Sisson Project

Conceptual Decommissioning, Reclamation and Closure Plan

Prepared for:
Northcliff Resources Ltd.
15th Floor, 1040 West Georgia Street
Vancouver, BC V6E 4H8

Prepared by:
EvEco Consultants Ltd.
526 East 30th Avenue
Vancouver, BC   V5V 2V6
t: +1 604 872 2855
f: +1 604 872 1374

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Executive Summary

The Sisson Project consists of developing, constructing, and operating an open pit tungsten and molybdenum mine. The Project is located in a rural and relatively remote part of west-central New Brunswick, in a landscape that is characterized by gently rolling topography with rounded uplands and broad, open drainage valleys. The uplands are typically well-drained, forested areas undergoing active commercial logging. Small lakes and wetlands are common in low-lying areas. Wildlife and aquatic resources are abundant and diverse, which generate some local recreational and traditional uses. Otherwise, forestry is the main land use.

The Sisson Project will involve the open pit mine and associated ore processing, as well as a tailings storage facility (TSF), rock quarry, water treatment plant, administration and warehouse buildings, and ancillary infrastructure. To prepare the Site for developing these facilities, facility footprints will be cleared of surface vegetation and stripped of their surficial materials to be retained for later use in site reclamation. Engineered diversion structures will be constructed up gradient of the facilities to keep non-contact, clean surface runoff water away from the Site and divert it to nearby watercourses. Precipitation falling on the Project Site will be collected, stored and used during Operations for ore processing. Water surplus to Project demands will be tested, treated if necessary, and released.

The mine will operate for about 27 years, after which time it will be closed and reclaimed to restore the Site to conditions similar to those that existed prior to mine development. This document is a Conceptual Decommissioning, Reclamation and Closure Plan (Plan) that describes in concept how this will occur. The Plan takes into account baseline conditions, the proposed end land use objectives for different Project facilities to be reclaimed, requirements for habitat compensation or mitigation, and best management practices for protecting the environment.

At Closure, all unneeded buildings and equipment will be decommissioned and removed. The water management / treatment system used during Operations will be re-configured to ensure stable Site drainage and water quality that meets applicable standards for discharge. The landforms that remain after Operations will be reclaimed to a variety of habitats, including upland forest, wetland, shrub-riparian, and rocky outcrop. These habitats will be most appropriate for wildlife use, with some potential for traditional, recreational, and possibly commercial forestry use.

The reclamation will involve preparing and covering the landforms with quarried rock, overburden, and soil, as needed, and seeding and planting them with locally-occurring, native plant species. Engineered channels will be constructed to direct surplus runoff from the quarry and TSF into the open pit to accelerate its filling.

Within about 10 years following this initial work, the open pit will be flooded. This begins the Post-Closure period and most active reclamation will be complete. Some Project facilities will be nearing their target end land uses. Work will focus on treating discharge water from the open pit as necessary to protect the integrity of downstream watercourses, monitoring the stability of the Site, encouraging the development of diverse and sustainable plant communities that are similar to those that were present prior to Project development, and Site maintenance. Some Site infrastructure will remain to support this work.

Reclamation research will be conducted during the active mining period and into Closure to guide operational reclamation, evaluate if reclamation is meeting desired end land use objectives, and identify/suggest approaches for mitigating potential impacts.

The Plan described in this document has been prepared to meet one of the requirements for the Environmental Impact Assessment of the Project, and to support the eventual preparation of a Mining and Reclamation Plan required by the *Mining Act* of the Province of New Brunswick. It is thus a living document that will be updated from time to time to reflect evolving mine design, ongoing environmental and other studies, consultation with the Province and stakeholders, and environmental requirements at the time of closure.

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1.0 INTRODUCTION

This Conceptual Decommissioning, Reclamation, and Closure Plan (the Plan) has been prepared to meet one of the requirements of the Terms of Reference for the Environmental Impact Assessment (EIA) for the Sisson Project (the Project) (Stantec 2012a). The Project is a proposed tungsten and molybdenum mine located in New Brunswick and owned by Northcliff Resources Ltd. It will include a conventional open pit mine, associated ore processing, water and waste management facilities, a rock quarry, and supporting infrastructure. The current proposed layout and operation of the Project facilities are described in the EIA Report and in the Canadian National Instrument 43-101 Technical Report on the Sisson Project, submitted by Northcliff in January 2013 (Samuel Engineering 2013). The mine will operate for about 27 years and extract about 30,000 tonnes per day of tungsten- and molybdenum-containing ore. The ore will be processed on-site to produce tungsten and molybdenum concentrates, and the tungsten concentrate will be further processed to ammonium paratungstate (APT). Wastes from ore processing will be placed in a tailings storage facility (TSF) to be constructed on the Project site (the Site). The mineral products will be trucked off-site to markets.

The contents of this Plan are based on feasibility and baseline environmental studies of the Sisson Project completed to date on Northcliff's behalf. As such, the Plan is conceptual in nature and is expected to evolve over time as findings from these and other studies develop. Summary findings of these reports are provided herein for background necessary to understand the Plan.

This Plan will also support the preparation of a Mining and Reclamation Plan as required by the *Mining Act* of the Province of New Brunswick (Province). It is based on guidelines provided by the Province of New Brunswick Department of Natural Resources (NBDNR 2013), which suggest a format for reclamation and closure plans that will be acceptable for review by the Province's Standing Committee for Mining and the Environment. The Plan is organised into seven major sections:

1. Introduction
2. Baseline Environmental Information
3. Project Facilities and Processes
4. Conceptual Decommissioning, Reclamation and Closure Plan
5. Reclamation Schedule
6. Reclamation Costs
7. References

Each section includes a number of subsections, organised specific to its content. Brief descriptions are given of the baseline environmental conditions at and near the Project, proposed Project facilities, general and specific closure and reclamation strategies, and plans for monitoring and maintenance of structures that may remain in at the end of mining operations. Figures are embedded in the text for easy reference.

In this document, “mining operations” (Operations) are defined as the development, construction, and operation of all mine facilities, up until the mineral resource has been fully depleted and processed.

The “closure period” (Closure) is defined as the time period between when mining operations cease and when the open pit proposed for the Project has filled with water as part of the reclamation strategy for that facility. Most of the active reclamation on the Site will occur during the closure period, including decommissioning the Site infrastructure and all Site preparation, re-vegetation and monitoring work required to reclaim each facility to its proposed end land use.

The “post-closure period” (Post-Closure) begins when the open pit has been filled and starts discharging water, treated as required to meet discharge quality standards set by the Province. Reclamation activities will be largely complete except for ongoing monitoring, care and maintenance of the Site.

2.0 BASELINE ENVIRONMENTAL INFORMATION

Studies for the EIA have generated detailed baseline environmental descriptions of the landscape and its associated terrestrial, aquatic, wildlife and human use values. The Study Area for EIA studies comprises the Project Development Area (PDA) where actual Operations will occur (approximately 1250 hectares [ha]), approximately 5000 hectare (ha) of immediately adjacent areas, watersheds connected to the PDA, and nearby locations to be used as reference sites of baseline environmental conditions.

The baseline environmental data are being used to anticipate potential environmental impact from the Project, and to identify measures for impact avoidance, mitigation or compensation. They also provide an important source of information for reclamation and closure planning, so are briefly described here.

2.1 LOCATON AND INFRASTRUCTURE

The Sisson property is located on Crown land in east-central New Brunswick. It is approximately 100 km northwest of the City of Fredericton by road, and approximately 10 km southwest of the community of Napadogan. The Site is accessible by gravel roads. Like much of the Central New Brunswick, the area is sparsely populated.

A high voltage transmission line from the provincial grid crosses the property.

2.2 CLIMATE

In general, climate in the vicinity of the Sisson Project is cool and wet (Samuel Engineering 2013). The estimated mean annual temperature for the area is 3.3°C, with average temperatures of -12.4°C in January and 17.7°C in July. The mean annual precipitation for the area is estimated to be 1,350 mm, of which about approximately 25% falls as snow. Snowfall generally occurs from November to March, with accumulations remaining on the ground from December to February.

2.3 GEOLOGICAL SETTING

Mineralization of interest to the Sisson Project occurs almost exclusively in quartz veins, fractures, and their alteration envelopes. Although tungsten and molybdenum are the metals of principal economic interest, several other metals (including copper, zinc, lead, arsenic, and bismuth) occur in geochemically anomalous but sub-economic concentrations.

2.4 PHYSIOGRAPHY

The physiographic area in which the Sisson Project is located is characterized by gently rolling topography with strongly glaciated, rounded hilltops and broad, open drainage valleys. The uplands are typically well-drained, forested areas undergoing active commercial logging. Small lakes and wetlands are common in low-lying areas (NBDNR 2007).

The surface elevation in the PDA ranges from approximately 290 to 400 meters above sea level (masl).

The PDA is within the Nashwaak River watershed, which is a tributary of the Saint John River to the south. Four main sub-watersheds of the Nashwaak River will be potentially affected by the Project: Bird Brook, Sisson Brook, West Branch Napadogan Brook and McBean Brook (Figure 2.1).

2.5 LANDSCAPE VALUES

Some landscape values are relevant to reclamation planning, such as the kinds and characteristics of surficial materials, terrestrial vegetation and wildlife, and aquatic resources. They are summarized in this section.

2.5.1 Surficial materials

In this document, "surficial material" is defined as all consolidated and unconsolidated sediments overlying bedrock. "Soil" is the weathered, upper portion of surficial material between the vegetated surface and the underlying unweathered parent material. The underlying, unweathered parent materials are defined as "overburden". Together, soil and overburden comprise surficial materials.

Surficial materials in the Study Area are derived from granitic and meta-sedimentary bedrock. They occur predominantly as lodgement till and glacio-fluvial sediments. Colluvium occurs on and at the base of steeply sloping terrain, and fluvial sediments occur along active stream margins.

Textures of surficial materials are mostly sandy with minor silt, and moderate to high amounts of boulders, cobbles and gravels (NBDNR 2007). Textures are finer with fewer coarse fragments in valley bottoms and surface water-receiving areas. Soil fertility varies from moderate to poor, and materials are well to poorly-drained depending on parent material, texture, consolidation, and landscape position.

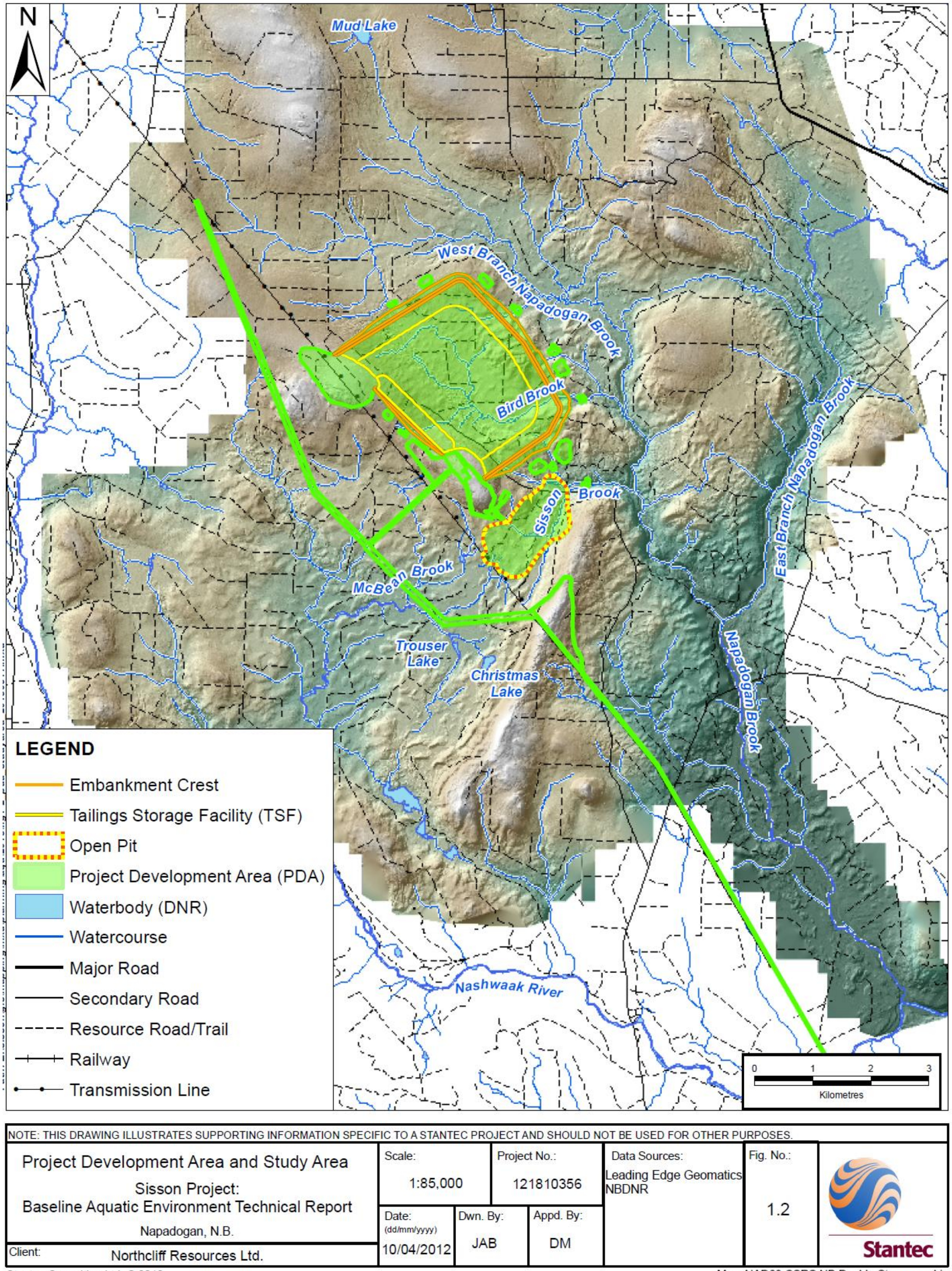
The thickness of surficial materials varies between 1.5 m and 17 m (Samuel Engineering 2013), and is generally thicker in the valley bottoms and thinner on hill slopes and crests. Rock outcrops are rare.

A typical profile of surficial material (measured at a location within the TSF footprint) consists of the following sequence of layers:

- soil comprised of organic materials (leaves, humus, roots) with varying quantities of silt, sand, and coarse fragments, ranging from 0 to 1.4 m thick;
- a coarse sand and gravel unit between 0 to 7 m thick; and/or
- a till unit comprised of silt, sand, gravel, and cobbles ranging from 1.5 to 9.5 m thick.

The till is usually compact at depth.

Figure 2.1 - Project physiographic setting in central New Brunswick



2.5.1.1 Soils

Stantec (2012b) describes five soil types in the Study Area, which in this Plan are grouped into two categories based on their functional value as a growth medium in reclamation.

- Category 1. Irving and Tuadook soils are in the first category. Within the PDA, they occur in the moderately sloping terrain along the West Branch Napadogan Brook and in the proposed footprints of the quarry and plant site. Textures are loam to silt loam, with low to moderate coarse fragments. They have the highest fertility, and thus the highest productivity potential for reclamation.

- Category 2. Pinder, Big Bald Mountain and Catamaran soils comprise the second category. They occupy the remaining and most of the PDA. Their salvage potential is relatively high because of their expanse, but their quality is only marginally better than tailings sand and shattered rock because of their coarse texture, high coarse fragment content, low nutrient content and poor ability to retain water. They are thus prone to drought and infertility, and may require supplementary water and fertilizer when used for reclamation.

Organic soil materials are a separate soil type, but are not categorized separately in this Plan because they occur in relatively small, disconnected areas of the PDA and cannot be reasonably separated from their underlying mineral materials. They are best salvaged and mixed with underlying mineral soils. When so combined, organic materials improve the texture, reduce the effect of coarse fragments, and increase the capacity of salvaged materials to store water and nutrients. They are also a source of an abundant, diverse seed bank of locally-occurring, native plant species that are adapted to site-specific conditions. These properties make salvaged organic materials invaluable in re-vegetation efforts.

Organic soils have been found in a small bog identified by Stantec (2012b) in the proposed footprint for the TSF, in forested wetlands, and in beaver ponds that have existed for a decade or longer. Thin layers of organic materials also occur as litter, humus and root mats on the surface of upland landscapes.

Quarried, crushed rock is not a soil type, but is also considered here because it will be an amendment used for reclamation. It will be quarried as required throughout the life of the mine for construction and operational purposes, and for reclaiming parts of the TSF.

2.5.1.2 Metals in Surficial Materials

Based on the nature of the Project (a tungsten and molybdenum mine), the known composition of soils in central New Brunswick, and trace metals that are generally of "primary toxicological concern", the trace metals of primary consideration for ecological and human health risk modelling are considered to be arsenic, cadmium, lead, mercury, molybdenum and tungsten (Stantec 2012c). Samples of surficial materials have been collected for analysis to assess the presence of some of these metals. Of 51 samples collected, six were from within the PDA, including three over the location of the proposed open pit. Samples were taken to depths less than 30 cm below ground surface (*i.e.*, in the soil depth, only), and tested for general parameters and total metals. Trace metal test results identify arsenic, cadmium and tungsten as regionally elevated near to or inside the PDA footprint.

2.5.2 Terrestrial Environments

Most of the terrestrial environment is forested uplands, with a network of small lakes and wetlands of various types in valley bottoms. Stantec (2012b) has identified several terrestrial environments, of which three are most relevant to reclamation planning.

- Upland Forest.
- Wetland.
- Shrub-Riparian.

Stantec does not describe Rock Outcrop since it rarely occurs in the landscape; however, it is included as a terrestrial environment in this Plan because it may be an important habitat type for reclaiming some mine features.

2.5.2.1 Upland Forest Habitats

Stantec (2012b) reports that, in general, upland forests are composed of varying amounts of coniferous and deciduous species, depending on slope position, aspect, drainage, and soil type. Many stands are relatively young due to decades of logging activity, and so have a strong presence of early successional tree species.

Stantec identifies five upland forest types, which in this Plan are grouped into three groups based on landscape position and species composition:

- Group 1 – Spruce-Balsam Fir and Rich Softwood – these forest types occur in low-lying areas and on slopes leading to watercourses. The overstory of both types is dominated by red or black spruce (*Picea rubens, P. mariana*) and/or balsam fir (*Abies balsamea*), with smaller amounts of red maple (*Acer rubrum*), white birch (*B. papyrifera*) or yellow birch (*B. alleghaniensis*). The herbaceous layer may be sparse.

- Group 2 – Tolerant Hardwood and Intolerant Hardwood – these forest types occur on high slope positions where soils are rich and drainage is good. They differ from each other by the presence (Tolerant Hardwood) or absence (Intolerant Hardwood) of shade-tolerant species. Maples (*Acer spp.*), birch (*Betula spp.*), beech (*Fagus spp.*) or trembling aspen (*Populus tremuloides*) predominate in the overstory, with scattered amounts of red spruce, and balsam fir. There is an abundant, diverse herbaceous layer of ferns, moss, and forbs in both types.

- Group 3 – Mixedwood – this forest type typically transitions between Group 1 softwood stands at lower elevations and Group 2 hardwood stands on upper slopes. The tree canopy contains red spruce, yellow birch, balsam fir, red maple, and/or white birch. The herbaceous understory is usually dominated by wood sorrel (*Oxalis montana*), ferns, goldthread (*Coptis trifolia*), and wild sarsaparilla (*Aralia nudicaulis*).

2.5.2.2 Wetland Habitats

Common wetland habitats in and near the PDA include forested wetlands, open water wetlands, and peat lands (NBDNR 2007). The Shrub-Riparian type is also technically a wetland, but is discussed as a separate habitat in this document because of the important effect of its shrubby vegetative cover on wildlife values.

Stantec (2012b) has identified seven wetland types which in this Plan are grouped into three groups:

- Group 1 – Forested Wetland – two types occur that are differentiated by landscape position, water supply and vegetative cover:
  - Oligotrophic Forested – occurs in the upper reaches of catchments, serving as a transition between Group 2 upland forests and other wetland types at lower landscape positions. Their primary water source is from rain and surface runoff, so they tend to dry out during the summer. Soils are comprised of thin peat accumulations over coarse textured, mineral soils. Trees are dominated by black spruce, with lesser amounts of balsam fir. The understory is primarily composed of ericaceous shrubs, with sedges, bunchberry (*Cornus canadensis*) and sphagnum moss (*Sphagnum spp.*) in the herbaceous layer.
  - Mesotrophic Forested – occurs along water courses and areas of seepage and groundwater recharge, often as a transition between the Oligotrophic Forested Wetland and Shrub-Riparian types. Due to their position near to watercourses, they tend to flood and be consistently wet throughout the year. Soils have varying depths of peat over silt loam and silty organic muck (associated with former beaver activity). They have a mixed coniferous / deciduous forest cover, with an understory dominated by small, regenerating trees, ferns and sedges.
- Group 2 – Open Water Wetland – include Lacustrine Shallow Water, Disturbed Scirpus Meadow, Fen, and Beaver Empoundment types. All occur infrequently in the PDA, except for Beaver Empoundment. They are identified by varying sizes of open water fringed by vegetation that can tolerate either seasonally or permanently wet conditions. They differ from each other in terms of landscape position, the source, size, depth and seasonal duration of open water, and vegetative cover. Soils vary from deep peat deposits to silty organic mucks. Vegetation in Lacustrine Shallow Water type is primarily aquatic or semi-aquatic; all other open water types have at least some terrestrial vegetation.
- Group 3 – Peatland – peatlands in the PDA occur only in the one small Bog identified by Stantec (2012b). Bogs are primarily fed by rainwater, but also by flooding and seepage from adjacent forested wetlands. They are composed of deep peat deposits with a predominantly sphagnum moss vegetative cover, grading to sedge, grasses, scattered Labrador tea (*Rhododendron groenlandicum*), leatherleaf (*Chamaedaphne calyculata*), stunted tamarack (*Laris laricina*) and black spruce out towards the margins.

2.5.2.3 Shrub-Riparian Habitat

The Shrub-Riparian type occurs along water courses subject to flooding and in seepage zones at the base of steep slopes. Fluctuating water levels inhibit the development of a mature tree cover, so vegetation is dominated by a shrub layer of alder (*Alnus spp.*), hybrid birch (*Betula occidentalis*) and willow (*Salix spp.*) and a poorly developed herbaceous layer. Soils consist of interbedded layers of mineral and organic sediments of varying thicknesses, depending on the frequency and duration of flooding events.

2.5.2.4 Rock Outcrop Habitat

There are few rock outcrops in the area; however, it is expected that some exposed rock will remain Post-Closure on quarry and pit walls and benches.

2.5.2.5 Metals in Vegetation

Stantec (2012c) selected ten locations for vegetation sampling. Interpretation of the data suggests no consistent trends or correlations between trace metal concentrations, vegetation type or location; however, some trace metals (not always metals of primary consideration or of primary toxicological concern) occur at their highest concentrations in sampling locations down-gradient of the PDA in East Branch and West Branch Napadogan brooks.

2.5.3 Aquatic Environments

The aquatic environment comprises lake and brook habitats, groundwater resources, and the aquatic species that depend on them. This section describes the physical and chemical properties of water and sediment in the aquatic environment, and important aquatic species. Their vegetative and hydrologic characteristics are described above as part of the wetland and shrub-riparian discussions.

Aquatic characteristics in the Study Area are highly variable, but are considered to be generally very good as would be expected in rural and undeveloped areas of New Brunswick (Stantec 2012d).

2.5.3.1 Watercourses

The current proposed locations and layouts of the open pit and TSF will eliminate a portion of at least three watercourses: Sisson Brook, Bird Brook and an unnamed tributary to West Branch Napadogan Brook. Small headwater streams to McBean Brook may also be affected. The remaining watershed will remain undisturbed by Project development, but is an important resource that warrants careful mapping, protection and monitoring to ensure the Project causes no deleterious effects on aquatic resources.

Stantec (2012d) reports that each watercourse provides cold water, shade from dense and stable vegetation, varied substrate with low embeddedness, and primarily riffle-run stretches with some pools. These characteristics are important factors in supporting aquatic species and maintaining the overall quality of the aquatic environment.

Surface water quality has been monitored in the brooks and lakes that are close to the PDA. Overall, Knight Piésold (2012) reports that surface water quality is, in general, “good” to “excellent” and suitable for supporting a variety of fish populations.

Physical parameters are affected by spring freshet and proximity to headwaters. Dissolved anions, nutrients, turbidity, and total suspended solids are very low at all sites, with the exception of fluoride which has exceeded the 0.12 mg/L Canadian Environmental Quality Guideline (CEQG) limit for aquatic life (CCME 1999) in at least 20% of samples collected.

Metal parameters are also affected by freshet and proximity to headwaters. Generally, both total and dissolved metal concentrations increase during and after freshet and do not decrease until the late summer and fall. At all monitoring sites, aluminum and cadmium concentrations consistently exceed the CEQG limits for aquatic life.

More sporadic exceedances of CEQG limits have been noted for iron and mercury, and rare exceedances have been noted for copper, zinc, arsenic, and lead, generally in the summer months, during and after freshet.

2.5.3.2 Groundwater

The groundwater resources within the Nashwaak River watershed are confined almost exclusively in fractured bedrock. Groundwater yields are estimated (NBDOE 1980) to be generally low and coincide with volcanic geology where the ore body is located. Groundwater testing in the Project area has identified concentrations of aluminum, arsenic, iron, and manganese that exceed one or both of the CEQG limits and Health Canada guidelines for drinking water (HC 2010; Knight Piésold 2012).

2.5.3.3 Sediment

Fine-grained sediment occurs in depositional areas of brooks and streams. Composite sediment samples collected by Stantec (2012d) for laboratory analysis indicate sediment quality is “good” to “excellent”. Sediments contain moderate amounts of organic carbon and low inorganic carbon, and high concentrations of extractable aluminum, calcium, magnesium, iron, and manganese. Sediment collected in proximity to the ore body show naturally-elevated concentrations of several trace metals, including arsenic, molybdenum, tungsten, and uranium. Some stations in the East Branch Napadogan Brook system show elevated concentrations of mercury, but the cause of the high mercury concentrations is not known.

2.5.3.4 Aquatic Populations

Aquatic populations are typical of cold water watercourses in New Brunswick, and are consistent with stream order, and the habitat type and quality found in the Project area.

Stantec (2012d) identifies several fish species including Atlantic salmon, brook trout, bass, and carp. Brook trout dominate the higher-order sections of watercourses whereas Atlantic salmon prefer the lower-order sections, possibly because of temperature variation along watercourses. Lower Napadogan Brook provides abundant salmonid-rearing habitat, with gravel, rocks, and boulders providing habitat for spawning and refuge. McBean Brook has the most diverse assemblage of fish species and families, with no Atlantic salmon present.

Analysis of brook trout tissues from West Branch Napadogan Brook and its tributaries indicate concentrations of a variety of trace metals in whole fish and liver samples, some above thresholds considered safe for wildlife consumers of fish.

Benthic species occur in high numbers, indicating high overall quality of the aquatic environment. They occur across the Nashwaak River watershed, but with distinct differences in abundance, richness, diversity, and evenness depending on location, which is normal for natural environments.

Periphyton data indicate a moderate level of primary productivity and moderate availability of organic matter in the periphyton biofilm. The periphyton is dominated by diatoms, which are a high quality food resource for benthic invertebrates.

2.5.4 Wildlife

Wildlife is widespread throughout the Project area, and thus wildlife habitat is an important end land use objective for the Project Site following closure. Wildlife population diversity, density, and distribution in the Project area are typical for remote areas of central New Brunswick, and are consistent with the climate, vegetative cover, and proximity to human-related activity that occurs in and near the PDA.

Wildlife surveys (Stantec 2012e) confirm the presence of white-tailed deer (*Odocoileus virginianus*), moose (*Alces alces*), American black bear (*Ursus americanus*), eastern coyote (*Canis latrans*), and many small mammals, amphibians, and reptiles.

Deer wintering areas (DWAs) are common in the area, occurring near watercourses or water bodies, often in old Spruce-Balsam Fir habitats (OSFH, Stantec 2012e). Although four OSFH blocks have been identified in the PDA, the DWA closest to the Project is located outside the PDA predominantly along the East Branch Napadogan Brook and partially along the West Branch Napadogan Brook.

Stantec (2012e) reports a total of 114 bird species in the PDA, most commonly occurring in or adjacent to shrub-riparian habitats, or in edge areas near to watercourses, open water wetlands, or beaver ponds. Terrestrial birds occur in all terrestrial habitats, including recent clearcuts and forest openings. Waterfowl use the open water found in lakes, beaver ponds, and wetlands. Raptors occur along lake margins, in open forest, and along upland forested and shrub-riparian habitats.

2.6 LAND STATUS AND USE

The Study Area supports a variety of rural uses by local residents and businesses, some of which may be important as end land use objectives after Project Closure. There is considerable recreational activity including overnight camping (some in non-permanent cabins), hunting, trapping, fishing, and ATV and snowmobile riding (Stantec 2012f). Most hunters and trappers using the Study Area are residents from surrounding communities, although local guide outfitters also provide hunting and recreational services for out-of-province residents.

Clear-cut logging and reforestation operations are active within the Sisson mineral claim.

The headwaters of the Nashwaak River are in traditional Maliseet territory (Stantec 2012f). An Indigenous Knowledge Study conducted for the Project (Moccasin Flower Consulting 2013) indicates that the Study Area has and is being used for traditional purposes by Aboriginal persons.

3.0 PROJECT FACILITIES AND PROCESSES

The configuration and management of Project facilities and processes during Operations affect reclamation and closure planning, so are briefly described here. They include:

- open pit;
- ore conveyance, storage and processing facilities (including the ore concentrator and APT plant);
- Barren Rock and Mid-Grade Ore storage;
- rock quarry;
- tailings storage facility; and
- related infrastructure.

These facilities at end of Operations in approximately Year 27 are shown in Figure 3.1.

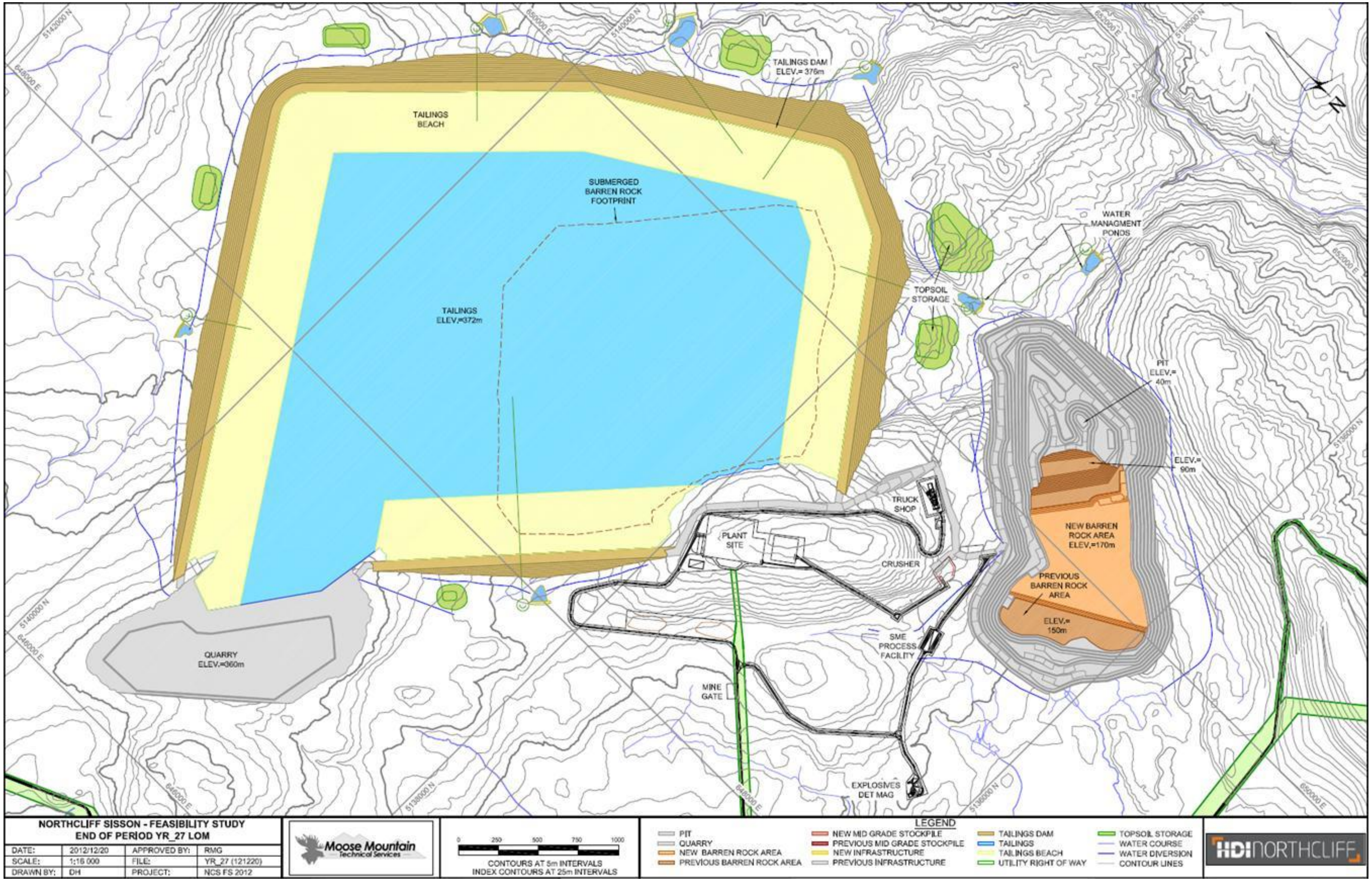
3.1 OPEN PIT

The area for the proposed open pit is located over the ore body along the eastern edge of the PDA. The pit will be excavated by drilling and blasting successive benches and removing the broken rock with a hydraulic shovel and/or wheeled loaders. Non-economic rock will be hauled for sub-aqueous disposal either in the TSF or into suitable locations of the mined-out pit bottom towards the end of Operations.

3.2 ORE CONVEYANCE AND STORAGE

Ore from the open pit will be truck-hauled from the pit to a primary crusher located beside the pit, and then by conveyor to the ore processing plant. An ore stockpile area will be constructed near the primary crusher with an appropriately prepared foundation designed to prevent seepage into groundwater. The size of the stockpile area will be large enough to accommodate up to one week’s production.

Figure 3.1 – Project facilities at end of Operations



Source: Samuel Engineering (2013)

3.3 BARREN ROCK AND MID-GRADE ORE

Any material mined from the open pit that is not ore is defined as Barren Rock. Tungsten and/or molybdenum mineralization in Barren Rock is not significant enough to designate it as ore. If mineralization of the Barren Rock is significant, but not currently economically viable, it is further designated as Mid-Grade Ore.

Barren Rock and Mid-Grade Ore are, or are assumed to be, potentially acid-generating (PAG), and thus will be placed in separate storage areas within the southern quadrant of the TSF footprint (Samuel Engineering 2013). These areas will be sequentially flooded and encapsulated in tailings as the TSF fills. In the final phase of mining, the two materials will be left in mined-out locations at the bottom of the open pit and flooded as part of the closure and reclamation strategy for this facility. Sub-aqueous storage of Barren Rock and Mid-Grade Ore in these ways will effectively mitigate the potential for metal leaching and the generation of acidic conditions.

3.4 ROCK QUARRY

Because Barren Rock from the open pit is assumed to be PAG, it will not be used to construct or reclaim any mine facilities. Northcliff will source non-potentially acid generating (NPAG) rock for construction and reclamation purposes from a quarry site located at the western corner of the TSF. The quarry will be excavated in four phases as the TSF expands over the life of the mine (Samuel Engineering 2013), and will be flooded and reclaimed along with the TSF at Closure.

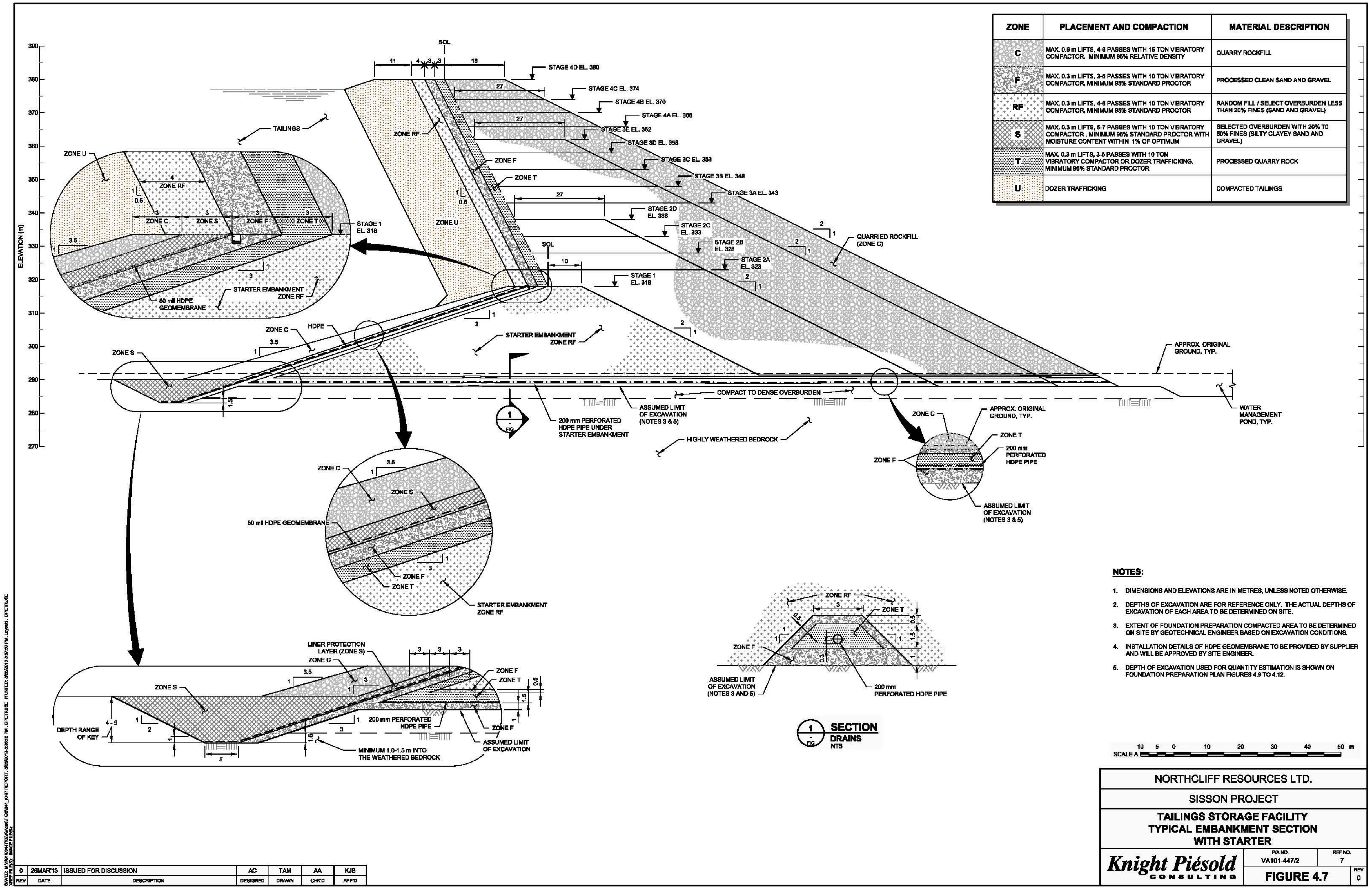
3.5 TAILINGS STORAGE FACILITY

The proposed location of the TSF is on the north and west sides of the PDA. It will be developed in phases as tailings are produced during Operations. Within the TSF embankment footprints, vegetation will be cleared and grubbed, and surficial materials will be salvaged to the depth of compact overburden or competent bedrock to provide a geotechnically stable base. The rest of TSF footprint will be cleared of trees before the TSF is filled.

The embankments will be constructed of NPAG overburden and quarried rock. Where the embankments are developed from starter dams during Project construction, a high-density polyethylene (HDPE) geomembrane will be placed on the upstream face of the starter embankments to collect water for early Operations. The embankments will be progressively extended and raised by further placing of NPAG quarried rock until the final design footprint and elevation are achieved. The downstream face will be surfaced with compacted quarry rock at a slope of 2H:1V (Figure 3.2 - Typical TSF embankment detail). Roads will be maintained along the top and at the base of the embankments to provide access during construction, for managing the tailings deposition during Operations, and for maintaining water management facilities around the TSF.

Seepage through the embankments will be controlled by compacting embankment materials and adjacent tailings during construction and expansion of the TSF. Seepage that may occur will be intercepted and collected by engineered foundation drains installed at the base of the embankments, connected to a network of ditches and water management ponds (WMPs) located around the outside perimeter of the embankments. Groundwater monitoring wells will be installed down-gradient of the WMPs to monitor the presence and quality of seepage in groundwater. If necessary, these wells will be converted and/or additional wells will be installed as pump-back wells, to intercept and pump groundwater back to the TSF.

Figure 3.2 - Typical TSF embankment detail



Source: Knight Piésold (2013a)

A small proportion of tailings is expected to be PAG, and will be deposited and stored sub-aqueously within the TSF to effectively inhibit potential metal leaching and acid generation. The bulk of the tailings will be NPAG and will be placed from the embankment crests to establish beaches and a tailings pond that will encapsulate PAG tailings, Barren Rock and Mid-Grade Ore within the TSF.

3.6 INFRASTRUCTURE

Infrastructure for the Project will include existing and new access roads to the Project Site, an electrical power supply line, ore stockpile(s), crushers and the ore processing plant, on-site buildings and ancillary equipment, parking and laydown (storage) areas, freshwater supply well(s), and other related facilities. Most of this infrastructure will be closely contained within an area of about 80 ha between the open pit and the TSF.

3.6.1 Access Roads and Electrical Power Supply

The main access to the Project Site will be via existing unpaved forestry roads that connect to paved Highway 104 or Highway 107. These forestry roads will be refurbished, in places, to accommodate Project needs, and one will be relocated around the southwestern perimeter of the Project. All refurbished and new roads will be designed to accommodate Project equipment size and operating characteristics.

A portion of the electrical transmission line that crosses the southwestern edge of the PDA will be moved to accommodate mine infrastructure. Power supply for the Project will not come from this source, but from a new electrical transmission line running beside the existing line that will tie into the New Brunswick grid approximately 42 km southeast of the Project location.

3.6.2 Ore Processing Plant, Equipment and Supplies

The ore processing plant will be enclosed in industrial buildings that will house all equipment to crush, grind, concentrate, and further process the ore.

Process reagents will be delivered in bulk or by specific container and stored on-site in designated, secure areas near or attached to the process plant buildings. Covered and open storage areas will be self-contained and equipped with spill containment and recovery sump systems.

Processed mineral products will be placed in containers and then trucked from the Site for long-haul shipping to markets.

3.6.3 On-Site Buildings and Ancillary Equipment

On-site buildings and ancillary equipment will include an administrative building, a metallurgical / analytical laboratory, sanitation systems, air, water and steam supply systems, fire suppression and first aid facilities, a maintenance shop and warehouse, and laydown areas.

An on-site explosives magazine will be used to store blasting accessories. Blasting materials will be transported and stored on-site in small quantities, and mixed in the Site Mixed Explosives (SME) facility for use as needed. The magazine and SME facility will be secured with fencing and locked gates.

Tanker trucks will deliver diesel fuel and gasoline to the Site on an as-needed basis for use by heavy equipment and Project vehicles. Fuels will be stored in above ground storage tanks equipped with secondary containment. Stationary mine equipment will be fueled with a fuel-dispensing truck.

3.6.4 Water Supply, Treatment and Discharge

The system for managing water supply, treatment and discharge will consist of a network of diversion, collection, recycling, treatment and discharge structures that are designed to conserve water resources and protect downstream ecological values and human health. Surface runoff around the Site ("non-contact" water) will be intercepted by berms and ditches and directed into existing watercourses. Water collected on the surface of the Site, in the open pit, and downstream from the TSF ("contact" water) in WMPs will be pumped back to the TSF for storage and eventual re-use in the process plant. Groundwater quality below the WMPs will be monitored, and groundwater pump-back wells will be installed and operated as needed to intercept and return groundwater back to the TSF.

The water used in the process will be recycled from the TSF and discharged back to the TSF with the tailings. Recycled process water will pass through a water clarification facility located near the process plant before being re-used. Underflow from the clarifier will be deposited in the TSF.

The water management system will be in a surplus condition starting in approximately Year 9 of Operations (Knight Piésold 2013b). At that point, surplus water will be clarified and further treated before discharge to a nearby brook. Discharge water will meet water quality conditions as set by the Province in the Project permit(s).

Freshwater will be required for domestic potable water, vehicle washing, dust suppression, fire suppression and reagent make-up; it will be sourced from on-site groundwater wells. Domestic wastewater from washrooms, office buildings, and worker facilities, will be discharged to on-site sanitation leach fields designed to accommodate Project requirements.

Northcliff has conducted substantial test work to determine the metal leaching and acid rock drainage (ML/ARD) potential of all bedrock, surficial, and waste materials to be disturbed or created during all phases of the Project. This information has been used to plan for the safe storage of tailings and PAG materials in the TSF or the open pit, as described above. It has also been used to predict the quality of water being circulated within the Project, to design Project water treatment facilities, and to predict the quality of water that will be discharged from the Project or may seep from the TSF. This testing, predictive, and design work has been undertaken to ensure process efficiency and effectiveness, to confirm that discharged water will meet the water quality standards set by the Province, and to confirm that the quality of receiving waters will not jeopardize ecological or human health.

A conceptual water quality monitoring program is described in Section 4.5.3 of this document. It will be updated as new information is generated by further environmental, ML/ARD testing, water quality modelling and other studies, and will be formalized during Project approval and in the subsequent Project permit conditions. A follow-up monitoring program for the aquatic environment will be implemented to verify the ML/ARD and water quality predictions, to assess the effectiveness of planned water quality protection measures, and to identify the potential need for other such measures.

3.6.5 Waste Management

Waste generated by the Project will be handled according to best management practices and either discharged to the TSF for storage or contained for transport to approved off-site facilities.

Ore processing will generate both liquid and solid wastes. Water in the tailings slurries will be recycled through the TSF back to the process as described above. Underflow from the clarifier at the process plant will be pumped to the TSF for storage, and residues from the APT plant will be stored in separate, lined ponds within the TSF that will be progressively covered with water and tailings. A very small amount of solid precipitate from the APT plant will be stored in drums and transported to an approved off-site disposal facility.

Other solid wastes, such as general refuse, construction materials or metal debris will be collected separately for off-site recycling or disposal to approved facilities. There will be no on-site solid waste landfill.

Other liquid wastes (*e.g.*, surplus water discharge and effluents from washroom facilities) are discussed in Section 3.6.4, above.

Waste fuels and oils, contaminated materials, spent laboratory reagents, and other potentially hazardous products will be collected separately and temporarily stored on-site in secure, approved containers before being transported for off-site treatment and/or disposal to an approved facility.

4.0 CONCEPTUAL DECOMMISSIONING, RECLAMATION AND CLOSURE PLAN

During and following the end of Operations, a Decommissioning, Reclamation and Closure Plan will be implemented to remove or reclaim facilities not required beyond Project Operation and to restore the Site to a condition similar to what is present now prior to mine development. The initial, conceptual Plan described in this section is a living document that will become more comprehensive over time to reflect evolving Project design, the results of ongoing environmental and other studies, input from the Province and stakeholders, and environmental requirements at the time of Closure.

The Plan takes into account baseline conditions, the proposed end land use objectives for different Project facilities that will undergo reclamation, requirements for habitat compensation or mitigation, and best management practices for protecting the environment and human health.

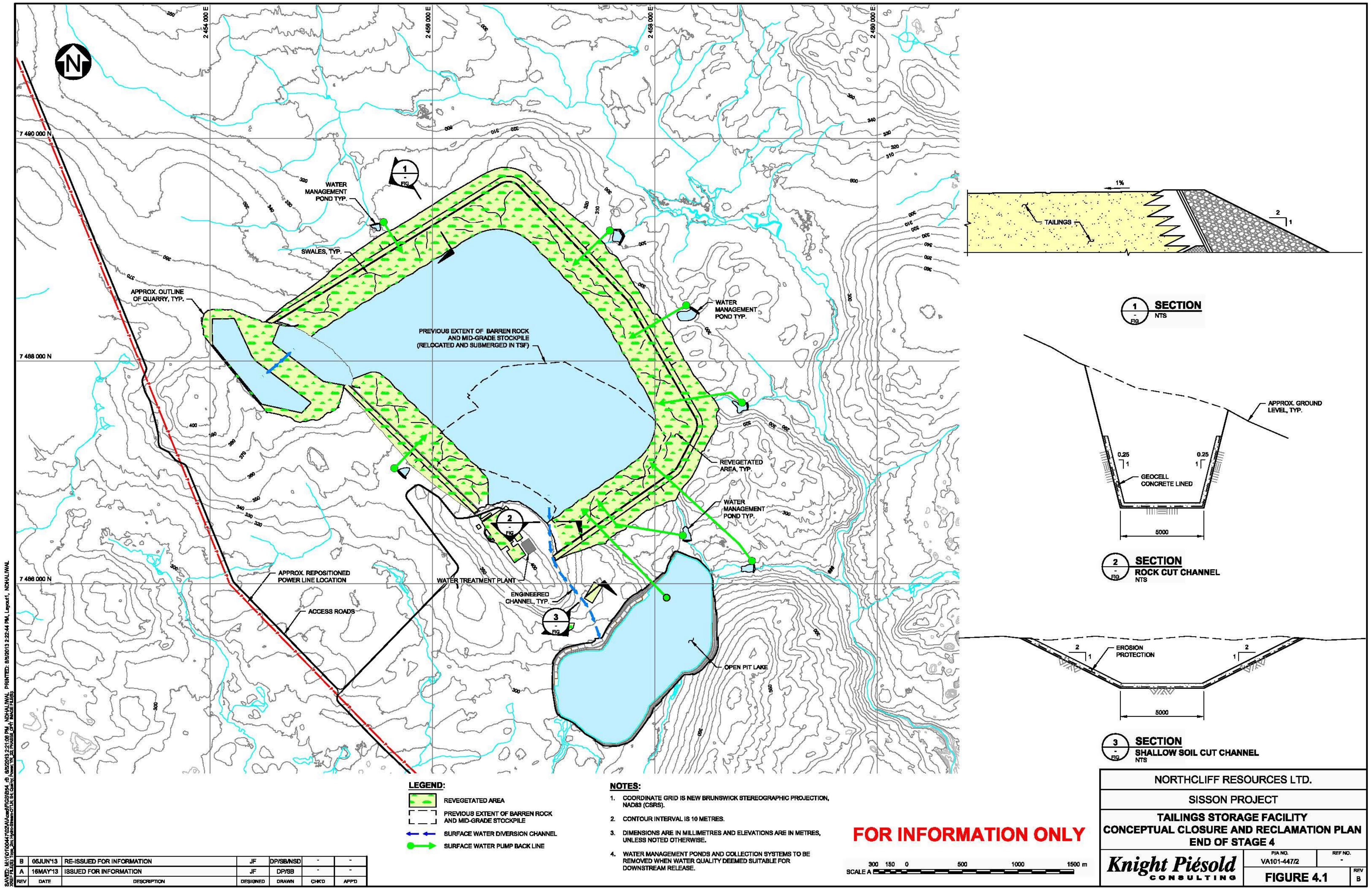
4.1 SITE DESCRIPTION AT CLOSURE

The Site will include the following elements at Closure.

- The open pit that will be flooded to create an aquatic feature.
- Permanent submersion of Barren Rock and Mid-Grade Ore within the TSF and at the bottom of the open pit.
- TSF embankments and beaches that will be undergoing re-vegetation with suitable species to provide forested, wetland, and open water habitats suitable for wildlife.
- Engineered channels connecting the quarry to the tailings pond and the tailings pond to the open pit, to manage the collection, treatment and discharge, as necessary, of on-Site water.
- Disturbed areas around the open pit, TSF, the former ore processing area, and most of the plant site that will be decommissioned and reclaimed to forested, wetland and shrub-riparian habitats primarily suitable for wildlife use with potential for traditional, recreational and commercial forestry use.
- Appropriate surface and groundwater drainages in and around the Site and the ongoing restoration of all surrounding watercourses to open water, shrub-riparian and aquatic habitats suitable for use by wildlife and fish.
- Site buildings, equipment, roads and power supply needed for care and maintenance of the Site after Operations cease.

These elements are shown in **Error! Reference source not found.**.

Figure 4.1 - Project facilities after Closure and reclamation



Source: Knight Piésold (2013a), with modifications (May 16 2013)

4.2 GENERAL STRATEGIES

The general strategies for decommissioning, reclamation and closure are to:

1. decommission and remove all buildings, equipment and infrastructure not required for future care and maintenance of the Site;
2. stabilize terrestrial and aquatic environments;
3. remediate disturbed areas using passive natural systems;
4. recreate a natural environment dominated by native vegetation;
5. restore aesthetics; and
6. restore land use potential and possibly create new opportunities.

In the short-term and conceptually, reclamation and closure will focus on-site restoration: establishing a stable growing medium to support pioneer vegetative species as soon as possible. Activities will include removing buildings, equipment and unneeded roads, preparing new landforms and covering them with overburden and soil, ensuring stable site drainage, and planting prepared areas with selected species. The new engineered channels to direct runoff from the quarry to the TSF, and from the TSF into the open pit to accelerate its filling, will also be constructed at this time.

Within about 20 years following this initial work, the open pit will be flooded and begin discharging water, treated as required to meet the Project's permit conditions. This begins the Post-Closure period and most reclamation will be complete. Some reclaimed sites will be nearing their target end land use objectives, and work will focus on rehabilitation: stabilizing and encouraging diverse ecosystems and capabilities that resemble those that were present prior to Project development. The main activities will be surveying reclamation success, spot-planting and reseeding where needed, water monitoring and treatment as necessary to protect the integrity of water resources, and Site monitoring and maintenance.

4.2.1 End Land Use Objectives

The specific reclamation undertaken for each Project facility will be defined by the tasks needed to achieve the desired end land use objective for that facility. End land use objectives are proposed in this conceptual Plan, but will be refined in consultation with the Province and stakeholders.

In general, wildlife habitat is a dominant element in all proposed end land use objectives because wildlife use is the primary and underlying component of all current uses in the Project area. Wildlife will also respond most quickly to reclamation efforts. The full recovery of other land use opportunities, such as recreational fishing or commercial forestry, cannot be expected in the short term and may never be possible (*e.g.*, due to safety concerns over access to and use of the pit lake). Over time, however, it is expected that most of the Project Site and its former uses will be restored to many of the natural conditions that existed pre-development.

4.2.2 Capability goals

Capability is the capacity of a landscape unit to support a specified vegetation community and is measured by species diversity, density, survival and growth rates, annual biomass production units, percent vegetative cover, and other factors. The higher these measures are, the higher the capability.

Capability goals and monitoring will be used to measure how well reclamation achieves the end land use objective for each reclaimed facility. Goals are typically determined from baseline conditions and early reclamation research. Monitoring typically consists of surveys of reclaimed areas at regular intervals.

Little capability information has been reported for landscapes around the Sisson Project, presumably because the baseline work to date has focused on identifying species composition and rarity in the landscape rather than the capability of the landscape to support species. Therefore, capability goals for each Project facility will need to be established in the process of moving from a conceptual to a final Plan.

Capability surveys typically begin three to five years after a site has been first seeded or planted, and occur at regular intervals thereafter. As capability goals are approached, monitoring intensity may increase over several consecutive years. Once capability goals have been reached, the Project facility will be considered successfully reclaimed to its end land use objective and will be considered sustainable.

4.2.3 Reclamation Research

At Closure, much of the Project site condition will be similar to typical disturbed sites including the presence of scarified surfaces with poor fertility, high amounts of stones and cobbles at surface, and high spatial variability in drainage, moisture retention and moisture availability. Many of these typical conditions will be relatively easy to manage because of common experience in working with them elsewhere in the region.

Other conditions may be more difficult to manage. TSF beach sediments will be infertile, droughty, and prone to wind erosion when dry. The TSF embankments will be a sloped surface of quarried rock and the pit environment will have steep, benched terrain; both will have little or no loose surficial material. These conditions may be challenging to reclaim and reclamation research will be undertaken to develop site-specific strategies.

On-site reclamation research will begin during the active mining period and continue into Closure. Findings will guide operational reclamation, identify/revise approaches for mitigating potential impacts, and provide a sound basis for site-specific reclamation planning. Research studies may include assessing different site preparation and planting techniques, identifying appropriate species composition, assessing the need for or rates of fertilizer applications, and monitoring species health and survival.

4.2.4 General Plan for Managing Surficial Materials

The general plan for managing surficial materials begins with evaluating the type, quality and quantity of materials, followed by using appropriate practices for salvage, storage, and replacement according to a schedule consistent with mine construction, operations and closure.

In general and whenever feasible, high quality surficial materials (such as the Category 1 soils described in Section 2.5.1) will be used to reclaim more demanding areas such as TSF beaches and embankments. Less critical areas will be treated with less productive materials.

4.2.4.1 Salvage Strategy

To prepare for salvage, all working areas of the PDA as they come into production will be cleared of the vegetative cover. Following clearing, surficial materials will be salvaged only from the footprint of the TSF embankments, the footprint of the open pit and quarry, from the ore processing area, and from the location of access roads, WMPs, or other small operational areas that require a solid, safe geotechnical base.

As much as possible, Category 1 and 2 materials will be salvaged separately and in two lifts.

The first lift will consist of the top 1.5 m of surficial material. Due to the limited amount of organic material available and its poor viability on its own for reclamation, organic materials will be salvaged together with the underlying mineral soil in this lift.

Organic materials include humus, roots, litter and coarse woody debris (branches, logs, stumps and logging slash). These materials will contain the bank of native seeds that will tolerate the range of conditions at the location from which the material was salvaged, will contribute organic matter and nutrients over the long-term, and minimize the risk of erosion once re-applied to reclaimed areas. Given suitable moisture and temperature conditions, coarse woody debris will also provide valuable substrate for soil fungi and other microorganisms, and habitat for insects, amphibians, reptiles and small mammals.

The second lift will consist of the overburden that underlies the soil materials. The depth and volume of overburden salvaged will depend on the location from which it is salvaged (*i.e.*, all overburden in the open pit footprint will be salvaged to bedrock, but under the TSF embankments the salvage depth will vary depending on when a suitable base is encountered as defined by the Geotechnical Engineer).

Salvaging activities will be scheduled as much as possible with consideration to moisture conditions. All materials, particularly the Category 1 materials, will be handled only when they are dry or stable enough to avoid compaction and structural degradation. Based on climate information for the Project, it is likely this will be most feasible from August through October or in the early winter months when soils are partially frozen.

All stripped surficial materials will be preserved in stockpiles located around the Project Site. As much as possible, stockpiles will be separated according to category and lift, placed on stripped, prepared surfaces close to where they were salvaged. Stockpiles will be located to avoid water courses, to prevent losses or impact to the surrounding landscape, and so as to minimize the need for moving materials before they are needed for reclamation.

Sediment and erosion control measures will be implemented to manage runoff from all stockpiles. All stockpiles will be seeded before late summer to ensure a stable, vegetative cover before the on-set of winter.

4.2.4.2 Replacement Strategy

Salvaged materials will be reserved for use on the beaches and embankments in the TSF and on difficult to reclaim areas on the former plant site and access roads. Volume estimates have been calculated to determine the amount of materials available for each area. Currently, it is estimated that there will be enough surficial material salvaged to provide an approximately 25 cm-deep surface cap on all these sites, on average. Further engineering field studies will help to more accurately estimate the amount of this material available, and the quantities will be confirmed during Project construction. Once the quantities are confirmed, a more detailed replacement strategy will be developed that takes into account the needs for different purposes. If quantities are limited, it may be necessary to be more selective about which areas are revegetated; for example, the TSF embankment slopes could be terraced, and only the flat terrace surfaces would receive a capping of surficial material.

Prior to replacement, sites to receive salvaged materials may be prepared by ripping the surface with blades on bulldozers and road graders, or with excavators equipped with toothed buckets. Extra care may be needed on sloping surfaces prone to erosion. Nearly flat sites may be gently re-contoured to provide surface water interception and diversion features. Graded and ripped sites may then be crown-chained to remove excessive amounts of boulders or other coarse debris.

Surficial materials will be returned to prepared sites at depths, of necessary quality, and using techniques specific to each facility as described in Section 4.3.

Clear records will be maintained showing the types and volumes of salvaged materials, and when and where they were stockpiled and replaced each year of Operations and Closure.

4.2.5 General Plan for Re-Vegetation

The general plan for re-vegetation will be to develop self-sustaining, diverse vegetation communities that emphasize locally-occurring native species.

The first task will be to establish a vegetative cover as soon as possible to increase organic matter and to reduce the risk of wind and water erosion. This may be achieved by introducing pioneering species, dominated by diverse graminoids and forbs, seeding with quickly-emerging mulch crops, adding fibre-based materials or takifiers in hydroseed mixes, or using flexible growth mediums (*e.g.* Flexterra® Flexible Growth Medium) impregnated with seed blends appropriate for the conditions.

Hydroseed mixes will include species that are tolerant of drought and infertile conditions, with an emphasis on quickly emerging and native species. Rye grasses (such as annual ryegrass [*Lolium multiflorum*] or fall rye [S*ecale cereale*]), native legumes such as birdsfoot trefoil (*Lotus corniculatus*), sweet clover (*Melilotus officinalis)* or white sweet clover (*Melilotus alba*), and creeping red fescue (*Festuca rubra*) and colonial bentgrass (*Agrostis palustris*) are species well suited to quickly anchor the soil, provide some nutrient and prevent erosion until the native seed bank is able to re-establish through natural colonization. Some of these species may not be appropriate to wetter areas, but wetter areas can be expected to naturally re-vegetate to full cover within three years.

In difficult to reclaim areas (*i.e.*, those with pH or fertility challenges, or extreme and/or fluctuating moisture conditions), early work will focus on encouraging native species with tolerance to site-specific limitations. The seed bank present in the soil lift that may be applied as final cover on some sites will be a good source of species adapted to these kinds of conditions.

On sloped terrain susceptible to erosion, it will be prudent to quickly establish woody shrub cover. Where seepage or other adequate moisture is available, long willow stakes may be planted for this purpose in shrub-riparian habitats. Similarly, sweet fern (*Comptonia peregrina*) may be appropriate for drier areas of forested habitats.

In more easily reclaimed areas (*e.g.*, the plant site area between and around the TSF and the pit, and at the base of the TSF embankments), early pioneering and hardy shrub species such as grey birch (*Betula populifolia*), pin cherry (*Prunus Pennsylvania*), and possibly trembling aspen will quickly re-establish at densities that may even exceed capability goals for the desired end land use objective.

Over time, re-vegetation efforts will focus on increasing diversity and achieving capability goals, such as for commercial forestry or wildlife and aquatic habitat uses. Work may include removing competition by non-commercial shrubs and trees, planting commercial tree species on suitable microsites, or periodically repairing riparian areas around the periphery of the Project Site that may have been damaged by seasonal flooding or beaver activity.

The research trials and monitoring programs will be valuable in determining if maintenance is required, such as brushing or thinning, or reseeding and hand-planting with selected species that are found to thrive under specific conditions. Monitoring may also be required to periodically assess the presence and distribution of invasive species so that problematic populations can be responded to before they become well-established.

4.2.6 General Plan for Water Management

As described in Section 3.6.4, the general plan for water management during Operations is to divert non-contact surface water away from the Site into natural drainages, and to collect all contact water in the TSF for recycling back to the process. Contact water in excess of Project water demand will be treated as necessary to meet water quality discharge criteria that will be specified in the Project's permit(s), and released.

At the end of Operations and through Closure, the non-contact surface water diversion strategy will be maintained. Contact water will no longer be required for process use at the Project. The WMPs around the TSF will be maintained to collect embankment runoff and seepage, and to pump collected water to the TSF (**Error! eference source not found.**) unless its quality allows its discharge into downstream drainages. Engineered channels will be established between the quarry, the TSF, and the open pit, to direct TSF runoff to the pit and accelerate its filling with water. The open pit will be allowed to fill to an elevation that maintains it as a groundwater sink, thus ensuring that groundwater in the area only flows towards the pit. It will take about 10 years to fill the open pit to this elevation (Knight Piésold 2013b) and until it does, surface contact water will not be discharged from the Site (with the possible exception of water from the WMPs, as above). Filling of the open pit to this elevation will mark the end of the Closure period.

Post-Closure, the elevation of the pit lake will be maintained by pumping the lake water to the water treatment facility, and treating it as necessary prior to discharge. All water that needs to be discharged will be treated for as long as is necessary to meet the Project's permit conditions for discharge water quality. It is expected that the water treatment facility used during Operations will be re-mobilized for this purpose, although it may need to be refurbished and/or reconfigured to suit Post-Closure water treatment requirements. When the pit lake water is of sufficient quality to allow its discharge into downstream drainages, pumping and treatment will cease, the pit will be allowed to fill completely, and the pit lake will discharge to Sisson Brook through an engineered channel.

During Closure and Post-Closure, all on-site and down-gradient water management features that are no longer needed will be reclaimed as open water features, wetlands and/or other appropriate end land uses.

Best management practices for controlling runoff, erosion and sediment transport will be implemented at all times during all phases of the Project. These will include establishing appropriate site grades, applying mulches and hydroseed mixes to stabilize exposed surfaces, and establishing a network of straw barriers, silt fences, ditches, and/or WMPs down-gradient of all Site facilities to manage on-site surface water runoff and transported sediment. Any sediment trapped by ditches and WMPs will be collected periodically as part of regular maintenance of these structures.

4.3 SPECIFIC STRATEGIES FOR SITE STABILIZATION AND RECLAMATION OF PROJECT FACILITIES

Specific strategies for stabilizing the Site and reclaiming each Project facility at Closure are described in this section, beginning with infrastructure removal and decommissioning, and then organized according to facility.

4.3.1 Infrastructure removal

At Closure, most of the Site infrastructure will be decommissioned and removed.

4.3.1.1 Buildings and Equipment

Plant site buildings and equipment no longer required at Closure include the primary crusher, grinding/milling circuit and concentrator, APT plant, SME facility, conveyors, warehouse, truck service bays, the laboratory, and the vehicle-fueling stations. The administration office and its freshwater supply and sanitation system, the Site water management and treatment systems, and one or two small buildings for housing equipment or supplies will be retained until no longer needed. All of the removable assets, which include everything except the buildings, will be disposed of prior to or concurrent with their dismantling. Following removal of the assets, most buildings will be either dismantled for re-use at another site or cut into pieces and sold or recycled as steel scrap.

Foundations will be broken or blasted down to or below ground level, and then backfilled to create natural-looking landforms. Broken concrete will be buried on-site. Other non-salvageable construction materials (*e.g.*, sheet metal, insulation, or roofing material) will be disposed of to an approved off-site facility.

4.3.1.2 Access Roads and Utility Corridors

All access roads, power supplies, sanitation infrastructure, freshwater supplies, water management structures, and other utilities will be decommissioned unless required for care and maintenance of the Site during Closure and Post-Closure.

All on-site power supplies and utility poles no longer needed will be decommissioned and removed from the Site to approved off-site facilities.

The main electrical transmission line supplying power to the Site will be retained until the Site is fully reclaimed, capability goals for each end land use objective have been achieved, and water resources have been restored to sustainable quality and levels. At this point, this line may also be decommissioned and reclaimed. It will have been installed and will remain the property of New Brunswick Power Transmission. That agency will be responsible for planning and executing any decommissioning and subsequent reclamation activities on all aspects of the electrical transmission line.

Sanitation infrastructure and freshwater supplies not required Post-Closure will be decommissioned. Above ground structures, pumps, and pipes will be removed, sold or recycled to an approved off-site facility. All below ground structures will remain in place and be reclaimed as part of the plant site reclamation described in Section 4.3.2.

4.3.1.3 Chemicals, Waste Products and Potentially Hazardous Materials

Chemicals, waste products, and potentially hazardous materials used or generated on the Project Site are described by Samuel Engineering (2013). In general, this Plan assumes that all these materials will be consumed, recycled, or relocated off-site before the property is placed into closure/reclamation status.

Inventories of chemicals used in ore processing and in the laboratory will be minimized as the end of mine life approaches. Unused process reagents will be returned to the suppliers. Anticipated small quantities of chemicals remaining in the laboratory will be offered to other users, such as contract laboratories or educational facilities. Chemicals that cannot be returned or distributed will be sent to an approved waste disposal facility.

Any hazardous wastes (*e.g.*, waste oil, oil filters and grease, spent fuels, explosive agents, remaining product, or chemicals) and related storage containers remaining after Operations will be returned to suppliers or sent to off-site disposal and/or recycling at approved facilities.

Other wastes, such as refuse and recyclable materials will be collected for off-site disposal or recycling.

During the decommissioning work, an investigation will be conducted to determine the presence, if any, of contamination from accidental spills and long-term use of hazardous materials. Any incidents identified will be remediated according to practices approved and signed off by the New Brunswick Department of Environment.

4.3.2 Plant Site

After the building, equipment, and foundation teardown are complete, there will be no visible features remaining on the plant site other than bare ground and the infrastructure required for Closure and Post-Closure care and maintenance. The area will be generally level at the crown of the hill on which the plant site was located and will grade to < 20% slopes where the area merges with adjacent undisturbed lands. The area to be reclaimed will comprise approximately 80 ha.

4.3.2.1 End land use objective

Given the landscape position and the relatively small amount of disturbance following Closure, the plant site will be suitable for planting to a combination of upland or wetland forest, and/or shrub-riparian habitat depending on landscape position and the presence of reclaimed water management structures and watercourses. Several end land uses are possible under these habitats, including wildlife, traditional, recreational, and possibly commercial forestry use.

4.3.2.2 Site preparation

The area will be scarified and ripped to a depth of 50 cm, crown-chained to move large coarse debris near to or into swales and other drainage features, and smoothed as needed. Slopes will be graded to merge naturally into adjacent undisturbed areas. Grading may include decommissioning ditches and other water management structures that are no longer needed, or enhancing them to provide natural swales for channelling surface water into nearby watercourses.

Former building sites, foundations and laydown areas will be capped with overburden to an approximate depth of 25 cm. Overburden and top soil will not likely be applied to the remainder of the area, since re-vegetation is not expected to be challenging.

4.3.2.3 Re-vegetation

Following site preparation, the area will be re-vegetated according to the end land use objectives for upland and wetland forests and shrub-riparian habitats. Since little soil will have been applied to the area, there will be little native seed bank present, so the area will be hydroseeded to help accelerate the establishment of a vegetative cover.

Once a vegetative cover has been established and the area is stable, native shrubs and trees such as speckled alder (*Alnus incana*), grey birch, trembling aspen and pin cherry will quickly invade within two decades. To enhance the area for possible future commercial forestry use, spot planting of black spruce, balsam fir, hardwoods, or other locally-occurring commercial tree species may be appropriate on sites where adequate moisture and mineral soil is present.

4.3.3 Access Roads and Utility Corridors

Access roads and utility corridors will have been relocated, decommissioned or even newly-established in response to changing Project requirements over the life of the mine. Thus, at the end of Operations, they will have an unknown aerial extent and consist of a variety of ages, configurations and conditions. If no longer required, they will be decommissioned and reclaimed to an end land use objective consistent with that on adjacent lands.

The main road access to the Site will be maintained after Closure. Other roads that may remain open include roads leading to the rims of the pit lake and quarry, to the top and bottom of the TSF embankments, and to the WMPs. They will be needed to access water monitoring stations, conduct geotechnical and reclamation inspections, and for maintenance. Roads that are only used for monitoring or inspections may be maintained for ATV access only.

Road beds will be decommissioned by removing all non-native road bed materials (*e.g.*, steel grates, asphalt, or concrete). Culverts, fencing and gates, if present, will be left in place only if needed to maintain the long-term stability or security of a location.

Decommissioned road beds will be prepared by ripping to a depth of approximately 50 cm to reduce compaction and provide suitable conditions for re-vegetation. Surficial materials will not be applied, except in areas where the bed materials are determined to be in appropriate for supporting vegetative growth. In that case, overburden will be applied to an approximate depth of 25 cm. Soil will not be applied to decommissioned road beds because re-vegetation is not expected to be challenging.

All other site preparation and re-vegetation work on roads will be the same as described for the plant site, above. The goal will be to establish a vegetative cover that closely resembles adjacent areas.

4.3.4 Open Pit

After the ore body has been mined out, the open pit will consist of exposed rock at the pit rim and on walls, benches and access roads, some ponded water, an outer network of water diversion and collection structures, and a narrow area surrounding the pit that may have been disturbed during construction and operation. It will cover an area of approximately 145 ha and range between 200 and 300 m deep (Samuel Engineering 2013). The ultimate base elevation of the bottom of the pit will be approximately 40 masl in the northeastern end. In the southwestern end, it will be between 90 masl and 170 masl, varying because of the presence of mined but non-economic rock that will have been placed there during the latter stages of Operations.

It will not be possible to reclaim the open pit other than as an open-water feature once the pit lake has been established with an acceptable water quality at Post-Closure. Bare rock faces and benches that may remain exposed above the pit lake will likely be subject to wide temporal and spatial variability in moisture availability, depending on runoff from surrounding slopes, seepages from surrounding pit walls, and seasonal changes. Reclaiming these areas will be difficult not only due to the challenging terrain, but also because of safety concerns. Finally, major earth-moving or other significant reclamation treatment in the narrow, disturbed area surrounding the pit is not recommended, in order to protect adjacent undisturbed lands and watercourses. As such, the open pit will not be reclaimed other than to allow it to fill with water and to monitor and treat water quality, as required.

4.3.4.1 End Land Use Objective

Because reclamation is not practical or even possible, Northcliff does not plan to develop habitats in the open pit. The pit lake will not likely be suitable fish habitat. The main end land use objectives for the open pit will thus be open water feature with some use by wildlife such as terrestrial birds, waterfowl, amphibians, reptiles, and small mammals. Large mammals will be excluded from the pit rim by security fencing.

4.3.4.2 Site Preparation

At Closure, the open pit will be allowed to fill with water as described in Section 4.2.6, above. The rim of the open pit cannot be safely re-contoured, crown-chained, or capped with salvaged surficial materials because of access and safety concerns. It will likely remain exposed rock outcrop. No preparation is planned for exposed rock walls, benches and roadways inside the pit. No preparation is proposed for submerged terraces or for the area immediately around the outside of the pit rim.

4.3.4.3 Re-vegetation

The pit lake will not need to be re-vegetated. The focus for reclamation will therefore be to encourage natural re-vegetation, with limited intervention. In the shallow water on rocky benches at the edges of the pit lake, some aquatic plants such as bulrush (*Scirpus spp.*) or cattail (*Typha spp.*) may be seen in the first few years, but vegetation population and diversity will likely remain low within the flooded portion for some time. Over time, sedges and pioneering species such as poverty oatgrass (*Danthonia spicata*), common mullein (*Verbascum thapsus*), or downy goldenrod (*Solidago puberula*) will introduce. In the longer term, shrub species such as leatherleaf (*Chamaedaphne calyculata*), speckled alder, mountain holly (*Ilex mucronata*), rhodora (*Rhododendron canadense*) sweet gale (*Myrica gale*) and willows may begin to appear. Over time, some natural habitats will emerge, such as rock outcrop on the pit rim and walls, possibly wetland habitat on shallow, submerged rock terraces, and upland forest in areas surrounding the pit.

4.3.5 Barren Rock and Mid-Grade Ore Storage

At Closure, the Barren Rock and Mid-Grade Ore storage areas inside the TSF footprint will be submerged beneath a minimum of seven meters of tailings and/or water. Any Barren Rock or Mid-Grade Ore left in the open pit near the end of mine life will be flooded under a minimum of 130 m of water, and no PAG materials will be left exposed after Closure. There are no end land use objectives, site preparation or re-vegetation procedures for these storage areas, other than as described in the reclamation of the TSF and the open pit.

4.3.6 Rock Quarry

As with the Barren Rock and Mid-Grade Ore storage areas, the majority of the quarry will be submerged beneath the TSF; the exceptions are the exposed walls and benches of the Phase 3 ridge and Phase 4 sink cut on the west side. At Closure, a channel will be cut to connect the Phase 4 cut sink with the TSF, and it will be allowed to naturally fill with precipitation and runoff until the quarry lake connects with the tailings pond. There may also be a narrow fringe of land on the outer edges of the quarry that may have been disturbed during construction.

The total estimated area of the quarry and surrounding disturbed areas at Closure is about 120 ha, of which a large part will be an aquatic feature connected to the tailings pond.

4.3.6.1 End Land Use Objective

Reclamation options for the quarry will be challenging for the same reasons as for the open pit. Possible habitats include a combination of rock outcrop on the quarry rim, walls and benches that remain exposed above the pond, some wetland habitat on shallow submerged rock terraces, and upland forest on drier sites in adjacent disturbed lands. Aquatic habitat for fish is likely not possible.

Most of these habitats, except for the pond, will be small and discontinuous, so the main end land use objective for the quarry will likely be for wildlife use only, including terrestrial birds, waterfowl, amphibians, reptiles and small mammals.

4.3.6.2 Preparation

As with the open pit, the preparation for the quarry will depend on safety, stability, access, and habitat concerns. The quarry rim will likely remain exposed rock outcrop. Shallow submerged terraces will not be reclaimed, but encouraged to regenerate naturally.

All remaining areas will be prepared as for similar areas in the open pit and plant sites.

4.3.6.3 Re-vegetation

Re-vegetation methods and species composition for all other quarry areas will be the same as described for similar areas at the open pit and plant sites. The rate of establishment will likely be slow and dominated by patches of bulrush and cattail growing in seepage zones or wet areas where water pools.

4.3.7 Tailings Storage Facility

The final configuration of the TSF at Closure will consist of a tailings pond bounded by tailings beaches and an outer perimeter of TSF embankments on three sides, a saddle embankment on the fourth side between the flooded rock quarry and the small hill on which the plant site was located, the outer network of water management structures, stockpiles of surficial materials to be used in reclamation, and roads to allow access. The TSF footprint, including the tailings pond, beaches, embankments and all surrounding infrastructure, will be occupy approximately 750 ha.

4.3.7.1 End Land Use Objective

Final habitats and end land use objectives for the TSF footprint will vary considerably, because of high variability posed by different features: aspect, slope angle and position, moisture regime, and the presence/absence of applied surficial materials. Reclamation will thus result in a combination of both terrestrial and aquatic features that will provide for a diverse wildlife habitat.

The following habitats and uses are anticipated.

- The open water of the tailings pond will be an aquatic feature, used for resting and escape terrain by waterfowl.
- The beaches adjacent to the open water will be flat to gently sloping shorelines, reclaimed as shrub-riparian or open water wetland to provide forage, cover, and nesting habitat for water fowl and shorebirds.
- The top of the TSF embankment will be maintained as an access road.
- The downstream slopes of the TSF embankments may be reclaimed to grassland and forest cover of varying composition depending on aspect and moisture regime.

Although reclamation will focus on forested habitats, the end land use objective will remain primarily wildlife use by mammals, birds, reptiles, amphibians and insects. Commercial forestry use will be discouraged because the TSF is an engineered facility unsuited to logging activity. Over the long term, some of the reclaimed footprint may become suitable for traditional or recreational end land uses.

4.3.7.2 Site Preparation

No preparation is required for the tailings pond, other than to cut the channel connecting it to the Phase 4 cut sink in the quarry, and to engineer the channel that will deliver excess water from the tailings pond to the open pit. The level of the tailings pond will be managed into Post-Closure until end land use objectives are reached, to reduce the potential for dust generation, and to ensure that sufficient storage exists for storm inflows.

The TSF beaches will be composed of tailings sand with a loose structure, low fertility, and subject to wind erosion; highly variable moisture conditions due to a fluctuating water table; and a poor base for vehicles used in reclamation. Therefore, approximately 60 cm of cobble-size quarry rock will be placed on the beach surfaces. The applied rock will be incorporated and compacted into the underlying sand by the haul trucks and/or dozers to provide a cover against wind erosion, a trafficable base for vehicles, and to reduce water infiltration rates. It is expected that the final substrate will closely mimic the cobbly, sandy native parent materials found throughout much of the Site prior to Project development. Shallow swales, protected with exposed quarry rock, will be constructed at intervals across the prepared beaches to capture and direct surface water to the tailings pond (**Error! Reference source not found.**).

A 25 cm lift of Category 1 soil will be applied to the entire prepared surface from the inner embankment wall to as close as possible to the edge of the tailings pond. Soil will not be applied to the swales. If necessary, the surface may be lightly scarified to loosen the structure and mix the soil lift into the underlying base.

Preparation of the TSF embankments for reclamation will begin during construction of the final embankment lift so that the appropriate sizes of quarried materials and desirable features on the embankment surfaces (*e.g.* terraces or swales) are established according to the final Plan. In general, the downstream slopes of the embankments will be composed of compacted quarried rock resting at an angle of about 26^{o}, capped with a 25 cm lift of overburden and/or soil (Figure 3.2 - Typical TSF embankment detail).

All materials for preparation will be sourced from the quarry and from stockpiles located near the quarry and along the base of the TSF.

4.3.7.3 Re-vegetation

Cattail and bulrushes are tolerant of the wide range of conditions which will likely prevail on the margins of the tailings pond, so are expected to proliferate in the littoral zone and disburse well through seed production and rhizomes. Through this natural process, this area of the TSF will likely develop as a Group 2 open water wetland habitat.

The prepared tailings beaches will have conditions conducive to the growth of mosses, sedges, rushes (*Juncus spp*.) and other species tolerant of sandy soil textures, basic soil pH, and a fluctuating water table. Their natural invasion will be augmented with seed blends containing cattail, bulrush, rushes, grasses and legumes, and by the use of mulches and fertilizers.

Once an acceptable ground cover is established, tailings beaches will be considered stable enough to plant shrubs and small trees to develop a shrub-riparian habitat. Shrub species may include willows, winterberry (*Ilex verticillata*), thinleaf alder (*Alnus incana subsp. tenuifolia*), Saskatoon (*Amelanchier alnifolia*), bearberry (*Arctostaphylos uva-ursi*), raspberry (*Rubus idaeus*), snowberry (*Gaultheria hispidula*), or rose species (*Rosa spp.*).

Wherever possible as determined in the final Plan, the tailings embankment will be re-vegetated to upland and wetland forests depending on slope and aspect. Upper and southwest-facing slopes of the embankments will be subject to summer drought, so may be reclaimed to an upland forest habitat such as Group 2 intolerant hardwood habitat. The lower and northeast-facing slopes may be wetter, so may be reclaimed to Group 1 spruce-balsam fir or rich softwood habitats. Natural invasion by native species will be encouraged, enhanced with hydroseeding with native grasses and legumes, and hand-planting with trees and shrubs. Species selection will resemble those in Group 2 upland forested habitats and Group 1 wetland forested habitats.

Some areas of exposed rock on the embankments may remain after the initial reseeding work. They will be left as exposed rock outcrop habitat. If micro-sites are available, they may be hand-planted with appropriate trees and shrubs.

4.3.8 Watercourse Reclamation

As discussed in Section 2.5.3, portions of Sisson Brook and Bird Brook, a tributary to West Branch Napadogan Brook, and perhaps some small headwater streams to McBean Brook will or may be affected by Project development. The loss of these aquatic habitats will be compensated for according to a plan that must be approved by the Department of Fisheries and Oceans under the *Fisheries Act* before the Project can be authorized.

Other aquatic habitat compensation is incorporated into this Plan. For example, engineered drainage ditches as described in this Plan will be constructed to intercept and redirect non-contact, clean water to nearby watercourses, thus maintaining as much flow as possible to these drainages during Operations. After Closure, the ditches will remain or be re-configured for potential long-term use as productive aquatic habitat.

Other water management structures that require closure and reclamation include road culverts, WMPs around all Project facilities, groundwater monitoring and pump-back wells down-gradient of the TSF embankment, and the engineered channels between the quarry and the TSF, between the TSF and the open pit, and as the eventual outlet of the pit lake.

Many of these structures will be decommissioned and reclaimed as part of the reclamation of nearby Project facilities. Others, like some of the ditches and WMPs, the engineered channels, the groundwater and pump-back wells, and/or the water treatment facility will remain at the completion of Operations. They will be used to manage surface water runoff and monitor Site stability, and to ensure discharge water quality is suitable for release to watercourses.

4.3.8.1 End land use objectives

Water management structures will be reclaimed to a combination of aquatic, wetland, and shrub-riparian habitats, depending on the type, size and location of the structure. For example, ditches, channels and other conduits may be reclaimed as watercourses with shrub-riparian habitat discharging to low-lying areas in receiving locations which may be reclaimed as mesotrophic forested wetland habitat. When no longer needed, WMPs may be reclaimed as open shallow-water aquatic habitat surrounded by shrub-riparian or fen-like habitats.

The engineered channels connecting the quarry, tailings pond, pit lake, and Sisson Brook will not be actively reclaimed, but may naturally regenerate as a combination of rock outcrop and shrub-riparian habitats.

The end land use objectives for most of these habitats will be primarily for aquatic and wildlife use. End land use for commercial forestry will be discouraged along watercourses. Some traditional and recreational land use may be possible once the Site is fully reclaimed and stable.

4.3.8.2 Site preparation

All water management equipment not needed for long-term maintenance or monitoring, such as pipes, pumps, pump houses and well infrastructure, will be removed. Culverts under access roads that are no longer required will be removed to eliminate the risk of obstructions and deterioration. Decommissioned road surfaces will be re-contoured and ripped to allow the passage of surface water and to provide a suitable planting media.

The final Plan will provide more detail on how aquatic, wetland, and shrub-riparian habitats will be recreated. In general, it is expected that berms around drainage ditches and sediment retention ponds will be broken down and stream channels will be constructed in all depressions as permanent, replacement watercourses. Gradual inlets and outlets will be excavated for the WMPs, possibly reinforced with stones, cobbles and woody debris and at a gradient to allow the passage of fish. The larger ponds will remain as open water features, so will not require further preparation after Closure.

Overburden and soil will not be applied to reclaimed watercourses because sediment deposition will occur naturally, and the associated terrestrial environments will be easy to re-vegetate because moisture will be readily available. Hydroseeding with fibre-based mulches, the use of fibre mats, and rip-rap reinforcement may be required to stabilize prepared surfaces and reduce the risk of erosion by seasonal flooding in watercourses.

Undisturbed watercourses downstream of the reclaimed structures will be monitored and maintained to ensure they maintain their original configuration as surface water flows return to pre-development rates.

Roads and equipment needed to maintain the Closure and Post-Closure water management and monitoring system will remain until the Site is fully stable and monitoring indicates water quality meets the Project's permit conditions for discharge. At that time, all remaining infrastructure will be decommissioned and reclaimed.

4.3.8.3 Re-vegetation

The final Plan will also describe detailed methods for re-vegetation of watercourses. In general, methods will include a combination of hydroseeding with native species, the use of seeded fibre mats such as Flexterra®, and hand-planting black spruce, alder, hybrid birch and willow in suitable micro-sites. There will be a strong emphasis on techniques that encourage natural colonization of native species from nearby, undisturbed lands. For example, brushing and weeding may be required to remove vigorous, unwanted species to allow room for those that are more difficult or slow to return.

4.4 SITE SAFETY AND SECURITY

Because the open pit and quarry at Closure will remain as open water features with abrupt, steep, and sometimes unstable edges, they will present potential safety issues and liabilities. They thus warrant exclusion of both people and terrestrial wildlife, and will be fenced around the edges to prevent access. No other continuous fencing is planned.

Much of the remaining area will be accessible (particularly during the winter), so fencing, berms, rock barriers, or warning signs discouraging public access may be employed in target areas to prevent accidents and minimize exposure to potentially harmful conditions. Warning signs will be posted at regular intervals along fenced areas and along the base of the TSF, on posts of sufficient height so the signs will be visible during winter conditions.

The main access to the Site and the on-site access roads to the open pit and quarry will be restricted with locked gates. Locked gates will be accessible to mine personnel and contractors only. All buildings will be secured.

On-site roads required for Closure and Post-Closure maintenance will not be secured. Those required for water quality monitoring or vegetation surveys will be partially decommissioned with water bars and berms to discourage all traffic use, except by ATV or snow machines. All other on-site roads no longer required will be permanently decommissioned as described in Section 4.3.3.

4.5 CLOSURE AND POST-CLOSURE MONITORING AND MAINTENANCE

Certain aspects of the Plan will require ongoing commitment beyond the initial closure and active reclamation period. This generally includes engineering support, reclamation and water quality monitoring, and site maintenance.

Specific activities for the Site will include:

- maintenance of electrical infrastructure to ensure available power for needed Site equipment;
- maintenance of geotechnical instrumentation for long-term monitoring of the stability of the TSF;
- operation of the water treatment facility, as needed, to treat all surplus Site water for discharge to ensure it will meet the Project's permit conditions for discharge water quality;
- upkeep of water management infrastructure as needed, including ditches, engineered channels, WMPs, and groundwater monitoring and pump-back wells, to monitor, capture and pump runoff and seepage, if any, back to the TSF;
- water quality monitoring around the Site to support the effective collection and treatment of water, as required, before discharge to nearby watercourses; and
- upkeep of Site roads and buildings that are kept active to support ongoing inspection, monitoring, and maintenance.

4.5.1 Geotechnical monitoring

Northcliff will be required to regularly inspect and report on the geotechnical stability of all Project facilities after Closure. Piezometers, inclinometers, and/or movement monuments will have been installed for this purpose within the TSF embankments and foundations. Inspections and reporting will continue during the Closure period, including ongoing evaluations of instrumentation records and seepage flow rates and volumes, and may be required during Post-Closure to confirm the continued stability of the embankments.

4.5.2 Reclamation monitoring

Reclamation monitoring of all reclaimed areas will continue after the active reclamation period.

Each re-vegetated, reclaimed area will be monitored approximately five years after final planting to assess re-vegetation success. As vegetative cover approaches the capability goals established for the specified end land use objective(s) for the area, sites will be monitored more frequently. The frequency will depend on how close the area is to its capability goal, but is usually every two to three years until a site's goals are reached. At that time, monitoring will occur annually for three consecutive years to confirm that the site is self-sustaining. It will then be considered successfully reclaimed.

Areas on the Site that will be challenging to reclaim (such as the TSF beaches) will be inspected annually following initial re-vegetation to determine if they should be reseeded, replanted, fertilized or otherwise maintained. TSF embankments and other sloping areas will be monitored for signs of erosion; erosion controls will be implemented as needed. Once re-vegetation of these areas is considered stable, the monitoring schedule will conform to the schedule for other areas as described above.

Beaver activity on the mine site will be monitored annually. Problem beaver dams and beavers may need to be removed as needed by a local trapper.

4.5.3 Water quality monitoring

Project design and water quality prediction studies will be discussed with the Province and used to determine a list of monitored parameters, the location of monitoring stations and a monitoring schedule during Operations. Details for a water quality monitoring program during Closure and Post-Closure will be included as part of the final Plan for the Project. The program will specify monitoring objectives, components of the environment to be monitored, where, how often and for how long monitoring will occur, and how the results will be reported.

Some monitoring concepts for surface water and groundwater during Closure and Post-Closure are described following.

4.5.3.1 Surface water

Surface water monitoring programs for mining facilities at the close of active operations typically include end-of-pipe locations (to monitor on-site water quality at the point-of-discharge to the environment) to assess if discharge standards are being met; and receiving environment locations (to verify that water treatment and discharge are maintaining the integrity of downstream water courses).

Monitoring frequency and parameters will be proposed in the final Plan as outlined above, and specified by the Province in the Project's permit(s). At present and conceptually, Northcliff assumes they will likely be a function of the monitoring location and purpose. For example, monitoring may occur weekly at the discharge location, monthly at points downstream of the discharge location, and quarterly at reference locations. Monitoring parameters may include physical measurements such as flow rates or levels, general testing such as pH or total suspended solids, detailed chemical analyses for organic carbon, ion balance, or dissolved metals, and biological tests such as estimating in-stream fish populations or toxicity testing.

4.5.3.2 Groundwater

The presence and quality of groundwater seepage will be determined by the groundwater monitoring well system installed during Operations around the TSF embankments and WMPs. As during Operations, groundwater monitoring results will be used to determine the need for and location(s) of additional groundwater pump-back wells for returning water back to the TSF, or directly to the water treatment facility, for treatment and discharge. Wells and instrumentation will be monitored monthly during Operations and into the Closure and Post-Closure periods. Over time, this frequency will diminish until it is determined that groundwater quality is no longer a downstream risk to human or ecological health.

4.5.4 Site maintenance

Closure and Post-Closure site maintenance will include physical inspections and repairs, as well as short-term maintenance of reclaimed areas. The water treatment facility and related infrastructure will be maintained until no longer needed. Other physical maintenance may include maintaining access roads, culverts, gates, fencing or signage, inspecting and repairing/replacing groundwater monitoring wells, pumps and piping, and ongoing waste management.

Reclamation maintenance may include repairing flood-damaged watercourses, inspecting and repairing slopes for erosion, clearing debris or sediment from ditches, culverts and WMPs, brushing or weeding unwanted vegetation to encourage growth of desired species, and spot-planting or hydroseeding in select areas.

Maintenance will continue until end land use objectives of all reclaimed Site facilities have been reached, the quality of water discharged from the Site meets regulated criteria and no longer needs to be treated, and the Site is considered fully reclaimed and stable. At that time, roads, equipment, and other infrastructure no longer required will be decommissioned and reclaimed as described for similar components in this Plan.

5.0 RECLAMATION SCHEDULE

A detailed reclamation schedule will be developed after Operations begin, and will be updated in successive iterations of this Plan. Conceptually, reclamation will begin as soon as possible after mine start-up, as much as mine development and operations allow. Northcliff recognizes that most Site areas may not be able to be reclaimed until Closure, but it is in the company's best interest to conduct as much progressive reclamation as possible prior to Closure. For example, reclamation may begin soon after mining begins in areas that were disturbed during construction but are no longer needed, such as old forestry roads, or internal haul roads that are superseded by others. Early reclamation also will be more cost-effective since Northcliff can use the available work force and equipment at the mine during Operations rather than using contractors during Closure. Suitable surfaces for progressive reclamation work and research trials will be identified during Operations. Early reclamation work will provide valuable experience in identifying suitable treatment techniques for different areas after Operations cease.

The general plan for decommissioning, reclamation and closure at the completion of Operations has been discussed above. It is expected that the bulk of the decommissioning and initial reclamation activities will take place over an initial spring/summer/fall period lasting about nine months. During this period, all decommissioning of Site infrastructure and roads not needed post-Operations will take place; the channels between the quarry and the TSF, and between the TSF and the open pit, will be constructed; the TSF embankments and beaches, and disturbed areas, will be prepared and receive their initial revegetation treatments; the open pit and quarry will be fenced; and the post-Operations monitoring and Site management programs will be established.

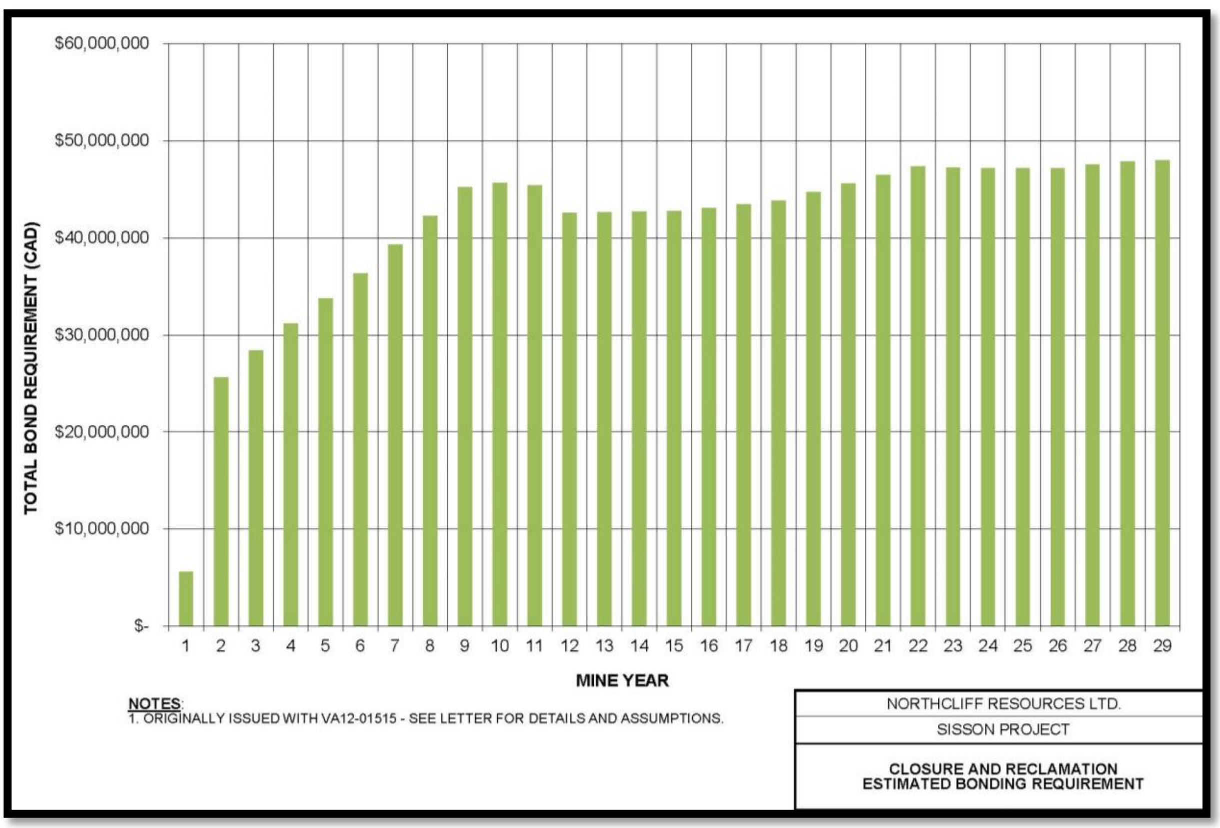
When the open pit has been filled, about 10 years later, the water treatment facilities will be re-furbished as required to treat surplus pit water before it is discharged to Sisson Brook.

6.0 RECLAMATION COSTS

A financial security is required by the Province to insure acceptable decommissioning, reclamation, and closure of the Project. The amount of the required security will grow over the life of the Project (Figure 6.1), to an estimated value of 50 million dollars (Samuel Engineering 2013).

The estimated security amount covers staged decommissioning, reclamation and closure costs beginning one year before mine start-up, and grows progressively to the full estimated value at the fourth and final stage of mine development. Thus, at any point during the life of the Project, the amount of the security is sufficient for decommissioning, reclamation and closure of the Project at that point in time. The closure concept and related costs are based on a number of assumptions for Site decommissioning, water treatment to meet water quality discharge standards, for facility reclamation (*i.e.*, preparation, soil / overburden salvage and replacement, and re-vegetation to meet desired end land use objectives), and for on-going Site monitoring, care and maintenance into the Post-Closure period. Salvage values are considered nil and are not included in the estimates.

Figure 6.1 - Decommissioning, reclamation and closure: Estimated bonding requirement



Source: Northcliff Resources Ltd. (personal communication 2013)

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