediment removal	35,000
Support vehicles	310,749
Equipment mobilization and demobilization	30,000
Vegetation	1,100,000
Maintenance activities	730,000
Monitoring activities	3,832,140
Supplemental manpower	2,460,782

Item	Cost (\$)
General and administration	2,173,709
District taxes	1,269,670
Total Direct Costs	18,641,039
Contingency @ 15% on Total Direct Costs	2,796,156
Insurance @ 1.5% of Total Direct Costs <i>not including General and Administration and District Taxes</i>	191,053
Contractor Bonding @ 3% of Total Direct Costs <i>not including General and Administration and District Taxes</i>	382,106
Engineering design and construction plans @ 4% of Total Direct Costs <i>not including Monitoring, Supplemental Manpower, General and Administration and District Taxes</i>	509,475
Contractor Administration @ 5% of Total Direct Costs <i>not including Supplemental Personnel, General and Administration and District Taxes</i>	636,844
Contractor profit	Already accounted for in Blue Book Values
Grand Total	23,156,674

Notes: @=at; \$=Canadian dollar; %=percent

8.3 End of Operation Phase Conceptual Reclamation Cost Estimate

The expected cost of reclamation at the end of the Operation in Year 21 is approximately \$43,649,019. Costs associated with reclamation for this point in time are summarized by **Table 8.3-1**.

Table 8.3-1: Expected Reclamation Cost at the End of the Operation Phase

Item	Cost (\$)
Equipment removal	887,548
Structure demolishment	2,376,388
Foundation breakup	18,623
Contaminated soil removal	180,000
Resloping and ripping	1,720,585
Material movement for final reclamation landform	2,356,353
Growth medium placement	10,160,314
Woody debris placement	0
Pond decommissioning	121,784
Liner decommissioning	100,000
Water removal	50,000

Item	Cost (\$)
Sediment removal	35,000
Support vehicles	1,242,995
Equipment mobilization and demobilization	60,000
Vegetation	4,400,000
Maintenance activities	1,142,500
Monitoring activities	3,832,140
Supplemental manpower	2,460,782
General and administration	2,173,709
District taxes	1,269,670
Total Direct Costs	34,588,390
Contingency @ 15% on Total Direct Costs	5,188,259
Insurance @ 1.5% of Total Direct Costs <i>not including Supplemental Manpower, General and Administration and District Taxes</i>	430,263
Contractor Bonding @ 3% of Total Direct Costs <i>not including Supplemental Manpower, General and Administration and District Taxes</i>	860,527
Engineering design and construction plans @ 4% of Total Direct Costs <i>not including Supplemental Manpower, General and Administration and District Taxes</i>	1,147,369
Contractor Administration @ 5% of Total Direct Costs <i>not including Supplemental Manpower, General and Administration and District Taxes</i>	1,434,211
Contractor Profit	Already accounted for in Blue Book Values
Grand Total	43,649,019

Notes: @=at; \$=Canadian dollar; %=percent

8.4 Post-closure Monitoring and Maintenance

8.4.1 Post-closure Monitoring

8.4.1.1 Water Monitoring

Table 8.4-1 below lists anticipated cost components of the water monitoring program, which will be carried out during both the Decommissioning and Reclamation, and Post-closure phases. It is assumed that water monitoring will be conducted by locally based consultants. The total for water monitoring in the Post-closure and Decommissioning and Reclamation phases is 1,554,840 which is the same for the end of five (5) years as the end of the mine life.

Table 8.4-1: Water Monitoring Program Annual Costs

Item	Unit Rate and Assumptions	Decommissioning and Reclamation Phase	Active Closure Phase	Passive Closure Phase
Frequency	n/a	Monthly	Quarterly	Semi-annual (low flow and high flow)
Labour	2 field samplers, 1 day at site plus travel, sample management 36 hrs at \$130/hr = \$4,680 per trip	\$56,160/year, 12 trips	\$18,720/year, 4 trips	\$9,360/year, 2 trips
Field expenses	- Vehicle, sampling supplies & rentals, travel expenses \$700/trip	\$8,400/year, 12 trips	\$2,800/year, 4 trips	\$1,400/year, 2 trips
Analytical costs (surface and groundwater)	Could be \$150-\$450 depending on analytes. Assuming \$250 per sample	Assume 10 locations for 120 samples per year=\$30,000/year	Assume 10 locations for 60 samples per year=\$15,000/year	Assume 10 locations for 20 samples per year=\$5,000/year
Reporting	\$25,000/year for full sampling	\$25,000/year	\$25,000/year	\$15,000/year
Total per Phase		\$478,000	\$615,200	\$461,400
Total cost of Monitoring	\$1,554,840			

Notes: \$=Canadian dollar; hr=hour

8.4.1.2 Revegetation Monitoring

The estimated revegetation monitoring program cost is \$1,592,100. A detailed summary of cost, including expected professional fees and associated disbursements (i.e. accommodations, incidentals, and vehicle rentals), is provided in **Table 8.4-2** below. The cost summary is based on 28 planned inspections and one (1) event-triggered inspection in Years 25-75, for a total of 29 inspections. Each inspection is expected to take six (6) days, inclusive of travel time, and require two (2) skilled technicians.

A \$250,000 allowance has been included for reclamation research and planning which will be included in the first five (5) years of this phase.

Table 8.4-2: Revegetation Monitoring Program Costs

Task	Professional Fees (\$)	Disbursements (\$)	Total (\$)
Revegetation inspection (cost per inspection)	21,600	3,300	24,900
Reporting	30,000		30,000
Total cost per inspection			54,900
Total cost of revegetation monitoring program (29 inspections)			1,592,100

Note: \$=Canadian dollar

8.4.1.3 Wildlife Monitoring

The wildlife monitoring program is outlined in 0. Data downloads will occur during the water or vegetation monitoring site visits described in the preceding subsections. Assumed costs associated with wildlife monitoring are provided in the list below:

- ▶ remote cameras: \$1,200;
- ▶ data collection during revegetation and/or water monitoring visits (i.e. closure Years 1 to 5, 8, 11, and 14); and
- ▶ reporting: \$2,400 per year.

8.4.1.4 Geotechnical Monitoring

Geotechnical monitoring of management ponds and reclamation works will occur in Closure Years 1 to 5, 7, 10, 15, and 30. The geotechnical monitoring program will require site visits and reporting, with an expected cost of \$15,000 per year, for a total program cost of \$135,000.

8.4.1.5 Coal Mining Effluent Regulation Monitoring

An allowance of ~ \$80,000 is included for environmental effects monitoring (over 15 years) and reporting. One (1) report will be generated at the end of Active Closure and a final report will be generated at the end of the Passive Closure Phase. This will provide a comparison with the regulatory limits provided by this regulation once it comes into law both of which are unknown as the date of this report.

8.4.2 Monitoring and Reclamation Research Cost Summary

The total cost of reclamation research and monitoring over the life of reclamation and post-closure and beyond is estimated at \$3,832,140. A summary of costs associated with reclamation and monitoring during the Decommissioning and Reclamation Phase and the Post-closure Phase is provided in **Table 8.4-3**.

Table 8.4-3: Cost Summary for Reclamation and Monitoring During the Decommissioning and Reclamation and Post-Closure Phases of the Project

Item	Decommissioning and Reclamation Year 22 to 25	Post-closure 25 years			Beyond Year 75
		Active Closure Year 26	Active Closure Year 27-36	Passive Closure Year 38-75	
Water	\$478,240	\$61,520	\$553,680	\$461,400	\$0
Reclamation research and planning	\$250,000	\$0	\$0	\$0	\$0
Revegetation	\$164,700	\$0	\$274,500	\$384,300	\$768,600
Wildlife	\$10,800	\$2,400	\$21,600	\$36,000	\$74,400
Geotechnical	\$120,000	\$15,000	\$30,000	\$30,000	\$15,000
Coal mine effluent	\$0	\$0	\$40,000	\$40,000	\$0
Subtotal	\$1,023,740	\$78,920	\$959,780	\$911,700	\$858,000
Total cost					\$3,832,140

8.4.3 Post-closure Maintenance

Once reclamation is complete, maintenance activities are required to maintain access to the mine, ensure that reclamation is progressing, and ensure that water management systems are operational. Post-closure maintenance activities are outlined in the list below:

- ▶ conduct inspections on the Goathorn and Four Creek bridges every three (3) years;
- ▶ inspect culverts annually and ensure clear of debris;
- ▶ inspect spillways twice annually to ensure clear of debris;
- ▶ inspect inlets and outlets of ponds twice annually;
- ▶ conduct replanting in areas that are not showing adequate revegetation; and
- ▶ install any replacement monitoring equipment.

Table 8.4-4 below summarizes the maintenance costs for the Decommissioning and Reclamation Phase and the active and passive stages of the Post-closure Phase of the Project. The total expected cost for maintenance is \$1,142,500.

Table 8.4-4: Maintenance Costs During the Decommissioning and Reclamation and Post-closure Phases of the Project

Item	Decommissioning and Reclamation Year 22 to 25	Post-closure 25 years	
		Active Closure Year 26-36	Passive Closure Year 38-75
Bridges	\$20,000 (\$5,000 per annum)	\$50,000 (\$5,000 per annum)	\$30,000 (\$5,000 per annum)
Culvert Clean out	\$40,000 (\$10,000 per annum)	\$100,000 (\$10,000 per annum)	\$150,000 (\$10,000 per annum)
Spill way maintenance	\$20,000 (\$5,000 per annum)	\$50,000 (\$5,000 per annum)	\$30,000 (\$5,000 per annum)
Inlets and outlets	\$20,000 (\$5,000 per annum)	\$50,000 (\$5,000 per annum)	\$0
Replanting	\$500,000 (Assume 10% of total area cost in Year 4)	\$50,000 (Assume 1% of total area cost in year 10)	\$0
Monitoring Equipment	\$20,000 (\$5,000 per annum)	\$10,000 (\$1,000 per annum)	\$7,500 (\$500 per annum)
Total per Phase	\$620,000	\$305,000	\$217,500
Grand Total			\$1,142,500

Note: \$=Canadian dollar

9. REPORTING

9.1 General Reporting

Reporting will be used to confirm consistent implementation of the RCP, including monitoring and adaptive management measures employed, and the results from mitigation and monitoring programs. Summary reports of monitoring activities and results will be compiled and reviewed annually.

9.2 Compliance Reporting

Compliance reporting will be subject to the EAC, *MA/EMA* permit conditions. The information gathered during monitoring practices will be summarized, with appropriate information from other management plans, into an Annual Environmental Management Summary Report and upon permitting completion, the Annual Environmental Reports as required by *MA/EMA* permits. Community engagement activities will be an aspect of the **Socio-economic Management Plan (S13.0-C16) (SEMP)**. The **SEMP** will have requirements related to reporting on community engagement programs.

9.2.1 Annual Reclamation Report

Annual reclamation reports will be submitted in compliance with *Mines Act*, RSBC 1996, c 293 (GovBC 1996) permit conditions and the Code. Annual Reclamation Reports will also be submitted to Indigenous groups and will summarize Project activities conducted on the mine property on an annual basis, including:

- ▶ mine development, including surface mining, clearing, salvage, stockpiling, disposal, and storage of materials,
- ▶ reclamation activities including soil placement, sloping and recontouring, facility decommissioning and removal, equipment removal, seeding, and vegetation growth, and
- ▶ activities, research, and monitoring results associated with the development and implementation of the environmental protection programs detailed in the overarching EMS and relevant management plans.

The Annual Reclamation Report will also provide a projection of mining and reclamation activities planned for the next five (5) years.

9.2.2 Five (5)-Year Mine Plan and Reclamation Program Updates

An updated Five (5)-Year Mine Plan and Reclamation Program will be prepared every five (5) years (or more frequently, if required to reflect major permit amendments) as per Part 10, Section 10.4.1 of the Code, which states:

- (1) After commencement of operations, mine plans, including programs for reclamation and closure, shall be updated, at a minimum, every 5 years.*
- (2) Reclamation plans shall outline progressive reclamation activities for the 5 years following the date on which the plans are updated in accordance with subsection (1).*

Updates to the reclamation and closure plan will present ongoing refinement of reclamation and closure planning, such as updates of the QEA model, cover designs and revegetation prescriptions, based on results from ongoing monitoring and research. Updates will present detailed reclamation and mine plans for the next five years and updated closure cost estimates to reflect the existing and planned mining activities, and liabilities for the Project.

9.3 Internal Reporting

The results from implementation of mitigation measures, monitoring programs, and adaptive management in this RCP will be documented in a daily log. Daily logs will be stored in a digital data storage system that will be maintained by the Environmental Coordinator. Details of the monitoring will be reported internally on an annual basis according to the adaptive management framework of the EMS. The report will provide monitoring results, assessment of **Performance Objectives** in 7.5, summarize and evaluate the success of wildlife and wildlife habitat mitigation and control measures for the Project, and identify management reviews and adaptive management strategies that were employed.

TCL staff or contractors will be strongly encouraged to report any inefficiencies to TCL management for evaluation and consideration.

10. ROLES AND RESPONSIBILITIES

10.1 Mine Manager

The Mine Manager bears overall responsibility for phases of the Project, and responsibility for onsite mine reclamation and closure. The Mine Manager is responsible for implementing the regulatory requirements of permits and authorizations and will ensure progressive and closure reclamation prescriptions and reclamation monitoring measures, as outlined in the RCP are followed.

The Mine Manager reports to the executive steering committee for TCL and will coordinate with this group to ensure that Project objectives are being met.

Specifically, the Mine Manager will:

- ▶ implement the RCP;
- ▶ provide the necessary budget and resources to allocate sufficient resources to carry out the RCP and
- ▶ facilitate the annual review of the RCP.

10.2 Mine Superintendent

The Mine Superintendent reports to the Mine Manager and will:

- ▶ assist the Mine Manager to implement the RCP;
- ▶ coordinate personnel, equipment, and resources to undertake reclamation and monitoring programs;
- ▶ coordinate the integrated reclamation and mine planning process and make sure reclamation procedures such as the fact sheets described in the RCP have been developed and communicated to site staff and contractors,
- ▶ complete annual update of the Five (5)-year Mine Plan;
- ▶ complete update to the mine plan and reclamation program every five (5) years for submission to the regulatory agencies; and
- ▶ assists the Mine Manager and Environmental Coordinator to complete an annual review of the RCP.

10.3 Environmental Coordinator

The Environmental Coordinator is responsible for the day-to-day management of Project environmental programs and permits. The Environmental Coordinator reports to the Mine Superintendent.

The Environmental Coordinator will:

- ▶ provide guidance relating to permit conditions, commitments, regulations, acts, interpretation of legislation, and company policies;
- ▶ ensure adherence to mitigation measures and BMPs for management plans related to reclamation such as this **RCP**, the **WMP**, **SEPSCP**, **VRMP**, etc.;

- ▶ be responsible for implementation of the **EMS** and management plans;
- ▶ conduct research and reclamation monitoring with the assistance of QPs, as required;
- ▶ produce annual compliance summaries as per EAC and *MA/EMA* permit requirements;
- ▶ be the liaison for government agencies for permitting, inspections etc.;
- ▶ be the liaison for Indigenous groups, through their designated representatives, for reclamation planning involving indigenous traditional values, and
- ▶ conduct the annual review of the RCP.

10.4 Environmental Technician

The Environmental Technician reports to the Environmental Coordinator and will:

- ▶ assist the Environmental Coordinator with research and monitoring as required in this RCP;
- ▶ provide vacation cover for the Environmental Coordinator;
- ▶ assist the Environmental Coordinator with the Annual Environmental Management Summary Report; and
- ▶ assist the Environmental Coordinator with the Annual review of this RCP.

11. COMMUNICATIONS

Communication of the RCP at TCL will be based on internal requirements and will primarily take place through this RCP and relevant SPPs. Any substantial change to the RCP will be communicated to the Project's employees and contractors through a site-wide email, announcements over radio channels by Minesite supervisors and bulletins posted around the Project's Minesite. When effective to do so, maps will be marked to show the changes. Change management is detailed in 13.

11.1 Training and Awareness

Training of TCL employees, the IEM, and contractor employees will be conducted using the RCP including related Appendices, and standard BMPs. These will be implemented during construction in the various areas as detailed in the **CEMP**. Flagging of environmentally sensitive areas and adherence to them, along with construction plans for surface erosion and sediment control, will be an important component.

11.2 Employee and Contractor Training

The environmental training of all personnel involved in construction activities on the Project is considered a critical factor in achieving the objectives outlined in this RCP. Employees will attend a site induction and will be trained in the RCP to the degree that is appropriate for their role. All those responsible for the management, implementation, and operation of any aspect of this RCP will be competent for their role.

11.3 Visitor Training

Visitors will not be required to be knowledgeable of this RCP as they will be under the direction of TCL employees and will not be allowed to be in a situation involving the Construction Phase activities.

12. EVALUATION AND ADAPTIVE MANAGEMENT

12.1 Evaluation

The RCP will be reviewed by the Environmental Coordinator on an annual basis to comply with regulatory and permit requirements, assess the implementation of the RCP for effectiveness and the appropriateness of mitigation measures, and update the RCP, as appropriate.

The Environmental Coordinator will compare data and trends from reclamation monitoring programs and surveys and evaluate the effectiveness of the mitigation measures implemented as directed in this RCP, to determine if adjustments or corrections are required, through the adaptive management program. This process will include a review of the work plan deliverables and input received from Indigenous groups through the **SEMP**.

12.2 Adaptive Management

A philosophy of adaptive management will be adopted to verify that the EMS and associated mitigation measures are consistently meeting or exceeding performance targets. Adaptive management is a structured decision-making approach to reduce uncertainty over time via targeted system monitoring. This will be achieved through periodic reviews of the RCP and the results of monitoring programs.

Adaptive management techniques will be employed where measures in the RCP are found to be not performing as designed or expected, and TCL will work towards continual improvement for the Project. The RCP is a living document that will be reviewed and improved as site conditions change and following the evaluation of monitoring and sampling data collected through the life of the Project. TCL will amend the RCP as required based on input from consultations, monitoring results, regulatory or legislative changes, and any updated, improved, or revised BMPs and scientific methods will be considered.

TCL will amend the RCP as required based on annual evaluations and feedback from stakeholders and Indigenous groups. If, significant changes to the mine plan or reclamation program are required, TCL will apply for an amendment of the *Mines Act* permit. Any proposed changes will be sent out for review by Indigenous groups and communities before being finalized and implemented into the RCP.

If issues involving reclamation are noted during the life of the Project (e.g., vegetation or plant deficiencies), Project design, operational procedures, and/or mitigation measures will be reviewed and adapted, and if appropriate, to minimize effects. The Environmental Coordinator will investigate opportunities for adaptive management based on observing trends in the monitoring data and will report to the Mine Manager any adapted practices, that resulted in improved outcomes which should be applied to other areas of the Project.

The Environmental Coordinator or their delegate will design and implement a suitable corrective action if monitoring demonstrates that objectives are not being achieved. Examples of corrective actions could include:

- ▶ additional training of employees and contractors on soil salvage or reclamation procedures;
- ▶ enhancement of or alterations to mitigation measures or monitoring programs;
- ▶ development and implementation of additional mitigation measures or monitoring programs; and/or
- ▶ additional capacity to deliver mitigation or monitoring measures.

TCL has an adaptive management process in place to effectively address any changes in a timely manner.

12.3 Continual Improvement

TCL will work towards continual improvement at the Project. The Mine Manager or their delegate will investigate improvements in any trend and assess whether the practices responsible for the improvements can be applied to other areas of the Project. Deteriorating trends will be studied to determine the root cause. When the cause is identified, the Mine Manager or their delegate will implement a suitable corrective action. Examples of corrective actions could include:

- ▶ finding improved ways to improve reclamation materials during the salvage process;
- ▶ changing the composition and/or thickness of reclamation materials to assist the RCP;
- ▶ additional training of employees and contractors on procedures;
- ▶ enhancement of maintenance and/or monitoring measures; and/or
- ▶ additional supervisory oversight.

TCL will review the RCP annually and amend it as required based on annual evaluations and feedback from relevant stakeholders and Indigenous groups. Any proposed changes regarding management of the public roads leading to the Project and concerns from the public or Indigenous groups will be sent out for review by these groups as needed before being finalized and implemented into the revised **PAMP**.

13. CHANGE MANAGEMENT

Changing any part of the RCP requires a formalized process. If substantial changes are being planned to objectives, plan structure, key operational milestones, communication and/or information management, the Management of Change (MOC) Procedure in the TCL **EMS** will be followed. Minor edits and/or updates to this RCP will be controlled through version control and content approval functions.

14. CONCLUSION

Mitigating potential effects on the end land use objectives of wildlife habitat and/or traditional indigenous harvesting at the Project is important in maintaining regulatory compliance and to avoid and minimize effects on the environment. The RCP has been developed following review of Project-specific baseline studies and the environmental assessment of the Terrain and Soils, Vegetation, and Wildlife VCs. Through implementation of the RCP, and adaptive management to address changing site conditions, TCL will use effective strategies and BMPs to avoid and minimize Project-effects on the land during Project phases. Through the implementation of the RCP, TCL is confident that the post-ecosystems at the end of the Project will have a similar productivity to the climate shifted pre-project ecosystems.

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