# 7.9 Vegetation

This section describes the vegetation in the project area, assesses potential project and cumulative effects, and identifies mitigation measures and monitoring programs. Information provided in vegetation and ecosystem mapping is used to support wildlife habitat analyses in Section 7.10.

## 7.9.1 Scope of Assessment

### *Issues and Selection of Valued Ecosystem and Cultural Components*

The key issue for project effects on vegetation is change in the abundance, distribution or health of plants or plant communities. Potential effects on vegetation include

- loss of vegetation due to the direct effects of clearing for minesite facilities and access road construction
- reduction in the health of vegetation due to a variety of indirect effects including, but not limited to, project emissions, dust generation, windthrow, changes in hydrology, and dispersal and establishment of invasive species

The implications of project effects on vegetation in this relatively undisturbed area of the Yukon are related to the contribution of vegetation to landscape-, community- and species-level biodiversity; the importance of vegetation as habitat; and potential uses of vegetation, such as timber harvesting or harvesting for traditional purposes (e.g., berry picking, medicinal plant use). In order to characterize project effects on vegetation in this context, six vegetation VECCs were identified to focus the impact assessment on the most important issues and values.

Table 7.9-1 identifies the vegetation VECCs and provides a brief summary of the rationale for their selection, the associated regulatory context and the baseline data sources for each VECC.

### *Additional Vegetation Issues*

Collection and presentation of baseline information relating to trace element concentration in vegetation, and forest productivity have been incorporated into the data collection and data presentation components of this chapter. Although they are not specifically identified or assessed as VECCs, they provide important baseline values to facilitate the reclamation program and support assessment of effects on wildlife. Neither will be discussed beyond the baseline section.

### Table 7.9-1 Vegetation Valued Ecosystem and Cultural Components (VECCs), Selection Rationale and Data Sources

| Vegetation VECC | Rationale for Selection | Linkage to EA ReportGuidelines or other regulatory drivers | Baseline Data for EA |
|---|---|---|---|
| Rare Plants | • Potential for project impacts is unknown<br>• Contribute to species-level biodiversity | • Information requested in the EA Report Guidelines and Baseline Assessment Workplan<br>• Federal SARA legislation<br>• COSEWIC lists | • field data |
| Uncommon Vegetation Communities | • High potential for rare plant occurrence in these areas<br>• Potential to sustain impacts due to project<br>• No reliable reclamation<br>• Contribute to community-level biodiversity | • Potentially associated with "Ecological Reserves" (referenced in EA Report Guidelines)<br>• COSEWIC lists | • project ecosystem mapping<br>• field data |
| Mature and Old Forest | • Limited extent in the project area due to latitude, elevation and disturbance history<br>• extended time periods required for the development of old forest structural and species composition attributes<br>• Potentially high wildlife habitat value<br>• No reliable reclamation<br>• Contribute to community- and landscape-level biodiversity | • Information requested in the EA Report Guidelines and Baseline Assessment Workplan | • field data<br>• Yukon vegetation cover mapping (2003) |
| Wetlands and Riparian Communities | • High potential for rare plant occurrence<br>• High habitat value<br>• Sensitive to disturbance<br>• Sensitive to potential effects of contaminated drainage<br>• Potential monitoring sites for metals bioaccumulation and related effects on fish and wildlife<br>• Contribute to community- and landscape-level biodiversity | • Potentially associated with "Ecological Reserves" (referenced in EA Report Guidelines)<br>• Federal policies on wetland conservation – no net loss | • field data project ecosystem mapping<br>• Yukon vegetation cover mapping (2003)<br>• NTDB mapping |
| Alpine Vegetation Communities | • Very sensitive to disturbance<br>• High potential for rare plant occurrence<br>• Contribute to community-level biodiversity<br>• Difficult to reclaim | • Potentially associated with "Ecological Reserves" (referenced in EA Report Guidelines) | • Yukon bioclimate zone mapping<br>• field data project ecosystem mapping<br>• |
| Traditional Use Plants/Communities | • Assumed to be of social and cultural value by local First Nations<br>• Contribute to community-level biodiversity | • Requirements to integrate TK and address social and economic issues in EA Report Guidelines | • field data<br>• project ecosystem mapping |

#### *Trace Element Concentration in Vegetation*

Baseline measurements of tissue element concentrations are required to adequately evaluate and monitor the effects of the proposed project. Determining the level of background metal enrichment will eliminate the possibility of falsely attributing elevated element concentrations to minesite activities. Vegetation in the project area is a potential accumulator of heavy metals, and it is used as forage by ungulates (e.g., moose, caribou) that are important resources for the Kaska Dena First Nations (Braune et al. 1999); therefore, determining background levels of metal enrichment is also important for monitoring the health of local wildlife populations. Willows (*Salix* sp.) are important forage species for snowshoe hares, grouse, moose, and caribou, and are found in wet areas that may be subject to elevated metals levels as a result of effluent discharges or contaminated ground water seepage; therefore, willows represent a probable access point for metal contaminants to enter the food web. In particular, willows have been implicated in the high cadmium content of caribou organ tissues in the Finlayson region, which cannot be explained by elemental concentrations in lichen forage (Braune et al 1999).

#### *Forest Land Capability*

Forest land capability is of interest because of the potential for the project to remove productive forest land from the timber harvesting landbase; however, due to the northern climate, physiography and soils, the amount of productive forested land base suitable for industrial-scale forest management within Yukon is limited with the majority occurring in southeast Yukon. The Project is located in the Upper Liard Forest Management Unit (Y03).

### *Temporal Boundaries*

For the purposes of the vegetation assessment, three scenarios will be used: 1) baseline; 2) full build-out; and 3) closure. Accordingly, the timeframe for the vegetation effects assessment spans the test mining, construction, operation, decommissioning and closure phases of the project. There was very little disturbance in this area prior to the initiation of focused exploration in the early 1990s. The period immediately prior to this exploration activity will be considered ‘pre-baseline’. Because the construction, operations and decommissioning phases do not vary greatly in terms of their respective effects on vegetation VECCs they will be amalgamated into the ‘full build-out scenario’. The closure scenario represents the period after decommissioning and reclamation are complete.

#### *Pre-baseline*

Pre-baseline conditions are reflected in the project terrestrial ecosystem mapping which is based on 1992 National Air Photo library 1:40 000 scale black and white aerial photography. This imagery predates any of the mining exploration disturbances within the RSA and has been used to develop the ‘pre-baseline’ scenario.

#### *Baseline*

Baseline is based on conditions prior to the initiation of the current test mining and primarily represents the conditions inherited by the proponent from previous leaseholders. It should be noted that because the project minesite and industrial complex will be located in the area of the test mine portal, the project effects will not be entirely additive to the existing disturbance. In fact a large proportion of the existing disturbed area will fall within the disturbance footprint of the project. Accordingly, the full build out area summaries for each VECC (Tables 7.9-20, 7.9-21, 7.9-22 and 7.9-23) are likely to provide the most accurate estimate of total vegetation loss within the RSA.

### *Full Build-out*

The full build-out scenario is essentially the maximum disturbance that could be anticipated based on an aggregation of all disturbances associated with the construction, operations and decommissioning phases. In actual fact, due to progressive reclamation, natural regeneration and succession, these disturbances are not likely to cover the entire mined area at any one time and this scenario is therefore considered to be conservative in nature. In addition, the full build-out scenario assumes the entire area of claim areas directly affected by minesite facilities and access road will be disturbed (approximately 2186 ha). In actual fact, this area grossly overstates the likely extent of direct disturbance (anticipated to be approximately 100 ha), which further underscores the conservative perspective of this assessment.

The full build-out scenario encompasses the potential effects of the following project phase timeframes.

#### Construction

The construction phase (June 2006–October 2007) is expected to be the period of most extensive land and vegetation disturbance (i.e., full build-out scenario). Direct project effects on vegetation will occur primarily during clearing, grubbing and grading for project construction.

#### Operations

The operations phase will span the period 2007–2019, and assumes a full build-out scenario. During the operation phase, there is potential for direct and indirect effects due to incremental site development (clearing), emissions from diesel generators, changes to drainage patterns, dispersal of invasive species, windthrow at cleared edges, and progressive reclamation. There is also the potential for metal bioaccumulation in the event of exposure of vegetation to contaminated drainage or effluent.

#### Decommissioning

The decommissioning phase includes activities associated with shutting down the mining operations and reclaiming disturbed sites. It assumes implementation of all mitigation recommendations. Reclamation of the minesite area will be complete five years following the end of production. The tailing facility will be reclaimed as a permanent pond, and the airstrip and access road will remain in place. Decommissioning will occur over a period of about five years. Initially mine backfilling and sealing of portal will be completed, and the processing plant and all extraneous facilities will be removed and the sites reclaimed. The water treatment plant will be retained to treat tailings pond supernatant, as required. In the latter phases of decommissioning the treatment plant and any remaining project buildings will be removed and the sites reclaimed. The tailings facility will be reclaimed as a permanent pond with a passive discharge to Go Creek.

#### Closure

The closure phase represents conditions forecasted into the future following complete decommissioning and reclamation of the minesite. Reclamation will focus on the minesite footprint, camp and borrow areas. The airstrip and access road will remain at closure. At closure, it is expected that, in most instances, successional processes will move vegetation communities towards the pre-disturbance vegetation type, ideally within a 10-year period following decommissioning and final reclamation. Accordingly, the closure phase is assumed to span a period of 10 years following decommissioning.

#### *Spatial Boundaries*

Definition of spatial boundaries for the characterization of baseline vegetation conditions and the project effects assessment considered the following:

- the physical extent of the project itself and the territory the proponent will control through surface or sub-surface leases or claims
- the extent of project effects on aquatic and terrestrial ecosystems (e.g., the zone of influence as defined by a range of a species)
- the zones of local and regional ecological, social and economic impact

Three study areas were defined for the assessment of project effects on vegetation VECCs.

##### *Local Study Area (LSA)*

The vegetation LSA (Figure 7.9-1) is defined as the area within which project-specific effects to the six vegetation VECCs may potentially occur. This area is based upon the disturbance boundary defined by YZC, which includes the claim areas that will be affected by mining operations, mine infrastructure and the access road. While it is understood that this disturbance boundary is a very conservative estimate of project disturbance, uncertainty surrounding the precise location of project infrastructure and other mine-related disturbances requires an assumption that any portion of this area could be affected. Therefore, the vegetation LSA is defined as the affected claim areas buffered by 100 m. In addition to encompassing all anticipated direct project-specific effects, this LSA also accounts for indirect project-specific effects on vegetation associated with dustfall/emissions, edge effects (windthrow, drying), changes in drainage, invasive species establishment/dispersal and road salt etc. The total area of the vegetation LSA is 2900 ha. The vegetation LSA will be located entirely within the area of detailed ecosystem mapping developed for the project.

**Figure 7.9-1 Wolverine Project Vegetation Study Areas and Ecoregions (Vol. 2)**

##### *Regional Study Area (RSA)*

The vegetation RSA (Figure 7.9-1) is designed to provide a regional context for the assessment of project-specific effects and to serve as a frame of reference for the vegetation cumulative effects assessment. In addition, this area sets the boundaries for the review of existing knowledge. This area includes the vegetation LSA and provides for adequate representation (consistent with occurrence in the broader regional landscape) of the four bioclimate zones affected by the project. It also includes the entire area of detailed ecosystem mapping. The establishment of the RSA was largely dictated by the availability of the ecosystem mapping. The bioclimate zones represented in the RSA are as follows:

- Alpine (8.7%)
- Subalpine (34.7%)
- Boreal Highland (50.9%)
- Boreal Lowland (5.8%)

The vegetation RSA has a total are of 13,993 ha. Unless otherwise specified, the acronym 'RSA' will refer to this area wherever it appears in the vegetation section.

*Forest Resources Regional Study Area (FRRSA)*

The forest resources study area (Figure 7.9-1) is a larger regional area (54,691.6 ha) defined to provide a regional context for the evaluation and assessment of forest resources based solely on the Yukon vegetation cover mapping. The representation of bioclimate zones within the FRRSA is roughly proportional to the bioclimate zones within the RSA:

- Alpine (6.5%)
- Subalpine (32.8%)
- Boreal Highland (45.9%)
- Boreal Lowland (14.9%)

Wherever possible, the vegetation FRRSA boundary follows watershed boundaries, watercourses, and bioclimate zone boundaries.

### 7.9.2 Methods

***Data Collection and Review***

The description of baseline vegetation in the project area was developed from existing literature and mapped information and was augmented by field investigations and mapping to provide a comprehensive assessment of project effects on the identified VECCS. Existing mapping for the project area included 1:50 000 scale National Topographic Data Base (NTDB) maps, Yukon bioclimate zone mapping, and 1:50 000 scale Yukon vegetation cover mapping.

The vegetation cover mapping is based on 1:40 000 scale black and white aerial photography. Polygons with ≥10% forest cover are considered to be 'forested' and contain attribute data such as species composition, crown closure, height and origin. Non-forested units are also described.

A number of previous vegetation studies have been completed for projects in the region. Those which included vegetation types and species lists for the region were used to develop baseline vegetation descriptions and to focus field investigations. A previous vegetation survey of the project area (Access Consulting Group 1996) provided descriptions of 19 vegetation types, which were based on types identified elsewhere in the Liard Basin (Zoladeski and Cowell 1996). These classifications were used as the basis for a vegetation community classification for the Project, which was further refined through field surveys.

### *Field Surveys*

Field surveys were conducted in the project area during summer 2005 and included terrestrial ecosystem mapping (including mapping and description of stand structure, wetlands, alpine communities, and rare/uncommon ecosystems), collection of forest productivity data, and targeted rare plant surveys.

#### *Terrestrial Ecosystem Mapping (TEM)*

As part of the ecosystem mapping, vegetation communities within the ~14,000 ha RSA were mapped at a scale of 1:20 000 following the BC methodology for terrestrial ecosystem mapping (RIC 1998) (Figure 7.9-2). A combination of air photo mapping and ground surveys were conducted to produce the map and describe the vegetation associations. The ecosystem classification presented here is based on the vegetation types described by Geomatics International for the southeast Yukon (Zoladeski and Cowell, 1996). In the interests of consistency with other recent mapping projects in the region, the TEM map codes conformed as much as possible to existing mapping for earlier mapping for the Wolverine Project (Access Consulting Group 1996).

**Figure 7.9-2 Wolverine Project Ecosystems and Bioclimate Zones in the RSA (Vol. 1 Oversize Map Pocket and Vol. 2)**

To support vegetation classification and the development of the project mapping products, 137 TEM plots were established, including detailed, ground inventory and visual TEM plots (Luttermerding et al. 19908). Survey effort was distributed as follows: five detailed plots, 30 ground inspections, 58 ground-visual inspections, and 44 quick-visual inspections. Sample plots were generally 10 m x 10 m (100 $m^2$); however some plot sizes were modified to fit linear patches of homogenous vegetation (e.g., riparian communities) while maintaining a fixed area. TEM plots were distributed across all RSA bioclimate zones. TEM plot density was particularly high in the minesite area to ensure accurate baseline mapping within areas of maximum planned disturbance. TEM plots were located in polygons that represented the full range of RSA ecosystems, and wherever possible, were located at least 100 m from polygon boundaries.

Within all sample plots, vascular and non-vascular plants were recorded to species level or were collected if not identifiable in the field. Vegetation characteristics (percent cover by strata layer by species) and site descriptions (slope position, soil drainage, nutrient regimes) were recorded for each survey location on Yukon Government vegetation and site description forms provided by Yukon Environment.

Thirty-two distinct vegetation types were identified, which were then refined into 17 distinct communities that could be mapped at a 1:40 000 scale. The project TEM data was summarized to assist with analysis of project effects on vegetation and wildlife and with reclamation planning (Table 7.9-7).

In order to summarize the area of each ecosystem unit in the RSA (e.g., to determine which polygons were to be considered ‘uncommon’), it was necessary to “decompose” complex ecosystem units. For instance, a 10 ha polygon comprised of 50% of one vegetation community and 50% of another would be broken into 5 ha of each vegetation community type in summary tables.

For VECC analyses, TEM polygons are themed as uncommon vegetation communities or old forest based on the presence of those features within the polygon, so that they can be effectively mapped. However, because of landscape variability, mapping scale and photo resolution, many polygons are ‘complex’ (i.e., containing more than one vegetation community or age class). Therefore, a polygon themed as an uncommon vegetation community denotes the presence of such a type, but does not indicate the % representation of the uncommon vegetation community within the polygon. Summary tables for VECCs are based on the availability of polygons containing the vegetation types of interest in order to be consistent with the polygon-based mapping. This approach is considered to be appropriately conservative for the purposes of assessing impacts to vegetation VECCs.

The key limitation of both approaches to vegetation data analysis is that neither is spatially explicit about where the component ecosystem types are located within a given polygon. In order to consistently describe and summarize baseline conditions and project impacts, it has been assumed that that component ecosystem types within a complex TEM polygon are distributed evenly.

*Rare Plants*

Rare plant surveys were conducted over four days by a qualified botanist and assistant. Rare plant survey effort was focused on the project disturbance footprint, including the minesite and the access road, but it also included some localities elsewhere within the RSA. For areas of the RSA outside of the project footprint, representative vegetation types and vegetation types with high potential for rare plants were selected for rare plant surveys. Air photographs and mapped information for the minesite and access road were reviewed, and sites judged to have high potential for rare plant occurrence were identified as field survey targets. These habitats included wetland areas, areas of significant topographic or vegetative change, and habitats at both the xeric and hydric ends of the soil moisture spectrum.

Information about habitat and phenology was researched and compiled for each of the rare plant species identified, and illustrations were obtained from taxonomical references (Cody 1996).

At each survey location, a meandering search pattern was followed to locate microhabitats with high potential for rare plants. Microhabitats, such as raised hummocks or moist depressions, were carefully inspected for rare plant occurrences. Vegetation and site characteristics were recorded for each survey location on Yukon Government site description and ground vegetation forms. Species that could not be identified in the field were collected (where populations were sufficiently large to allow collection), pressed and later identified using a dissecting microscope.

Where a rare plant or community was found, an area of ≥50 m or more beyond the initial location was examined to determine the extent of the population and the approximate population size, and to map the location of groups/individuals. Photographs were taken of the individuals as well as the habitat and site characteristics, and the occurrence was documented on a NatureServe Yukon field form.

A list of all vascular and non-vascular species documented during the vegetation and rare plant surveys is presented in Appendix 7.9-1.and a summary of the V-types surveyed is included in Appendix 7.9-3.

It is important to note that rare plant surveys can only confirm the presence of rare species in an area; however, they cannot rule out the presence of rare species on a site (Lancaster 2000).

*Invasive Species*

Field surveys recorded all species encountered at survey sites, including occurrences of noxious weeds and other invasive non-native plant species, but no specific weed surveys have been undertaken. No problem species were noted or recorded during the field surveys, and the project species list has been screened against the species list contained in *Invasive Plants of Natural Habitats of Canada* (White et al. 1993) to confirm that no invasive plant species were identified in any of the field data collected.

*Forest Land Capability*

Forest land capability has been represented for the FRRSA in Figure 7.9-5. A summary of forest mensuration data collected at forested field survey sites is included in Appendix 7.9-6.

***Trace Element Concentrations in Vegetation***

During the course of the ecosystem mapping fieldwork, 16 vegetation samples of high value browse species were collected at several sites to supplement five previous samples collected during earlier field reconnaissance (Access Consulting Group 1996). The species collected during the 2005 vegetation surveys included lichens (Cladina spp.) and willows (Salix spp.). Unfortunately, due to a processing error, only seven willow samples were suitable for metals analysis. The results of the field sample metals testing for the willow species are included in baseline section and summarised in Table 7.9-18, and a complete summary of field data collection sites and the analysis results are included in Appendix 7.9-5.

***VECC Definition***

*Rare Plants*

Rare plants were defined as those species ranked S1, S2 or S3 in the Yukon (i.e., usually those with fewer than 100 documented occurrences) based on a list of rare species and their associated rankings provided by Bruce Bennett of NatureServe Yukon (Appendix 7.9-4.

*Uncommon Vegetation Communities*

The Yukon does not currently have a vegetation classification system in place (Syd Cannings pers. comm. May 19, 2005). It also does not have any regional vegetation mapping aside from some vegetation cover mapping, nor does it currently track rare ecosystems. Therefore, rare ecosystems were defined based on the detailed project ecosystem mapping.

For the purposes of this assessment, uncommon vegetation communities are defined as those occupying <1% of the area of detailed ecosystem mapping (see Table 7.9-10 in presentation of baseline results below). For this area, the Open Lodgepole Pine-Aspen (mapcode LT), Open Trembling Aspen-Spruce (pine) (mapcode TS), Open White Spruce (mapcode PC), and Wet Sedge Herb (mapcode SH) ecosystems are considered to be uncommon ecosystem types.

### *Mature and Old Forest*

The structural stage and tree species information contained in the project TEM (1:20 000) is more detailed than the Yukon vegetation cover (1:50 000) and has been used to characterize mature and old forest within the vegetation RSA. Mature forests are those defined as forested ecosystems 80–140 yrs in age (TEM structural stage six), while old forests are defined as forested stands older than 140 years (TEM structural stage seven). Mature and old forests can occur in any of the forested ecosystem types in the project area.

### *Wetland and Riparian Vegetation Communities*

For this Project, wetlands have been defined as "areas where soils are water-saturated for a sufficient length of time such that excess water and resulting low soil oxygen levels are principal determinants of vegetation and soil development. Wetlands will have a relative abundance of hydrophytes in the vegetation community and/or soils featuring 'hydric, characters" (Mackenzie and Moran 2004). For this project, wetlands were identified and delineated using a combination of the NTDB mapping and the project TEM.

Wetlands include bogs, fens, swamps, and shallow open waters and are specifically defined using the following mapped ecosystem types from the project TEM:

- Wet Sedge Herb (SH)
- Wetland or riparian phase of the Willow Tall/Medium Shrub ecosystem (WTy)
- Pond (PD)
- Open Water (OW)

Riparian communities are bands of vegetation surrounded water features such as river, lakes, and wetlands. For this report, riparian areas include a 30 m buffer surrounding on the following features:

- Wetlands (as defined above)
- Lakes (LA)
- Any creek or river from the NTDB mapping

### *Alpine Vegetation Communities*

Alpine vegetation communities are defined as all vegetated areas located in the Alpine Tundra (AT) bioclimate zone.

### *Traditional Use Plants*

Traditional use plants are culturally important plant species. They can be used for nutritional, medicinal, and/or spiritual purposes. Any plants and vegetation communities of interest for traditional purposes will be identified in the Traditional Knowledge study that is being conducted by the Kaska Dena (Section 7.12: First Nations and Traditional Knowledge). At the time of assessment, a list of culturally important plant species was not available for the project; therefore, it was not possible to model specific Kaska traditional use plants/communities. For the purposes of this assessment, a generic berry production model was created to identify areas of potential traditional use value.

### *Zones of Influence*

In order to accurately characterize the availability of VECCs at baseline, it is necessary to account for both existing disturbance and the degree to which these disturbances have degraded the value of VECCs within a zone of influence (ZOI). To accomplish this, zones of influence, as defined in Table 7.9-2, were applied to existing disturbances and VECCs were modified as follows:

#### *Rare Plants*

Existing disturbances are assumed to have removed any previous occurrences of rare plants within the ZOI.

#### *Uncommon Vegetation Communities*

Where one of the uncommon vegetation communities is mapped within the ZOI of an existing baseline disturbance, the 'conservation status rating' was reduced by one class in the 4-class system to reflect the influence of existing disturbance on the value of the community at baseline (see Table 7.9-3 in presentation of baseline results below).

#### *Mature and Old Forest*

Where old and mature forests occurred within the zone of influence of an existing disturbance, the 'mature and old forest rating' was reduced by one class in the rating system to reflect the decreased value of these stands at baseline conditions (see Table 7.9-4 in presentation of baseline results below)

#### *Wetland and Riparian Communities*

Wetland and riparian communities within the zone of influence of an existing disturbance were re-categorized as a new community type termed 'wetland and riparian edge'.

#### *Alpine Vegetation Communities*

Alpine vegetation communities within the zone of influence of an existing disturbance were re-categorized as a new vegetation type termed 'alpine vegetation communities edge'.

#### *Traditional Use Plants*

As with rare plants, it was assumed that existing disturbances effectively nullified the value of disturbed areas within the zone of influence for gathering culturally important plant species. Areas of traditional use plants found within the ZOI are, therefore, assigned a null value.

### Table 7.9-2 Vegetation Zone of Influence (ZOI) Buffers

| Feature Type | ZOI |
|---|---|
| Bridge | 0 |
| Drill road | 50 |
| Ground level road | 50 |
| Limited-use, cart track, road | 50 |
| Main road | 100 |
| Main, ground level, loose surface, operational road | 100 |
| Main, hard surface, operational road | 100 |
| Road | 100 |
| Secondary, ground level, hard surface, operational road | 100 |
| Trail | 0 |
| Clearing – burn | 50 |
| Clearing – camp | 100 |
| Cutlines | 50 |
| Industrial liquids dump/depot | 50 |
| Structure – buildings | 100 |
| Structure - campground | 100 |

In the full build-out and closure scenarios the availability of VECCs has not been reduced through the application ZOI buffers (as has been done to reflect the influence of the baseline disturbance on vegetation VECCs). The rationale behind this approach is that the use of a conservative full build-out and post-closure scenarios (i.e., the affected claim areas) as a proxy for mine disturbance is considered to be sufficiently conservative to account for the reduction in vegetation VECC values in proximity to minesite disturbance and infrastructure without the application of an incremental ZOI buffer.

#### *VECC Modeling*

This section will describe how each VECC was modeled to facilitate analysis and the assessment of project effects

##### *Rare Plants*

Project effects to rare plants were analysed with a simple overlay of the full build-out scenario on known rare plant occurrences. . Rare plants were not rated.

##### *Uncommon Vegetation Communities*

For the purposes of assessment of project effects, uncommon vegetation communities were assigned to one of four conservation status classes. The classes are based on both a subjective estimate the sensitivity of the ecosystem type (sensitivity rating) and the predominant structural stage in the host TEM polygon, such that rare ecosystem polygons with older forest structural stages were assigned a higher conservation value than polygons in younger seral stages (Table 7.9-3).

## Table 7.9-3 Uncommon Vegetation Community Ratings

| Uncommon Vegetation Communities and Associated Sensitivity Ratings[21] | Structural Stage Rating[22] | Uncommon Ecosystem Conservation Status Rating[23] |
|---|---|---|
| LT - Open Lodgepole Pine-Aspen Forest (rating value = 1) | Structural Stage 1 (rating value = 2) | 2 |
| | Structural Stage 2 (rating value = 2) | 2 |
| | Structural Stage 3 (rating value = 1) | 1 |
| | Structural Stage 4 (rating value = 1) | 1 |
| | Structural Stage 5 (rating value = 1) | 1 |
| | Structural Stage 6 (rating value = 2) | 2 |
| | Structural Stage 7 (rating value = 3) | 3 |
| TS - Open Trembling Aspen-Spruce (Pine) Forest (rating value = 1) | Structural Stage 1 (rating value = 2) | 2 |
| | Structural Stage 2 (rating value = 2) | 2 |
| | Structural Stage 3 (rating value = 1) | 1 |
| | Structural Stage 4 (rating value = 1) | 1 |
| | Structural Stage 5 (rating value = 1) | 1 |
| | Structural Stage 6 (rating value = 2) | 2 |
| | Structural Stage 7 (rating value = 3) | 3 |
| PC - Open White Spruce Forest (rating value = 2) | Structural Stage 1 (rating value = 2) | 4 |
| | Structural Stage 2 (rating value = 2) | 4 |
| | Structural Stage 3 (rating value = 1) | 2 |
| | Structural Stage 4 (rating value = 1) | 2 |
| | Structural Stage 5 (rating value = 1) | 2 |
| | Structural Stage 6 (rating value = 2) | 4 |
| | Structural Stage 7 (rating value = 3) | 6 |
| SH – Wet Sedge Herb (rating value = 2) | Structural Stage 1 (rating value = 2) | 4 |
| | Structural Stage 2 (rating value = 2) | 4 |
| | Structural Stage 3 (rating value = 1) | 2 |
| | Structural Stage 4 (rating value = 1) | 2 |
| | Structural Stage 5 (rating value = 1) | 2 |
| | Structural Stage 6 (rating value = 2) | 4 |
| | Structural Stage 7 (rating value = 3) | 6 |

The uncommon ecosystem conservation status ratings were then summarized into four general categories as follows:

- 1 = ‘Low’
- 2 and 3 = ‘Moderate’
- 4 = ‘High’
- 6 = ‘Extremely High’

[21] Sensitivity ratings for uncommon vegetation communities is a two-class system designed to reflect the degree of resilience of an ecosystem type to disturbance: ‘1’ is less sensitive and ‘2’ is more sensitive.
[22] Structural stage rating assigns a rating according to a three-class system which represents the relative ecological importance of each of the seven TEM structural stage codes (Luttermerding et al 1998) to overall ecosystem function; a score of 3 denotes the highest ecological value.
[23] The conservation status of an uncommon vegetation community is applied by polygon and is simply the product of the highest sensitivity rating and the highest structural stage rating for the ecosystems within each polygon.

### *Mature and Old Forest*

Mature and old forest is defined as TEM structural stage six (80–140 yrs) and TEM structural stage seven (>140 yrs) respectively. In order to develop a rating system for the value of mature and old forest stands within the RSA, ratings were assigned for stand age and ecosystem sensitivity, then multiplied together to generate an ‘Old and Mature Forest’ rating value (Table 7.9-4). These rating values were then summarized into ‘high’, ‘moderate’, and ‘low’ classes to facilitate the characterization of baseline conditions and assessment of project effects.

## Table 7.9-4 Mature and Old Forest Ratings

| Structural Stage and Stand Age Rating | Ecosystem Type and Sensitivity Rating | Mature and Old Forest Rating |
|---|---|---|
| 7 (> 140 yrs)<br>(rating value = 2) | BS (rating value = 2) | 4 |
| | SF (rating value = 2.5) | 5 |
| | PC (rating value = 3) | 6 |
| | LS (rating value = 2) | 4 |
| | LP (rating value = 1.5) | 3 |
| | LT (rating value = 1.5) | 3 |
| 6 (80-140 yrs)<br>(rating value = 1) | BS (rating value = 2) | 2 |
| | SF (rating value = 2.5) | 2.5 |
| | PC (rating value = 3) | 3 |
| | LS (rating value = 2) | 4 |
| | LP (rating value = 1.5) | 1.5 |
| | LT (rating value = 1.5) | 1.5 |
| | TS (rating value = 1) | 1 |

The three value classes for mature and old forest ratings were defined as follows:

- 0 - 2.0 =’low”
- 2.1 - 4.9 = ‘moderate’
- 5.0 - 6.0 = ‘high’

### *Wetlands and Riparian Vegetation Communities*

The assessment of wetland and riparian vegetation communities was completed using the ‘wetland’, ‘riparian’, and the ‘wetland and riparian edge’ classes. No rating system was applied.

### *Alpine Vegetation Communities*

Alpine vegetation communities were simply defined as the vegetation comities mapped within the Alpine Tundra (AT) bioclimate zone.

### *Traditional Use Plants/Communities*

A generic berry productivity model was developed and applied to identify areas of high productivity for a range of edible berry-producing shrubs. The berry productivity model was based on the project TEM mapping. It can be used to locate vegetation units in the project area that are of potential interest for traditional harvesting purposes and it allows some assessment of project effects to this VECC. The final TEM polygon rating was based on the low, medium, or high ratings for each separate ecosystem, yet the highest rating for each polygon was used to build the model. For example, three distinct ecosystems can represent a single TEM polygon and in the case where there were different berry productivity ratings, the highest rating was applied to the polygon.

#### 7.9.2.1 Results

***Physiographic Setting***

The project area lies within the Liard Basin and Pelly Mountains Ecoregions of the Boreal Cordillera Ecozone and abuts the Yukon Plateau-North Ecoregion (Smith et al 2004). The area ranges from approximately 920-1900 m asl and covers four elevation bioclimate zones: 'Boreal Lowland', 'Boreal Highland', 'Subalpine', and 'Alpine'. Much of the project area is above the altitudinal treeline, which occurs between 1250 m and 1500 m asl depending on exposure and cold air drainage and ponding. Discontinuous but widespread permafrost occurs throughout the area, particularly on north-facing slopes, under thick organic soil layers, and in bog complexes. Alpine soils are generally acidic and often show signs of cryoturbation (YEWG 2004). Ecoregions in the project area are shown on Figure 7.9-1 and described below.

*Pelly Mountains*

The following description of the Pelly Mountains Ecoregion is a summarised excerpt from the publication, 'Ecoregions of the Yukon Territory: Biophysical Properties of Yukon Landscapes' (Smith et al. 2004):

> *This ecoregion is a rolling plateau topped by numerous mountain peaks and dissected in places by small rivers. The relief is generally greater than 1,500 m asl, with a maximum elevation of 2,404 m asl. This ecoregion represents 7% of the Yukon landscape and includes two major mountain ranges, separated by the Dease Plateau; the more rugged Pelly Mountains in the north and the Cassiar Mountains in the south. The ecoregion encompasses a ' hydrologic divide, with the Teslin and Pelly rivers of the Yukon River watershed and Liard River tributaries of the Mackenzie River watershed. Landcover types within the ecoregion break down as follows:*
>
> - *boreal/subalpine coniferous forest, 50%*
> - *alpine tundra, 35%*
> - *alpine rockland, 10%*
> - *lakes and wetlands, 5%*
>
> *Permafrost occurs regularly in the alpine zone, but at lower elevations it is more variably distributed. In northern parts of the ecoregion, most valley floors are underlain by frozen ground, such as near Ross River and Finlayson Lake, where only some south-facing slopes and river courses are permafrost-free. In the southern portion of the ecoregion, dry coarse-grained deposits tend to be permafrost-free, while throughout the region fine-grained mineral soil and sites covered by organic soil support near surface ground ice.*

*Shrub and dwarf shrub tundra dominate the vegetation at higher elevations. Coniferous, and sometimes mixed, forests mantle the slopes below 1,350 m asl. High elevation valleys are often subject to cold air drainage such that forest growth is suppressed on the valley floor (1000 m elevation) but vigorous on the sidehills.*

*White spruce is the dominant tree species in the ecoregion. White spruce–feathermoss forests occupy more mature sites on most soils, while white spruce–lichen is the most common forest type on well and rapidly drained soils. Throughout most of the ecoregion, white spruce is found with pine and aspen following fire. The groundcover on these sites usually contains a significant Peltigera lichen, ground shrub and grass component. Further north, white spruce is found on warmer sites, often mixed with subalpine fir or black spruce. Where the canopy is denser, the groundcover is feathermoss and a shrub layer of Labrador tea is common. Where the trees are less dense, a shrub birch, ground shrub — kinnikinnick, lingonberry and twinflower — lichen understory is common. In the northern part of the ecoregion, black spruce is common on cool wet sites and paper birch is a significant component of the canopy. These two species are much less frequent in the south.*

*Pine may regenerate after fire, but in many cases willows and aspens are the first species to colonize burned areas. Black spruce occupies cooler wet sites on the valley floors, north-facing slopes and wetland habitats. In the north part of the ecoregion, subalpine fir is common between 750 and 1,400 m asl. Here, it is often found in mixed stands with white or black spruce. In the remainder of the ecoregion, fir is confined to alpine valleys between 1,200 and 1,400 m asl. Dense stands of fir are common on north facing slopes are underlain by feathermoss. As the trees become sparser with increasing elevation and exposure, krummholz growth form is common and the abundance of shrub birch and lichen increases. Shrub birch dominates the subalpine above subalpine fir, and in the cool, well-drained valley floors where cold air drainage restricts tree growth. Shrub birch on drier sites is associated with lichen, grass and lingonberry, and on wetter sites with willow, horsetail, shrubby cinquefoil, grass and moss. Mountain summits composed of granitic rocks are usually dry lichen heath. Dryas integrifolia, D. octopetala, lichen (dominantly Cetraria spp., Alectoria, Thamnolia vermicularis), grasses (Hierochloe alpina, Poa spp.) and ground shrubs are the most common species found. In contrast, sedimentary rocks at high elevations are dominated by Salix reticulata, Dryas and other forbs. Alpine meadows or flower gardens develop in moist alpine locations, commonly associated with non-porous granitic rocks that cause restricted drainage or persistent snow patches.*

### *Liard Basin*

The following description of the Liard Basin Ecoregion is a summarised excerpt from the publication, "Ecoregions of the Yukon Territory: Biophysical Properties of Yukon Landscapes" (Smith et al. 2004):

*This ecoregion is an area of low hills separated by broad plains, surrounded by mountains and plateaus. The low elevation, moderate precipitation and relatively long, warm summers result in vigorous forest growth, most notably in the floodplains of the Liard, Meister, Frances, Hyland and Coal rivers.*

*This ecoregion comprises approximately 4% of the Yukon territory and breaks down into the following land cover types:*

- *boreal coniferous and mixed wood forest, 90%*
- *alpine tundra, 5%*
- *lakes and wetlands, 5%*

*The soils of the Liard Basin have formed on level to undulating landscapes of primarily morainal, glaciofluvial, and lacustrine parent materials. Much of the landscape adjacent to the Liard River is mantled by up to 50 cm of silty loess. Soils underlain by near-surface permafrost are confined to north-facing slopes and some wetlands.*

*Wetlands are a common, though not extensive, component of the ecoregion. Fen vegetation characterizes the ecoregion's wetlands. Basin fens are a common wetland form; these tend not to be underlain by permafrost. In areas where permafrost has established within the fens, peat plateau and palsa bogs are found. The Liard River floodplain upstream from Watson Lake is formed of nutrient-rich, silty alluvium. Stable surfaces can support very productive forests of balsam poplar and white spruce. More active alluvial surfaces are vegetated by alder–willow shrubs.*

*Most of the Liard Basin lies below treeline and the vegetation is dominantly boreal forest. The low elevation, moderate precipitation and relatively long, warm summers result in good vegetative growth.*

*Coniferous forests dominate the landscape. The best growth, with tree heights of 30 m or more, occurs along the nutrient rich loamy floodplains of the Liard, Meister, Frances, Hyland and Coal rivers. This area has the one of the highest potentials for producing commercial volumes of timber in the Yukon (INAC 2003). White spruce is the dominant tree species found on river terraces, where it is underlain by feathermoss and a rich shrub layer including willow, alder, rose, high-bush cranberry and ground shrubs. Younger stands are often mixed with balsam poplar. On very dry and gravelly fluvial sites, a lichen–kinnikinnick groundcover is found under lodgepole pine or white spruce. Subalpine fir forms extensive open stands in the subalpine between 900 and 1,500 m asl. On low wooded hills and broad treed uplands, white and black spruce are found with a moss or moss/shrub understory. Where soils are drier and nutrient poor, as on many morainal and glaciofluvial soils, lodgepole pine–black spruce forests are common. Younger stands are often mixed forests of spruce, pine, and trembling aspen, which are found on many sites; paper birch and black spruce are on north aspects, and white spruce and balsam poplar on fluvial sites.*

*Shrubby–herbaceous fens surrounded by permafrost-induced moss–sphagnum (peat) plateau bogs are typical wetlands in the ecoregion.*

### Bioclimate Zone Descriptions

The following provides a description of the bioclimate zones that are represented in the vegetation LSA and RSA (Figure 7.9-2) (Grods and McKenna 2005).

#### Boreal Lowland (BOL)

The Boreal Lowland bioclimate zone (below 980 m asl) is characterized by a relatively high cover of lodgepole pine and white spruce forest with varying amounts of aspen/pine on crests and south-facing slopes. Black spruce dominates in valley bottoms adjacent to wetlands. There are several large wetlands in the BOL the valley bottom at the northern-most extent of the project LSA.

#### Boreal Highland (BOH)

The Boreal Highland bioclimate zone (980–1320 m asl) is dominated by black and white spruce in the forested areas with willow/birch mosaics along gentle side slopes. A number of wetlands are located in the valley bottom in the northern part of the proposed mine access road corridor, but they also exist near the airstrip at the headwaters of Go Creek.

#### Subalpine (SUB)

The Subalpine bioclimate zone (1320–1650 m asl) is characterized by extensive scrub-birch and forb meadow complexes that occupy the low relief areas. The upper elevations of the subalpine contain more dwarfed shrubs including heathers, *Ledum decumbens*, and avens. Steeper subalpine areas are located to the north and above the airstrip and mine portal; these have steep gullies and exposed rock and are mainly willow and birch dominated, although open alpine forests dominate the gully site. The subalpine bioclimate zone occurs as a large area north of Go Creek and encompasses much of the western portion of the footprint area.

#### Alpine (ALP)

The Alpine bioclimate zone (above 1650 m asl) is located north of the mine portal and airstrip and is characterized by gently rolling, high elevation topography. The alpine bioclimate zone is dominated by lichens, sedges, altai fescue (*Festuca altaica)*, and alpine forbs. Steeper slopes are rocky with a high cover of white arctic mountain heather (*Cassiope tetragona)*, while moister meadows are characterized by diverse graminoid and forb communities.

### Table 7.9-5 Representation of Bioclimate Zones within the LSA, RSA and FRRSA

| Area | Boreal Lowland (ha) | Boreal Highland (ha) | Subalpine (ha) | Alpine (ha) | Total (ha) |
|---|---|---|---|---|---|
| **Project Footprint** | 108.9 | 1,088.7 | 988.7 | 0.0 | 2,186.4 |
| **Vegetation LSA** | 153.9 | 1,487.5 | 1,255.6 | 3.1 | 2,900.1 |
| **Vegetation RSA** | 808.9 | 7,114.3 | 4,842.8 | 1,210.5 | 13,992.7 |
| **Forest Resources RSA (FRRSA)** | 8,134.6 | 15,092.2 | 17,923.6 | 3,541.2 | 54,691.6 |

#### *Wolverine Project Ecological Setting*

Mixed stands of subalpine fir (*Abies lasiocarpa*) and white spruce (*Picea glauca*) dominate the landscape of the project area. These tree species typically occur in open stands with varying understory characteristics depending on soil texture and microclimatic factors. Feathermosses are common understory components in mesic areas with fruiticose lichens becoming the dominant cryptograms in drier sites. Dense trembling aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera ssp. balsamifera*) stands also occur; such stands are usually disturbance initiated and early successional. Black spruce (*Picea mariana*) is the dominant tree species of bogs and bog complexes and occurs primarily in open stands on thick organic soils. Some black spruce stands also occur in upland sites on mineral or thin organic soils, and with subalpine fir stands in the project area. Open subalpine fir stands are predominant at and immediately below treeline with individuals becoming krummholz or decumbent at the treeline. Dwarf birch (*Betula glandulosa*)-dominated communities become dominant immediately above the treeline and commonly co-occur with willows and/or ericaceous shrubs. At higher elevations, these communities gradually give way to alpine dwarf-shrub heath and herb communities with various species compositions that are influenced by soil texture (granitic vs. sedimentary). Extreme elevations and aspects are vegetated primarily by lichen or lichen-dwarf shrub communities.

#### *Wolverine Project Area Disturbance History*

Fire is the predominant natural disturbance in forested and subalpine zones of the project area. Post-fire community composition varies depending on disturbance intensity, pre-disturbance community composition, and local edaphic factors (e.g., slope, aspect, soil texture). On relatively well-drained substrates, recent fire-origin stands are commonly dominated by dense stands of lodgepole pine or trembling aspen. Above treeline, dwarf birch (*Betula glandulosa*) and willows (*Salix sp.*) are the most common post-fire colonizers.

Four natural disturbance zones have been defined for the Yukon (Table 7.9-6)

## Table 7.9-6 Yukon Natural Disturbance Zones

| Natural Disturbance Zone (NDZ) | NDZ Code | Description |
|---|---|---|
| Riverine | NDZ1 | areas actively influenced by water on floodplain rivers (>7m width) |
| Lowland | NDZ2 | areas with increased available summer moisture, where forests tend to develop, uneven aged or old-growth characteristics, due to extended periods without fire |
| Simple Upland | NDZ3 | lack of prominent terrain feature and dry conditions encourage large, regular stand replacing fires |
| Complex Upland | NDZ4 | prominent terrain features and dry conditions result in complex fire patterns and hence complex stand structure and components |

Based on fifty years of fire records, all parts of the Yukon are likely to experience at least one wildfire during a 200-year period (Yukon Department of Environment 2002). There are few forest stands more than 160 years old in the southeast Yukon, most of which are small fire-skipped stringers or patches in larger burned matrix (IFS 2003). The oldest trees sampled in the project study area were approximately 180 years old.

The occurrence of recent fires in the study area is evidenced by large tracts of scrub-birch communities. Two such recent burns (2-5yrs old) in the study area have removed overstorey trees, allowing the scrub birch understorey community to regenerate vegetatively dominate these sites. One of these recently burnt areas is located on an upper slope in the subalpine bioclimate zone north of the airstrip, and extends to the corner of the proposed road alignment. The other burn area spans from the east side of Little Wolverine Lake eastward around the south side of the subalpine ridge, to south of the airstrip. In general, lichen cover is very high in the Subalpine and Alpine bioclimate zones; however, lichens are negatively affected by fire, and have been reduced to very low cover levels in these recently burnt areas.

Alpine tundra communities are the most susceptible to anthropogenic disturbance. Damage to the insulating vegetative mat or soil organic layer (where present) can result in thermal erosion (thermokarst), potentially triggering slope failure/slumping. Environmental constraints (temperature, soil nutrients, and growing season length) limit growth rates and reproduction in these communities, making them slow to recover from disturbance relative to other vegetation types. Large-scale natural disturbance is infrequent in higher elevation alpine zones, although lightning-initiated tundra fires can occur. Smaller-scale disturbances, related to permafrost are more common. Where ice-rich permafrost is extensive, frost boils and polygons may form, initiating micro-scale changes in community composition.

In lower elevation riparian zones and floodplains, ice scouring and flooding are the most common natural disturbances; vegetation types in these areas are usually disturbance adapted and are maintained by periodic perturbations.

### *Wolverine Project Ecosystem Descriptions*

Ecosystems in the project areas were defined during the development of the project TEM.

Lower elevation forests are dominated by white spruce, black spruce, and lodgepole pine on sites with mineral substrates, while areas with organic soils are dominated by stands of black spruce. Lodgepole pine stands on well-drained sites often include trembling aspen as a co-dominant, especially on south-facing slopes. White spruce stands are infrequently distributed on moist and rich soils in the valley bottoms and on alluvial fans where moister conditions reduce the incidence of fire. At higher elevations, subalpine fir (*Abies lasiocarpa*) dominates the forested areas but becomes increasingly stunted (krummholz form) towards the Alpine bioclimate zone (Zoladeski and Cowell 1996).

Shrub communities consisting mainly of willows and scrub-birch dominate the landscape in the LSA from low to high elevations. At higher elevations, the willows and scrub-birch become reduced in size and species composition expands to include a variety of dwarf alpine shrubs.

Alpine communities are dominated by dwarf willows, scrub-birch, crowberry (*Empetrum nigrum*), arctic white mountain heather, mountain avens (*Dryas integrifolia*), and bilberry (*Vaccinium uliginosum*).

Thirty-two different vegetation community types (V-types) were described, from 137 sample plots, based on the ecosystem classification system for the southeast Yukon (Zoladeski and Cowell 1996). In order to facilitate mapping based on 1:40 000 scale black and white aerial photography, each of the 32 V-types was assigned to one of 17 mappable vegetation community classes developed for the project TEM mapping (see Appendix 7.9-2 for expanded legend and Figure 7.9-2 for ecosystem mapping). Of the 17 mapped vegetation communities, 3 describe non-vegetated units: Bare Rock (RO), Ponds (PD), and Lakes (LK). Table 7.9-7 summarizes the proportional representation of the 17 ecosystem types within the vegetation LSA, and Table 7.9-8 identifies the corresponding V-type(s) of the vegetated ecosystems. The ecosystem types are described as follows:

#### *Open subalpine forest (SF)*

This ecosystem has an open canopy of subalpine fir (*Abies lasiocarpa*) with occasional white spruce (*Picea glauca*) and black spruce (*Picea mariana*) and is the most stable forest type of the Subalpine zone. The open subalpine forests grade to krummholz at high elevations and fir-white spruce forests at low elevations. This ecosystem is located on deep well-drained slopes that have escaped forest fires. This ecosystem corresponds to the ‘Open Alpine Fir Forest’ v-type (V16).

#### *Open white spruce forest (PC)*

This ecosystem is uncommon in the study area and is found on rich slopes and alluvial fans in the Boreal Highland zone. The tree canopy is dominated by white spruce with subalpine fir and black spruce as codominants. This ecosystem corresponds to the ‘Open White Spruce Forest’ v-type (V17).

#### *Open black spruce forest (BS)*

This ecosystem is a very common forest unit found on medium to poor nutrient sites in the Boreal Lowland and Boreal Highland bioclimate zones. Forests on these sites are dominated by black spruce with subalpine fir as a codominant and occasional white spruce and lodegepole pine. This ecosystem corresponds to the ‘Open Black Spruce Forest’ vegetation types, including the mineral soil (V18) and organic soil (V19) v-types, as well as the ‘Black Spruce-Shrub Birch Medium/Tall Shrub’ v-type (V113).

*Open lodgepole pine-spruce forest (LS)*

This ecosystem is a very common forested unit found on shallow or well-drained soils in the Boreal Lowland and Boreal Highland bioclimate zones. The overstory is dominated by lodgepole pine with white and black spruce as codominants. This ecosystem corresponds to the 'Open Lodgepole Pine-Spruce Forest' v-type (V21).

*Open lodgepole pine forest (LP)*

This ecosystem is not common in the study area, but does exist as distinct forest units on well-drained soils in the Boreal Lowland and Boreal Highland bioclimate zones. The tree canopy almost always consists of pure lodgepole pine. This ecosystem corresponds to the 'Open Lodgepole Pine-Spruce Forest' v-type (V22).

*Open lodgepole pine-aspen forest (LT)*

This ecosystem is an uncommon mixed forest unit that is restricted to well-drained sites in the Boreal Lowland bioclimate zone and which often occurs as a maturing edaphic climax. The overstory is dominated by lodgepole pine with varying amounts of aspen. This ecosystem corresponds to the 'Open Lodgepole Pine-Aspen Forest' v-type (V33).

*Open trembling aspen-spruce (pine) forest (TS)*

This ecosystem is an uncommon mixed forest unit that is restricted to south-facing slopes in the Boreal Lowland bioclimate zone. The canopy is dominated by trembling aspen mixed with white spruce and lodgepole pine codominants. This ecosystem corresponds to the 'Open Trembling Aspen-Spruce (Pine) Forest' (V30), 'Open Black Spruce-Aspen Forest' (V35), and 'Open Trembling Aspen Forest' (V6) v-types.

*Scrub birch medium/tall shrub (DB)*

This ecosystem is a very common shrub community occurring from mid to subalpine elevations. Scrub birch units have typically developed in response to fire disturbance at lower elevations and on drier sites at higher elevations. This ecosystem corresponds to the 'Shrub Birch Medium/Tall Shrub' v-type (V101), the 'Shrub Birch-Labrador Tea Medium/Tall Shrub' v-type (V102) on poor nutrient sites and the 'Shrub Birch Dwarf Shrub' v-type (V106) in the Subalpine bioclimate zone.

*Willow-scrub birch medium/tall shrub (WD)*

This ecosystem is the most common shrub community from low to high elevations. This shrub unit occupies gentle to moderately steep upland sites and is dominated by willows and scrub birch. This ecosystem corresponds to the 'Willow-Shrub Birch Medium/Tall Shrub' v-type (V105) and the 'Willow Dwarf Shrub' v-type (V108) in the Subalpine bioclimate zone.

*Willow medium/tall shrub (WT/WTy)*

This ecosystem is very common from low to mid elevations and is either found on mineral soil on upland sites or in riparian zones. The shrub layer is dominated by various tall and medium height willow species with a diverse herbaceous layer. The map code for this ecosystem is WT on upland sites and WTy in riparian or wetland sites. This ecosystem corresponds to the 'Willow Medium/Tall Shrub' v-type (V104).

#### *Wet sedge herb (SH)*

This ecosystem is the main wetland vegetation type identified in the TEM area and is common in drainage channels where surface water is present. These lower elevation wet meadows are most often dominated by sedges (*Carex* spp.) but may also contain abundant bentgrasses (*Calamagrostis* spp.).Minor amounts of willows are often present as well as various forbs and aquatic vegetation. This ecosystem corresponds to the 'Wet Sedge Herb' (V206) and the 'Wet Grass Herb' (V205) v-types.

#### *Mesic mixed herb (MH)*

This ecosystem is highly variable and represents mesic and submesic meadows at mid to high elevations. These meadows range from dry graminoid-dominated communities to mixed (graminoid and forb) mesic meadows. The associated dry graminoid v-types (corresponding to V200, V201, V212) generally occur on submesic soils on level or crest positions, while the mixed mesic v-types (V202, V213) occur on rich soils on level or toe slope positions. This ecosystem is dominated by the 'Mesic Mixed Herb' v-type (V213) with varying representation of other graminoid and forb dominated communities such as the 'Dry Wood Rush Herb' (V200), 'Dry Grass Herb' (V201), 'Mesic Grass Herb' (V202), and 'Dry Mixed Herb' (V212) v-types

#### *Heather-avens dwarf shrub (AS)*

This ecosystem represents heather-dominated dwarf shrub vegetation communities on level or crest positions in the Alpine and Subalpine bioclimate zones. They are dominated by dwarf willow species (*Salix reticulata* and *Salix arctica*), arctic white mountain heather, mountain avens (*Dryas integrifolia*), crowberry, and bilberry but also contain high covers of fruticose lichens such as *Cladina* spp., *Cladonia* spp., *Cetraria* spp., *Dactylina* spp., and *Alectoria ochroleuca*. This ecosystem corresponds primarily to the 'Mountain Avens Dwarf Shrub' v-type (V107), but also encompasses the 'White Heather Dwarf Shrub' (V115) and the 'Crowberry Dwarf Shrub' (V119) v-types.

#### *Alectoria-cladina-cetraria fruticose lichen (AC)*

This ecosystem is restricted to the Alpine bioclimate zone and represents fruticose lichen-dominated communities on level or crest positions. Very low covers of dwarf shrubs, including white heather and prostrate willows, occur in some areas. In addition, sparsely distributed grasses and sedges are often intermixed with mosses and lichens. Lichen communities are dominated by fruticose species, including *Cladina* spp., *Cladonia* spp., *Cetraria* spp., *Dactylina* spp., *Masonhalea richardsonii*, and *Alectoria ochroleuca*. The *Cetraria-Alectoria Ochroleuca*. This vegetation community corresponds to the 'Fruticose Lichen' (V300) and the '*Cladina* Fruticose Lichen' (V302) v-types.

## Table 7.9-7 Representation of Ecosystems within the LSA

| Ecosystem | TEM Map-Code | BOL | BOH | SUB | ALP | Total |
|---|---|---|---|---|---|---|
| Open subalpine forest | SF | 0.31% | 10.94% | 8.32% | - | 19.57% |
| Open white spruce forest | PC | 0.10% | 0.56% | - | - | 0.66% |
| Open black spruce forest | BS | 0.98% | 11.58% | - | - | 12.56% |
| Open lodgepole pine-spruce forest | LS | 0.78% | 8.41% | - | - | 9.19% |
| Open lodgepole pine forest | LP | 0.32% | 0.22% | - | - | 0.54% |
| Open lodgepole pine-aspen forest | LT | - | 0.41% | - | - | 0.41% |
| Open trembling aspen-spruce (pine) forest | TS | 0.09% | 0.01% | - | - | 0.10% |
| Scrub birch medium/tall shrub | DB | - | 1.32% | 11.16% | 0.03% | 12.51% |
| Willow-scrub birch medium/tall shrub | WD | 1.97% | 14.81% | 12.76% | 0.0% | 29.54% |
| Willow medium/tall shrub | WT | 0.65% | 1.78% | 5.08% | - | 7.51% |
| Wet sedge herb | SH | 0.16% | 0.34% | 0.09% | - | 0.59% |
| Mesic mixed herb | MH | - | 0.46% | 3.63% | 0.00% | 4.09% |
| Heather-avens dwarf shrub | AS | - | 0.15% | 2.69% | 0.05% | 2.89% |
| *Alectoria-cladina-cetraria* fruticose lichen | AC | - | - | 0.02% | 0.03% | 0.05% |
| Lake | LA | - | 0.38% | - | - | 0.38% |
| Pond | PD | - | 0.38% | - | - | 0.38% |
| Rock | RO | - | 0.00% | 0.01% | - | 0.01% |

## Table 7.9-8 Concordance Summary for the Project TEM Codes and the V-Types from Zoladeski and Cowell 1996

| Ecosystem Name | TEM Map Code | V-Type from Zoladeski and Cowell 1996 |
|---|---|---|
| **Forested Ecosystems** | | |
| Open subalpine forest | SF | V16, V10 |
| Open white spruce forest | PC | V17, V11 |
| Open black spruce forest | BS | V18, V19, V23, V113 |
| Open lodgepole pine-spruce forest | LS | V21 |
| Open lodgepole pine forest | LP | V22 |
| Open lodgepole pine-aspen forest | LT | V33 |
| Open trembling aspen-spruce (pine) forest | TS | V30, V35, V6 |
| **Shrub Ecosystems** | | |
| Scrub birch medium/tall shrub | DB | V101, V102, V106 |
| Willow-scrub birch medium/tall shrub | WD | V105, V108 |
| Willow medium/tall shrub | WT | V104 |
| **Dwarf Shrub, Herb, Grass, and Lichen Ecosystems** | | |
| Wet sedge herb | SH | V206, V203 |
| Mesic mixed herb | MH | V213, V200, V201, V202, V212 |
| Heather-avens dwarf shrub | AS | V107, V115, V119 |
| Alectoria-cladina-cetraria fruticose lichen | AC | V300, V302 |

### 7.9.3 Effects Assessment Methodology

The objectives of the vegetation assessment are threefold:

- to identify, characterize and evaluate any measurable effects related to loss of vegetation due to clearing for minesite facilities and access road construction
- to identify, characterize and evaluate any measurable reduction in the health of vegetation due to Project emissions, dust generation and dispersal and establishment of invasive species
- to establish an environmental baseline for metals levels in plant tissues that are key browse species for focal wildlife species

#### *Effects Attributes*

Ideally, the assignation of effects attributes would be objective and based on comparison of VECC condition to ecological thresholds and policy objectives; however, ecological thresholds have not been developed in the Yukon for the vegetation VECCs used in this assessment. In the absence of well-defined criteria, a qualitative approach has been adopted based on subjective determinations of effects attributes and professional judgment.

Project and cumulative effects on vegetation will be characterized in accordance with the EA Report Guidelines using effects attributes defined in Table 7.9-9. The ecological and social context of effects attributes will be described in the text.

#### *Determination of Effect Significance*

The significance of residual project and cumulative effects on vegetation has been determined based on a consideration of the nature of the effects; the mitigation strategies that are available for reducing or eliminating these effects, and the nature and anticipated severity of residual effects after mitigation. Significance will be determined based on the defined effects attributes (Table 7.9-9), as follows:

A residual effect will be considered significant if it is;

- a high magnitude adverse effect unless it is local in geographic extent, or
- a high magnitude adverse effect that is local in geographic extent and far future in duration.

Otherwise, residual effects will be rated as not significant.

In addition to the determination of significance, as required by the EA Report Guidelines, the probability of occurrence of any significant adverse residual effects and the degree of confidence/uncertainty for each impact prediction will be stated with a supporting rationale.

## Table 7.9-9 Effect Attributes for Vegetation

| Attribute | Definition |
|---|---|
| **Direction** | |
| No Effect | Effect does not occur |
| Positive | Condition of VECC is improving |
| Negative | Condition of VECC is worsening or is not acceptable |
| Neutral | Condition of VECC is not changing in comparison to baseline conditions and trends |
| **Magnitude** | |
| Low | Effect occurs that might or might not be detectable, but is within the range of natural variability and does not compromise economic or social/cultural values |
| Moderate | Clearly an effect but unlikely to pose a serious risk to the VECC or represent a management challenge from an ecological, economic or social/cultural standpoint |
| High | Effect is likely to pose a serious risk to the VECC and represents a management challenge from an ecological, economic or social/cultural standpoint |
| **Geographic Extent** | |
| Site-Specific | Effect on VECC confined to a single small area within the Local Study Area (LSA) |
| Local | Effect on VECC within Local Study Area (LSA) |
| Regional | Effect on VECC within Regional Study Area (RSA) |
| **Duration[24]** | |
| Short term | Effect on VECC is limited to 1 year |
| Medium term | Effect on VECC occurs between 1 and 4 years |
| Long term | Effect on VECC lasts longer than 4 years, but does not extend more than 10 years after decommissioning and final reclamation |
| Far future[25] | Effect on VECC extends >10 years after decommissioning and abandonment |
| **Frequency (Short term duration effects that occur more than once)** | |
| Low | Frequency within range of annual variability and does not pose a serious risk to the VECC or its ecological, economic or social/cultural values |
| Moderate | Frequency exceeds range of annual variability, but is unlikely to pose a serious risk to the VECC or its ecological, economic or social/cultural values |
| High | Frequency exceeds range of annual variability and is likely to pose a serious risk to the VECC or its ecological, economic or social/cultural values |
| **Reversibility** | |
| Reversible | Effects on VECC will cease during or after the project is complete |
| Irreversible | Effects on VECC will persist during and/or after the project is complete |
| **Likelihood of Occurrence** | |
| Unknown | Effect on VECC is not well understood and based on potential risk to the VECC or its economic or social/cultural values, effects will be monitored and adaptive management measures taken, as appropriate |
| High | Effect on VECC is well understood and there is a high likelihood of effect on the VECC as predicted |

[24] Reclamation goals are assumed to be a stabilized surface and a native plant community. It is assumed that successional processes will move post-mine vegetation communities towards the original vegetation type, ideally within a 10 year period following decommissioning and final reclamation

[25] Effects to some VECCs may be permanent, i.e., not reversible.

### 7.9.4 Project Related Effects

#### 7.9.4.1 Baseline Scenario

***Rare Plants***

One plant species on the Yukon rare plant list, *Arnica angustifolia* ssp. *tomentosa* (J.M.Macoun) Douglas & Ruyle-Douglas, was located in a 'Mesic Mixed Herb' (MH) ecosystem unit northeast of the minesite (Figure 7.9-2; Figure 7.9-3). The conservation status of this species is characterized according to a ranking system in place throughout North America that was developed by the Nature Conservancy. Rankings reflect both the global and sub-national (i.e., territorial) status of the species and are based primarily on the number of documented occurrences. *Arnica angustifolia* ssp. *tomentosa* has a global rank of G5T5 (demonstrably secure but may be rare peripherally) and a sub-national or territorial rank of S1 (less than five occurrences in the Yukon). The location of this occurrence in the project area is as follows: Zone 9; Northing 6812443; Easting 440514; elevation 1760 m asl. The population at this site consisted of six scattered individuals growing along the crest and upper portions of a relatively mild (8–12%), undulating, north-facing slope.

The location of this population is more than one kilometre outside the disturbance footprint (Figure 7.9-3) and, therefore, should not be impacted by the project. No other rare plant locations were identified during project fieldwork or during a review of earlier inventories for the project area (Access Consulting Group 1996); therefore, no known rare plant populations or occurrences will be affected by the Project, and the rare plants VECC is not carried forward for further analysis of project-specific or cumulative effects. It should be noted that the rare plant survey conducted for this project is considered a sufficient level of effort but in no way does it confirm the absence of rare plants in the project disturbance footprint.

**Figure 7.9-3 Baseline and Full Build-out Distribution of Rare Plants within the RSA (Vol. 2)**

***Uncommon Vegetation Communities***

As discussed previously, uncommon vegetation communities include vegetated units comprising <1.0% of the ~14,000ha area of detailed ecosystem mapping. These are listed below:

- LT Open lodgepole pine-aspen forest
- PC - Open white spruce forest
- SH - Wet sedge herb
- TS - Open trembling aspen-spruce (pine) forest

Descriptions of these communities are included in Section 7.9.3, and the spatial distribution of the polygons containing uncommon vegetation communities units is portrayed in Figure 7.9-4. The availability of these communities at baseline (based on decomposed TEM polygons) in the LSA and RSA are provided in Table 7.9-9. In order to facilitate the assessment, it is assumed that rare plant communities in complex TEM polygons are evenly distributed within those polygons.

### Table 7.9-10 Baseline Area Summary of Uncommon Vegetation Communities in the RSA and LSA

| Uncommon Vegetation Community | Component V-Types (Zoladeski and Cowell 1996) | Bioclimate zone | Baseline Area RSA (Ha) | % of RSA | Baseline Area LSA (Ha) | % of LSA |
|---|---|---|---|---|---|---|
| LT - Open Lodgepole Pine-Aspen Forest | • V33-Open Lodgepole Pine-Aspen Forest | BOH | 50.08 | 0.40% | 11.67 | 0.40% |
| | | BOL | 6.29 | | 0 | |
| PC - Open White Spruce Forest | • V17- Open White Spruce Forest | BOH | 48.61 | 0.70% | 14.30 | 0.56% |
| | | BOL | 45.2 | | 2.04 | |
| | | SUB | 3.55 | | 0.00 | |
| SH - Wet Sedge Herb | • V206- Wet Sedge Herb<br>• V205- Wet Grass Herb | BOH | 86.51 | 0.91% | 9.73 | 0.57% |
| | | BOL | 23.67 | | 4.30 | |
| | | SUB | 16.76 | | 2.57 | |
| TS - Open Trembling Aspen-Spruce (Pine) Forest | • V30- Open Trembling Aspen-Spruce (Pine) Forest<br>• V35- Open Black Spruce-Aspen Forest<br>• V6- Open Trembling Aspen Forest | BOH | 37.85 | 0.40% | 0.37 | 0.08% |
| | | BOL | 17.57 | | 1.94 | |
| | | Total | 336.09 | 2.41% | 46.92 | 1.62% |

### Figure 7.9-4 Baseline and Full Build-out Distribution of Uncommon Vegetation Communities in the RSA (Vol. 2)

Table 7.9-11 summarizes the availability of TEM polygons containing uncommon vegetation communities in the LSA and RSA.

### Table 7.9-11 Baseline Availability of Uncommon Vegetation Community Conservation Status Classes

| Conservation Status | Baseline Area RSA (Ha) | % of RSA | Baseline Area LSA (Ha) | % of LSA |
|---|---|---|---|---|
| Low | 45.31 | 0.32% | 2.39 | 0.08% |
| Moderate | 373.86 | 2.67% | 51.66 | 1.78% |
| High | 625.14 | 4.47% | 98.02 | 3.38% |
| Extremely High | 30.92 | 0.22% | 11.31 | 0.39% |
| Total | 1075.23 | 7.68% | 163.38 | 5.63% |

### *Mature and Old Forest*

Disturbance, due largely to fire has limited the extent of large tracts of mature forest in the RSA. Some portions of the RSA, however, have escaped repeated burns, which have allowed mature and old forests to develop.

In the Boreal Lowland and Boreal Highland bioclimate zones, lodgepole pine stands generally regenerate after burns. These pine forests are often mixed with regenerating white spruce and trembling aspen but generally do not reach ages greater than 140 years. On richer soils and in areas that have longer fire intervals, white spruce becomes the climax tree species and can reach well over 140 years. In the Subalpine bioclimate zone, the dominant tree species is subalpine fir; however, canopy cover rarely exceeds 20%. These slow growing forests are influenced not only by cold temperatures and strong winds but also by fire disturbance; hence, they take many years to regenerate into mature forests. Some mature subalpine fir stands do exist in the RSA and can reach ages of 140 years.

Seven forested ecosystems were mapped in the RSA (Figure 7.9-2). These were summarized by structural stage for the RSA and the LSA in Table 7.9-12 and mapped in Figure 7.9-5. A summary of old and mature forest ecosystems by bioclimate zone and rating class is provided in Table 7.9-13 and Table 7.9-14, respectively.

**Table 7.9-12 Baseline Area Summary of Mature and Old Forest Ecosystems**

| Forested Ecosystem Type | Structural Stage | Bioclimate zone | Baseline Area RSA (Ha) | % of RSA | Baseline Area LSA (Ha) | % of LSA |
|---|---|---|---|---|---|---|
| BS | 6 | BOH | 1195.25 | 8.55% | 329.63 | 11.37% |
| | | BOL | 154.75 | 1.11% | 27.24 | 0.94% |
| | | SUB | 7.00 | 0.05% | 0 | 0% |
| LP | 6 | BOH | 131.93 | 0.94% | 6.44 | 0.22% |
| | | BOL | 47.57 | 0.34% | 8.07 | 0.28% |
| LS | 6 | BOH | 976.99 | 6.99% | 241.6 | 8.33% |
| | | BOL | 165.53 | 1.18% | 19.94 | 0.69% |
| | | SUB | 0.29 | 0.00% | 0 | 0% |
| LT | 6 | BOH | 48.50 | 0.35% | 11.67 | 0.40% |
| | | BOL | 1.68 | 0.01% | 0 | 0% |
| PC | 6 | BOH | 39.00 | 0.28% | 9.56 | 0.33% |
| | | BOL | 45.20 | 0.32% | 2.04 | 0.07% |
| | 7 | BOH | 9.61 | 0.07% | 4.74 | 0.16% |
| | | SUB | 3.55 | 0.03% | 2.54 | 0.09% |
| SF | 6 | BOH | 1201.07 | 8.59% | 304.53 | 10.50% |
| | | BOL | 8.93 | 0.06% | 8.93 | 0.31% |
| | | SUB | 668.00 | 4.78% | 230.26 | 7.94% |
| TS | 6 | BOH | 36.25 | 0.26% | 0.26 | 0.01% |
| | | BOL | 17.57 | 0.13% | 1.94 | 0.07% |
| | | Total | 4758.67 | 34.05% | 1209.39 | 41.70% |

**Figure 7.9-5 Baseline and Full Build-out Distribution of Mature and Old Forest in the RSA (Vol. 2)**

### Table 7.9-13 Baseline RSA Summary of Mature and Old Forest Representation within Bioclimate Zones

| Bioclimate Zone | Total Area of Mature and Old Forest (ha) | RSA Level Representation (%) | Proportion of Mature and Old Forest within each Bioclimate Zone in the RSA |
|---|---|---|---|
| BOH | 3,638.60 | 26.03% | 51.14% |
| BOL | 441.24 | 3.16% | 54.55% |
| SUB | 678.85 | 4.86% | 14.02% |

### Table 7.9-14 Baseline Availability of Mature and Old Forest Rating Classes

| Class | Baseline Area RSA (Ha) | % of RSA | Baseline Area LSA (Ha) | % of LSA |
|---|---|---|---|---|
| Low | 3717.74 | 26.57 | 921.93 | 31.79 |
| Moderate | 3703.64 | 26.47 | 941.67 | 32.47 |
| High | 34.00 | 0.24 | 14.39 | 0.50 |
| Total | 7455.38 | 53.28 | 1877.99 | 64.76 |

#### *Wetland and Riparian Vegetation Communities*

Wetland and riparian communities make up a relatively small percentage (13.9%) of the total RSA area (Figure 7.9-6) (Table 7.9-15), yet they are important ecosystems for wildlife forage and refuge, often house rare flora, and regulate water levels in adjacent drainage systems. The most common wetland vegetation type is Wet Sedge Herb denoted by the map code ‘SH’. The most common riparian vegetation type is a tall willow-dominated ecosystem denoted by the map code ‘WT’ and mapped with a ‘y’ modifier to indicate wet soil conditions.

### Figure 7.9-6 Baseline and Full Build-out Distribution of Wetland and Riparian Vegetation Communities in the RSA (Vol. 2)

### Table 7.9-15 Wetland and Riparian Vegetation Community Representation

| Wetland Riparian Feature Class | Bioclimate Zone | Baseline Area RSA (Ha) | % of RSA | Baseline Area LSA (Ha) | % of LSA |
|---|---|---|---|---|---|
| Riparian | BOH | 626.04 | 6.43% | 152.69 | 8.04% |
| | BOL | 57.95 | | 15.21 | |
| | SUB | 215.79 | | 65.26 | |
| Wetlands | BOH | 635.57 | 7.08% | 105.30 | 6.32% |
| | BOL | 131.2 | | 25.78 | |
| | SUB | 223.24 | | 52.18 | |
| Wetland and Riparian Edge | BOH | 16.71 | 0.37% | 16.58 | 1.21% |
| | BOL | 22.53 | | 8.00 | |
| | SUB | 12.62 | | 10.57 | |
| | Total | 1,941.65 | 13.9% | 451.57 | 15.57% |

#### *Alpine Vegetation Communities*

Alpine vegetation communities comprise only 6.47% of the vegetation RSA and 0.11% of the vegetation LSA. The project footprint does not have any direct effects on the alpine bioclimate zone (Figure 7.9-7). Accordingly, alpine vegetation communities have been dropped from the assessment and will not be discussed further

### Figure 7.9-7 Baseline and Full Build-out Distribution of Alpine Vegetation Communities in the RSA (Vol. 2)

#### *Traditional Use Plants/Communities*

Traditional use plant communities have been addressed by modeling the abundance of key berry-producing shrubs using the project TEM and field data to determine which vegetation communities from the project TEM are most productive for the target species. The model summarizes berry productivity for multiple species into three productivity classes: low, moderate, and high (Table 7.9-16). The distribution of potential berry picking areas at baseline is shown on Figure 7.9-8.

### Table 7.9-16 Baseline Availability of Productive Berry Areas

| Berry Productivity Rating | Baseline Area RSA (Ha) | % of RSA | Baseline Area LSA (Ha) | % of LSA |
|---|---|---|---|---|
| High | 181.85 | 1.31% | 2.68 | 0.09% |
| Moderate | 4,182.28 | 30.04% | 931.32 | 32.11% |
| Low | 9,197.52 | 66.06% | 1,701.07 | 58.65% |
| Total | 13,561.65 | 97.41% | 2635.07 | 90.86% |

### Figure 7.9-8 Baseline and Full Build-out Distribution of Productive Berry Areas in the RSA (Vol. 2)

### *Forest Land Capability*

Forest land capability in the forest resources RSA (FRRSA) has been characterized using Yukon vegetation mapping (Figure 7.9-9) displaying site index values for forested polygons within the forest resources RSA. Site index is an estimate of site productivity for tree growth. This attribute provides a common base for comparing the productivity of different sites. Site index is the height of a dominant or codominant tree at a given age. In the Yukon, the reference age for site index is 100 years. This source mapping database also contains site class ratings for each polygon, which are based on site index values for all commercial tree species found in the Yukon (Forest Resources 2003). Site classes are more general measures of site productivity and are correlated to site index values (Table 7.9-17).

**Figure 7.9-9 Distribution of Productive Forest in the Forest Resources RSA (Vol. 2)**

**Table 7.9-17 Yukon Forest Productivity Ratings (Site Class and Site Index)**

| Site Class Code | Site Class | Site Index Range |
|---|---|---|
| L | Low | 0-9.9 |
| P | Poor | 10-14.9 |
| M | Medium | 15.0-19.9 |
| G | Good | 20+ |

The study area forest polygons have site index ratings ranging from 0 to 13; the majority are below 10 (Figure 7.9-9) which corresponds to the ‘low’ site class. This is not productive forest land; therefore, the project is not expected to have an effect on forest productivity within the RSA or the Upper Liard Forest Management Unit.

In addition to the thematic mapping based on Yukon vegetation cover mapping, forested communities were surveyed as part of the ecosystem mapping fieldwork. TEM tree mensuration protocols (Luttermerding et al. 1998) were used to assess forest community distribution and composition. Mature trees in sampling plots were measured and cored with an increment borer to determine canopy cover, total height, diametre at breast height, and age at breast height. This forest mensuration sample data is included in a tabular summary in Appendix 7.9-6 and largely confirms the low productivity rating for the RSA, with the possible exception of the relatively productive, though uncommon Open White Spruce (PC) vegetation community and is not abundant enough to be reflected in the polygon-level site index values of the Yukon vegetation cover mapping.

### *Trace Element Concentrations in Vegetation*

Baseline tissue element concentration data were available from five sites sampled in 1996 and included both lichen (*Cladina*) and willow (*Salix*) samples (Access Consulting Group 1996). In 2005, samples of *Salix* species were collected at an additional seven sites in the study area ranging from the Boreal Lowlands to the Subalpine bioclimate zones. Leaves and twigs were collected and labeled according to site and were stored in a cooler for later analysis. Analyses were performed by CANTEST Ltd. of Burnaby, B.C. Samples were digested using nitric acid-hydrogen peroxide procedures based on EPA Method 200.3 prior to analysis. For all metals, excluding mercury, analysis was by Inductively Coupled Argon Plasma Spectroscopy (ICP), ICP Mass Spectrometry (ICP-MS) or Atomic Absorption techniques. Mercury was analyzed by Cold Vapour Atomic Absorption Spectrophotometry or Cold Vapour Atomic Fluorescence Spectrophotometry.

Results of the tissue analyses of *Salix* species from the 2005 collections are presented in Table 7.9-18. The full Cantest analytical report and the results from the 1996 study are included in Appendix 7.9-5.

**Table 7.9-18 Willow (*Salix* spp.) Tissue Element Concentrations from the 2005 Sampling Program**

| Sample Site | Bioclimate zone | Genus | Tissue element concentration (µg/g) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | As | Cd | Cu | Pb | Hg | Mo | Se | Zn |
| WZ03 | Boreal Lowland | *Salix* | 0.2 | 17.6 | 4.4 | 0.2 | <0.01 | 0.5 | 3.3 | 811 |
| WZ22 | Subalpine | *Salix* | <0.1 | 2.04 | 7.1 | 0.1 | <0.01 | 0.1 | <0.2 | 168 |
| WZ26 | Subalpine | *Salix* | <0.1 | 1.93 | 5.3 | 0.3 | <0.01 | <0.1 | <0.2 | 80.8 |
| WZ27 | Subalpine | *Salix* | <0.1 | 0.84 | 3.9 | 0.1 | <0.01 | 0.2 | <0.2 | 54.7 |
| WZ32 | Subalpine | *Salix* | <0.1 | 12.4 | 4.8 | 0.1 | <0.01 | 0.1 | 0.5 | 557 |
| WZ44 | Subalpine | *Salix* | <0.1 | 2.23 | 7.4 | 0.1 | <0.01 | 0.3 | <0.2 | 117 |
| DS34 | Boreal Highland | *Salix* | <0.1 | 1.52 | 6.3 | <0.1 | <0.01 | 0.4 | 0.2 | 140 |

### 7.9.4.2 Full Build-out Scenario

The full build-out scenario includes both the construction and operations phases of the project, but effects of each phase will be discussed separately where appropriate. The abundance and distribution of vegetation VECCs will change from baseline conditions as a result of direct effects from the project. These effects will be identified and described for the period immediately following mine closure.

The project has a footprint area of approximately 100 ha that is comprised of mine portal and industrial complex (including process plant, water treatment plant, ore stockpiles, temporary development rock storage, concentrate loading facilities), tailings pond, camp accommodations, airstrip, borrow pit and access road. All vegetation will be removed from this area during construction and then will be progressively reclaimed during and after production.

#### *Potential Interactions*

General project effects on vegetation during various phases of the full build-out scenario are summarized in Table 7.9-19. Specific effects on each VECC are described below.

### Table 7.9-19 Project Phase Activities and Potential Environmental Effects on Vegetation

| Project Phase | Project Activity | Potential Effects on Vegetation |
|---|---|---|
| Construction | Access Road ROW preparation | Loss of vegetation |
| | | Change in abiotic site conditions for vegetation development |
| | Minesite development | Loss of vegetation |
| | | Change in abiotic site conditions for vegetation development |
| | Clean-up and reclamation | Change in abiotic site conditions for vegetation development |
| | | Change in structure and composition |
| Operations | Invasive species introduction or dispersal | Change in structure and composition |
| | Dust, road salt and emissions | Change in abiotic site conditions for vegetation development |
| | | Change in structure and composition |
| | Windthrow | Change in structure and composition |
| Decommissioning | Reclamation of above ground facilities | Recovery of vegetation |
| | Discontinuation of dust generation and emissions | Recovery of vegetation |

#### *Uncommon Vegetation Communities*

*Project Effects*

The full build-out scenario s is expected to change the abundance, distribution and health of uncommon vegetation communities within the LSA. Direct effects comprise vegetation loss due to clearing activities. Indirect effects are expected to include changes in abiotic conditions for vegetation development, and changes in the composition and structure of vegetation communities due to vegetation drying, sunscald, windthrow, invasive species establishment, dustfall and emissions associated with project activities and disturbance. At pre-development, the four uncommon vegetation communities identified in the project area comprised a total of 1094 ha or 8% of the RSA (Table 7.9-20).

The direct effect of the full build-out scenario on uncommon vegetation communities, according to their relative conservation status, is summarized in Table 7.9-20. Because, in many instances, uncommon vegetation communities make up only a fraction of a complex TEM polygon (containing two or three vegetation communities), this summary is a provides only a coarse estimate of the area of vegetation loss for this VECC.

TEM polygons containing uncommon vegetation communities of 'extremely high' conservation value comprise only 33 ha of the RSA (<1%) pre-baseline. Availability of polygons containing these communities is expected to decrease by seven hectares as a result of build-out disturbance, a reduction of 21%. Uncommon vegetation communities of high, moderate and low conservation status represent 641 ha, 375 ha and 45 ha, respectively, in the pre-disturbance scenario. The availability of these communities is expected to decrease by 10%, 11% and 1%, respectively, under the full build-out scenario.

The most important impact to uncommon vegetation communities is the potential loss of the ‘extremely high’ conservation status areas, in particular, the polygons containing the old (structural stage 7) Open White Spruce Forest (PC) ecosystem. One of these areas is located on an alluvial fan in the southeast corner of Wolverine Lake (Figure 7.9-4). A tree age taken during field sampling indicated that this stand is greater than 180 yrs old. These mature and old alluvial spruce ecosystems are a known conservation concern in the Yukon (INAC 2003). The other polygon containing these communities is located northeast of Go Creek and is also considered to be an area of significant importance in the RSA.

#### *Mitigation Measures*

The key mitigation for uncommon vegetation communities is avoidance. Project design and operations should avoid mapped occurrences of uncommon vegetation communities, particularly the ‘extremely high’ conservation status area located on the alluvial fan in the southeast corner of Wolverine Lake. In addition, project personnel should be aware of the characteristics of the four uncommon vegetation communities identified for the project area and should endeavour to protect unmapped (small) high conservation value occurrences in instances where there is the operational flexibility to do so.

Based on the current project layout (Section 2.1) the proponent does not plan to create any incremental disturbance in the extremely high conservation status uncommon vegetation community polygon adjacent to Wolverine Lake. Avoidance of the other mapped ‘extremely high’ conservation status polygon, located in the access road corridor northeast of Go Creek (Figure 7.9-4), would mitigate impacts to all mapped occurrences of this high value vegetation community.

Other mitigations are recommended to address the indirect effects of dust generation, windthrow, and invasive species establishment on uncommon vegetation communities and are included in the list of vegetation mitigations compiled for the project (Section 9.2: Environmental Protection Plan).

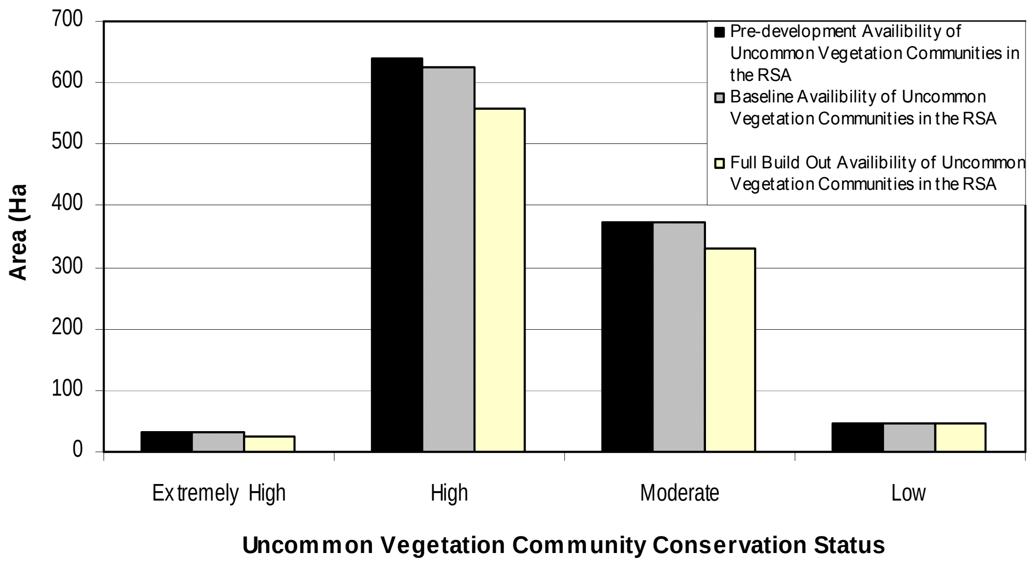
#### *Residual Project Effects*

The assessment of project effects on uncommon vegetation communities assumes avoidance of the two ‘extremely high’ uncommon vegetation community polygons only, and general application of the vegetation mitigations (Section 9.2) when working in the vicinity of all vegetation VECCs. Reclamation procedures (e.g., progressive reclamations, prompt reseeding of reclaim areas) will result in revegetation of these areas; however, anticipated changes in the soil moisture and nutrient regime within reclaimed areas will likely preclude recovery of the definitive biotic attributes of uncommon vegetation communities.

Taking into account the identified mitigations, and assuming the conservative disturbance footprint, the residual project effects to the uncommon vegetation communities of ‘high’, ‘medium’ and ‘low’ conservation status at full build-out are summarized on Table 7.9-20. A summary of the areas of uncommon ecosystems under the pre-baseline, baseline and full build-out scenarios is provided in Figure 7.9-10. Affected ecosystems are shown on Figure 7.9-4.

## Table 7.9-20 Project Effects on Uncommon Ecosystems in the RSA at Full Build-out

| Conservation Status | Pre-Disturbance Area (1992) | | Disturbance at Baseline (2004) | | Project Disturbance (Full Build-out) | |
|---|---|---|---|---|---|---|
| | Polygon Area (ha) | % of RSA | Area Disturbed (ha) | % Disturbed | Area Disturbed (ha) | % Disturbed |
| Extremely High | 33 | 0% | 2 | 6% | 7 | 21% |
| High | 641 | 5% | 16 | 3% | 66 | 10% |
| Moderate | 375 | 3% | 1 | 0% | 42 | 11% |
| Low | 45 | 0% | 0 | 0% | 0 | 1% |
| Total | 1094 | 8% | 19 | 2% | 115 | 11% |




## Figure 7.9-10 Comparison of Pre-baseline, Baseline and Full Build-out Availability of Uncommon Vegetation Communities in the RSA

### *Mature and Old Forest*

*Project Effects*

The primary direct project effect to mature and old forest in the LSA under the full build-out scenario is vegetation loss due to clearing activities for development of the minesite and its associated infrastructure. Indirect effects are expected to include changes in abiotic conditions for forest development, and changes in the composition and structure of forest communities due to windthrow, forest health issues, invasive species establishment, dustfall and emissions associated with project activities and disturbance. At pre-development, TEM polygons containing portions of one or more of the three mature/old forest classes identified for the project comprised a total of 7583 ha or 54% of the vegetation RSA (Table 7.9-21). Of these, only 36 ha were rated as high value old growth.

Based on the conservative full build-out scenario, the availability of polygons containing mature and old forest in the 'high' class will be reduced by 10 ha (27%) (Table 7.9-21). The limited extent of these high value forests (host polygons totaled only 36 ha in the RSA pre-baseline) elevates the ecological importance of this effect. In the full build-out scenario, TEM polygons containing mature and old forest in the 'moderate' and 'low' classes occupy a combined area of 7547 ha (54%) of the RSA pre-disturbance and the availability of polygons containing these classes in the RSA will be reduced by 736 ha (20%%) and 683 ha (18%), respectively, under the full build-out scenario (Table 7.9.21).

### *Mitigation Measures*

Because site characteristics and natural disturbances such as wind, disease, landslides and fire, which inhibit the development of mature and old forests, losses are considered to be permanent. Therefore, the only effective approach to mitigating the loss of mature and old forest is avoidance.

Recommended avoidance of the uncommon vegetation communities with 'extremely high' conservation status in the previous section will also result in avoidance of the 'high' rated old forest polygons. Application of vegetation mitigations (Section 9.2: Environmental Protection Plan) will mitigate impacts to mature and old forest (e.g., windthrow, forest health issues) adjacent to cleared areas; however, these mitigations will not reduce the area of mature and old forest removed by the project.

### *Residual Project Effects*

Residual effects on mature and forest classes in the RSA (Table 7.9-21) were quantified based on the following assumptions:

- avoidance of the 'high' rated old growth polygons
- reductions in class ratings for old growth in the ZOI of cleared areas
- conservative disturbance footprint for full build-out scenario

Areas of the three classes of mature and old forest in the RSA pre-baseline, and in the baseline and full build-out scenarios are shown on Figure 7.9-11. The distribution of areas (polygons) affected are shown on Figure 7.9-5

**Table 7.9-21 Project Effects on Mature and Old Forest in the RSA at Full Build-out**

| Mature/Old Forest Class | Pre-Disturbance Area (1992) | | Disturbance at Baseline (2004) | | Project Disturbance (Full Build-out) | |
|---|---|---|---|---|---|---|
| | Polygon Area (ha) | % of RSA | Area Disturbed (ha) | % Disturbed | Area Disturbed (ha) | % Disturbed |
| High | 36 | 0% | 2 | 6% | 10 | 27% |
| Moderate | 3755 | 27% | 52 | 1% | 736 | 20% |
| Low | 3792 | 27% | 74 | 2% | 683 | 18% |
| Total | 7583 | 54% | 128 | 2% | 1429 | 19% |

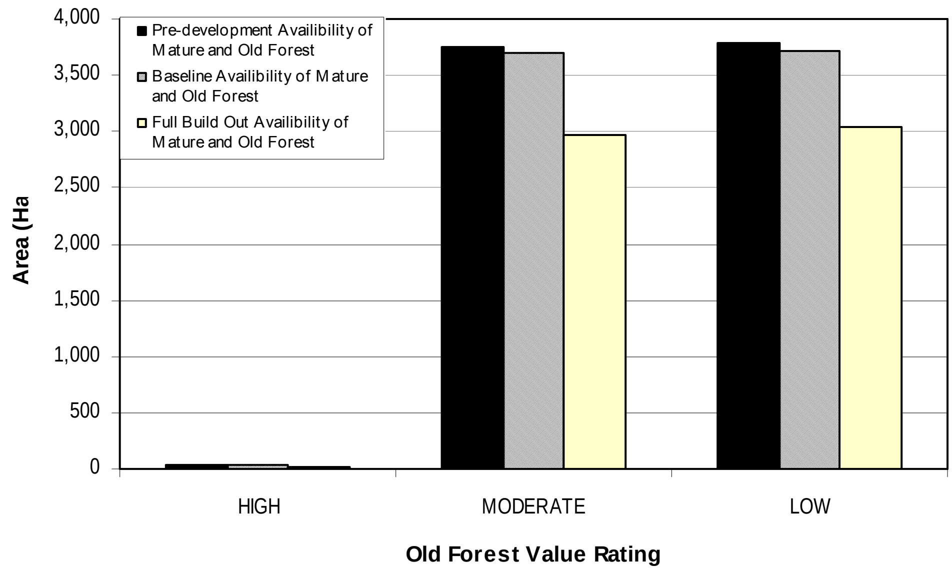



**Figure 7.9-11 Comparison of Pre-baseline, Baseline and Full Build-out Availability of Mature and Old Forest in the RSA**

### *Wetland and Riparian Communities*

*Project Effects*

Project-specific effects to wetland and riparian vegetation communities in the LSA occurring during the construction, operation and decommissioning phases of the full build-out scenario are expected to change the abundance, distribution and health of these communities within the LSA. Direct effects are expected in the form of vegetation loss and will also involve peat and soil removal due to clearing and construction activities. Indirect effects are expected to include changes in abiotic conditions for vegetation development, and changes in the composition and structure of vegetation communities due to changes in wetland hydrology, invasive species establishment, dustfall and emissions associated with project activities and disturbance. At pre-development, the combined area of riparian buffers and TEM polygons containing portions of one or more of the wetland vegetation communities identified for the project comprised a total of 1965 ha or 14% of the vegetation RSA (Table 7.9-22).

The primary project-specific effect to wetland and riparian vegetation communities is a reduction in the spatial extent of these vegetation communities due to minesite development and construction of related infrastructure. Loss and disturbance of wetlands and riparian areas may also have effects on wetland hydrology on and beyond the project footprint. Since the lateral movement of water influences the hydrodynamics of fens, these wetland types are particularly vulnerable. Other effects may include changes in drainage patterns, loss of floodplain communities due to bank erosion, and translocation of sediment and pollutants into wetland and riparian communities.

Based on the conservative full build-out scenario, the project will reduce riparian vegetation communities by 119 ha (12%) in the vegetation RSA based on pre-baseline availability of 1025 ha. TEM Polygons containing wetland vegetation communities will be reduced by 168 ha, a reduction of 18% of pre-baseline wetland availability of 940 ha in the RSA (Table 7.9-22). The area that was within the zone of influence for baseline disturbance ('wetland and riparian edge') will be reduced from 52 ha to 29 ha (a reduction of 55% from baseline availability); however, this effect is considered to be of lesser ecological importance than the other wetland and riparian effects, as the ecological value of these edge areas is assumed to have been previously compromised and of lower functional value at baseline than other wetland and riparian areas.

### *Mitigation Measures*

The primary mitigation of project-specific effects to wetland and riparian vegetation communities is avoidance. This strategy will require pre-development identification and delineation of these communities followed by optimal siting of facilities and transportation infrastructure (away from wetland and riparian areas) coupled with implementation of a suite of riparian management practices during operations.

Other mitigation measures to address environmental effects to wetlands include construction in frozen ground conditions only and salvage of organic materials. Salvaged organic matter should be replaced as the ground surface layer during backfill operations without incremental reclamation seeding.

### *Residual Project Effects*

Wetlands naturally undergo succession and can evolve in response to hydrological disturbances (Banner and Mackenzie 2000) although the site potential may be altered; however, many of the project impacts to wetlands are of a more permanent nature (e.g., roads, minesite). It is assumed that the application of the vegetation mitigations (Section 9.2: Environmental Protection Plan) will address many of the potential project effects on wetlands and riparian areas through the establishment of appropriate buffers and management reserves; therefore, residual project-specific effects are assumed to be the effects associated with the permanent disturbances and those which fundamentally change abiotic conditions. By contrast, wetland and riparian areas within the clearing only area (i.e., removal of trees and tall shrubs only with vegetated surface left intact) are not expected to sustain permanent impacts, but instead are expected to recover through successional processes as described previously in this section.

Without having a detailed project footprint, it is not possible to determine the nature and extent of project effects on wetlands and riparian communities within the area of the full build-out scenario. However, Figure 7.9-6 indicates that the access road will cross at least seventeen riparian strips and either cross or run adjacent to four wetland areas in addition to project effects to Go Creek wetland and riparian areas in the minesite area. Therefore, for the purposes of the assessment, it is assumed that the full build-out scenario applies and all wetland and riparian vegetation communities within the claim boundaries will be affected by the project to some degree (Figure 7.9-12). However, assuming that best management practices are applied to riparian buffer areas and that, as a rule, wetlands are avoided, it is expected that at least 50% of the vegetation loss predicted by the full build-out scenario can be avoided.

**Table 7.9-22 Project Effects on Wetland and Riparian Vegetation Communities in the RSA at Full Build-out**

| Wetland/ Riparian Feature | Pre-baseline Area (1992) | | Disturbance at Baseline (2004) | | Project Disturbance (Full Build Out) | |
|---|---|---|---|---|---|---|
| | Polygon Area (ha) | % of RSA | Area Disturbed (ha) | % Disturbed | Area Disturbed (ha) | % Disturbed |
| Wetland | 939 | 7% | 27 | 3% | 168 | 18% |
| Riparian | 1,025 | 7% | 68 | 7% | 119 | 12% |
| Wetland/Riparian Edge | 0 | 0% | 0 | 0% | 29 | NA |
| Total | 1,965 | 14% | 95 | 5% | 315 | 16% |

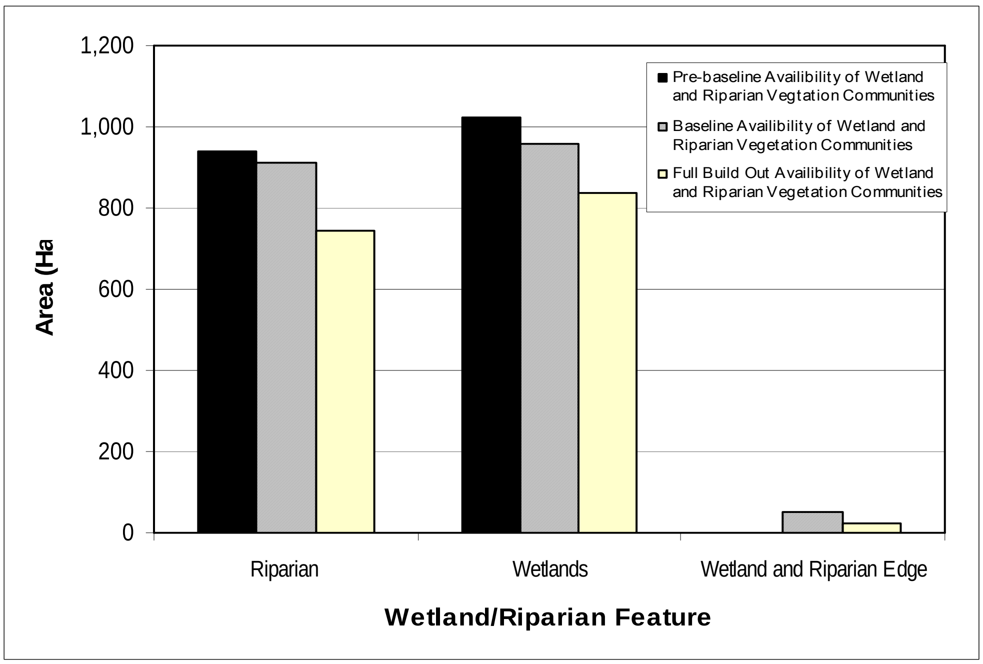



**Figure 7.9-12 Comparison of Pre-baseline, Baseline and Full Build-out Wetland and Riparian Vegetation Communities in the RSA**

### *Traditional Use Plants/Communities*

#### *Project Effects*

Project-specific effects to traditional use plants/communities in the LSA occurring during the construction, operation and decommissioning phases of the full build-out scenario are expected to change the abundance, distribution and health of these communities within the LSA. Direct effects are expected in the form of vegetation loss. Indirect effects are expected to include changes in abiotic conditions for vegetation development, and changes in the composition and structure of vegetation communities due to invasive species establishment, dustfall and emissions associated with project activities and disturbance. At pre-development, the area of TEM polygons containing berry producing vegetation communities in all three classes identified for the project comprised a total of 13,909 ha or 99% of the RSA (Table 7.9-23).

As a result of project development, some areas that are currently productive for berry-producing shrubs will be disturbed and replaced by minesite features or related infrastructure. Fortunately, the most productive berry-producing areas (rated as 'high' productivity) will not be affected by the project (Figure 7.9-8). As a result of project disturbance, the 'medium' and 'low' productivity berry areas, which are occupy extensive areas of the RSA, will be reduced by 15% and 14%, respectively, relative to pre-disturbance availability (Table 7.9-23; Figure 7.9-13). However, as 'low' productivity areas are unlikely to be used by local First Nations for berry gathering, the effects to these areas are expected to be of low cultural or social importance. The effects to moderate productivity areas will, therefore, be the main focus of the remainder of the assessment of project effects on this VECC.

### *Mitigation Measures*

The project-specific effects to 'moderate' productive berry areas will largely be addressed through natural regeneration and successional processes that occur after decommissioning. As many of the target species are early successional species, it may be possible to enhance natural processes by including culturally important berry species in reclamation plantings on appropriate sites (i.e., located away from minesite areas); however, no specific mitigation is prescribed.

### *Residual Project Effects*

The residual project-specific effect to traditional use plant communities is a 15% reduction in the regional availability of moderate productivity areas. This effect is considered probable, although because the estimate of disturbance area is very conservative, the loss will likely to be less than the analysis suggests. It is assumed that no specific mitigation will be applied to address this impact.

**Table 7.9-23 Project Effects on Traditional Use Plant Communities in the RSA at Full Build-out**

| Berry Productivity Rating | Pre-Disturbance Area (1992) | | Disturbance at Baseline (2004) | | Project Disturbance (Full Build-out) | |
|---|---|---|---|---|---|---|
| | Polygon Area (ha) | % of RSA | Disturbed Area (ha) | % Disturbed | Disturbed Area (ha) | % Disturbed |
| High | 231 | 2% | 49 | 21% | 0 | 0% |
| Moderate | 4263 | 30% | 81 | 2% | 660 | 15% |
| Low | 9416 | 67% | 218 | 2% | 1306 | 14% |
| Total | 13,909 | 99% | 348 | 3% | 1966 | 14% |

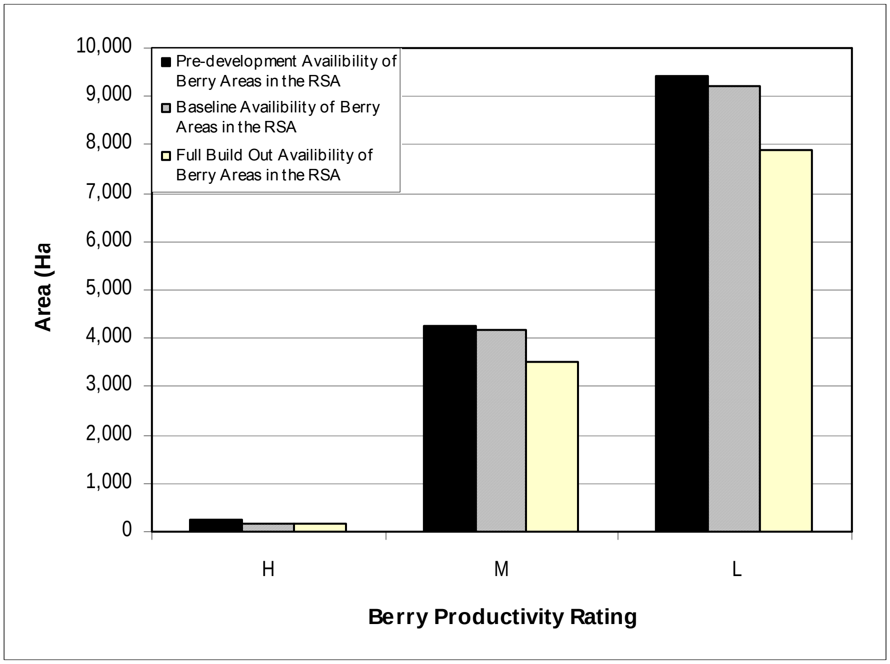



**Figure 7.9-13 Comparison of Pre-baseline, Baseline and Full Build-out Availability of Traditional Use Plant Communities in the RSA**

### 7.9.4.3 Closure

The closure scenario begins after decommissioning. The project infrastructure and facilities will be influenced by the following reclamation and closure actions:

- The development rock pile will be backfilled to completed mine workings within the first five years of operation.
- Final decommissioning will occur in two phases:
  1. Final mine backfilling and sealing of the portal along with the removal of the processing plant and all extraneous ancillary facilities, camp accommodations etc, with the exception of the water treatment plant. The water treatment plant will remain operational during this phase for the first five years after decommissioning, to treat tailing pond supernatant if required.
  2. Removal of the water treatment plant and final closure.
- The airstrip and access road will be left in place.
- Tailings facility will be reclaimed as a pond with passive discharge by a spillway and drainage channel to Go Creek.

#### *Uncommon Vegetation Communities*

Because uncommon vegetation communities have fairly specific ecological requirements and characteristics that reflect unique site conditions, post-closure recovery of areas that have been affected by the project is not expected to occur. In addition, because conservation status is a function of both the sensitivity and structural stage (age) of these vegetation communities, the time horizons required for recovery of high conservation status communities are lengthy (e.g., >140 years for the 'extremely high' class). For similar reasons, it is not expected that other ecological types will be able to be reclaimed to match the ecological characteristics of these uncommon vegetation communities; therefore, aside from avoidance of the 'extremely high' conservation status uncommon vegetation communities and application of vegetation mitigations (Section 9.2), the full build-out and closure scenarios are anticipated to be the same for uncommon vegetation communities.

#### *Mature and Old Forest*

Mature and old forest by definition requires extremely long time periods to develop (>80 years). Assuming appropriate reclamation measures are applied to affected areas at decommissioning (i.e., replanting or coniferous species), project effects to mature and old forest are potentially reversible over long time periods. In addition, through careful management of residual forest stands within the RSA, mature and old forest may be recruited from younger stands in the area over shorter time frames. However, because the closure scenario only extends 10 years beyond decommissioning, it will not vary from the full build-out scenario with respect to the mature and old forest VECC.

#### *Wetland and Riparian Vegetation Communities*

Assuming that appropriate mitigations are applied, wetland and riparian vegetation communities indirectly affected by the project are expected to regenerate and recover in areas where drainage patterns are not altered. However, based on the assumption that the mine access will remain in place and the minesite, with the exception of the tailings pond, will not be reclaimed to wetland or riparian communities, the recovery of wetland and riparian vegetation communities in the post-closure phase is expected to be minor. Therefore, the closure phase is assumed to be the same as the full build-out phase with respect to the availability of wetland and riparian vegetation communities. As stated earlier, the main opportunities to mitigate related effects is early avoidance during the construction phase through environmentally sensitive project design and to a lesser degree through mitigation of indirect effects with appropriate riparian area management during operations.

#### *Traditional Use Plants/Communities*

The berry-producing shrub species identified as having potential value for traditional use will likely re-colonize reclaimed mine areas to varying degrees due to their affinity for early and mid-seral conditions; however, reclaimed mine features are not expected to be perceived as suitable areas for traditional use gathering due to the potential (whether real or perceived) for contamination of berry species by mine spoils. Therefore, the post-mine condition of traditional use plants is not expected to vary appreciably from the full build-out scenario.

### 7.9.4.4 Residual Project Effects and Significance

Table 7.9-24 provides a summary of the post-closure project-specific residual effects (after mitigation) to each of the vegetation VECCs and the associated components. These effects are based on the conservative full build-out scenario developed for the project and any assumed mitigation measures described. The effects have been estimated without the benefit of a fully defined project footprint or reclamation plan and, therefore, largely reflect the full build-out scenario.

The significance of these residual effects will be determined based on the criteria established for the assessment (Section 7.9.4).

## Table 7.9-24 Residual Effects Summary

| VECC | Rating or Feature Class | Pre-Disturbance Area | | Disturbance at Baseline | | Project Disturbance | | Project Disturbance + Baseline Disturbance | |
|---|---|---|---|---|---|---|---|---|---|
| | | ha | % of RSA | ha | % Change | ha | % Change | ha | % Change |
| Uncommon Vegetation Communities | Extremely High Conservation Status | 33 | 0% | 2 | 6% | 7 | 21% | 9 | 28% |
| | High Conservation Status | 641 | 5% | 16 | 3% | 66 | 10% | 82 | 13% |
| | Moderate Conservation Status | 375 | 3% | 1 | 0% | 42 | 11% | 43 | 11% |
| | Low Conservation Status | 45 | 0% | 0 | 0% | 0 | 1% | 0 | 1% |
| Mature and Old Forest | High Mature/Old Forest Value | 36 | 0% | 2 | 6% | 10 | 27% | 12 | 33% |
| | Moderate Mature/Old Forest Value | 3755 | 27% | 52 | 1% | 736 | 20% | 788 | 21% |
| | Low Mature/Old Forest Value | 3792 | 27% | 74 | 2% | 683 | 18% | 757 | 20% |
| Wetlands and Riparian | Wetlands | 939 | 7% | 27 | 3% | 168 | 18% | 195 | 21% |
| | Riparian | 1025 | 7% | 68 | 7% | 119 | 12% | 187 | 18% |
| | Wetland/Riparian Edge | 0 | 0% | 0 | 0% | 29 | NA | 29 | NA |
| Traditional Use Plants/ Communities | High Berry Productivity | 231 | 2% | 49 | 21% | 0 | 0% | 49 | 21% |
| | Moderate Berry Productivity | 4263 | 30% | 81 | 2% | 660 | 15% | 741 | 17% |
| | Low Berry Productivity | 9416 | 67% | 218 | 2% | 1306 | 14% | 1524 | 16% |

### *Uncommon Vegetation Communities*

*Residual Effects*

The residual effects to uncommon vegetation communities are related primarily to the unmitigated effects of vegetation loss in the 'high' (10%), 'moderate' (11%) and 'low' (1%) conservation status classes. Project effects to the 'extremely high' conservation status areas are assumed to be entirely mitigated through project design. These residual effects are likely to be overstated due the conservative nature of the full build-out scenario.

#### *Ecological and Cultural Context*

As stated earlier, the Yukon does not currently track rare ecosystems. Additionally, the uncommon vegetation communities identified for the project are based solely on relative abundance within the RSA. Therefore, while impacts to these ecosystems are important from a local perspective, it is not possible to comment on the relevance of impacts at a regional or territorial level.

#### *Reversibility*

As stated previously, project effects to uncommon vegetation communities are not considered to be reversible due to the specific abiotic and natural disturbance conditions required for their development, which cannot reliably be replicated in the post-closure scenario.

#### *Significance*

Effects to uncommon vegetation communities are adverse, moderate in magnitude, local in extent and far future in duration. These effects are, therefore, not significant.

#### *Likelihood of Occurrence*

Thresholds for acceptable losses to rare plant communities have not been developed. The ability of these sites to recover will vary with the availability of suitable species to re-colonize a site, whether the uncommon vegetation community is an early seral or a climax plant community, and whether the conditions that created these associations are still present; therefore, the likelihood of effects occurring as predicted is unknown.

### ***Mature and Old Forest***

#### *Residual Effects*

Residual effects to mature and old forest include a 20% and 18% reduction in the availability of forest in the ‘moderate’ and ‘low’ classes respectively. It is assumed that effects on polygons within the ‘high’ class will be entirely mitigated through avoidance. These effects are likely to be overstated due the conservative nature of the full build-out scenario.

#### *Ecological and Cultural Context*

The Yukon does not currently have any regulatory- or policy-driven thresholds for mature or old forest retention at the landscape scale. The Yukon *Timber Harvest Planning and Operating Guidebook* (Yukon Forest Resources 1999) may provide some guidance in this respect, but is currently under review and is not being actively used for policy or operational guidance. The recent screening of the *Kaska Forest Resources Timber Harvest Agreement* (INAC 2003) emphasized the key habitat values of old stands of white spruce growing on alluvial deposits and the relatively high impacts sustained by these stands as a result of past forest harvesting in the southeast Yukon. In addition, the increase in both human- and lighting-caused fires in the last 50 years (Yukon Department of Environment 2002) indicates that the regional availability of mature and old forests may be under increasing pressure due to fire disturbance.

#### *Reversibility*

As stated previously, effects to mature and old forest that result in vegetation loss are not considered reversible within the frame of reference used for this assessment, due to the long time periods and specific site conditions that are required for these forests to develop. However, at the landscape scale these project effects are considered to be reversible over longer time periods (e.g., 100-120 years) and it is anticipated that younger unaffected forest stands in the region will be recruited to mature and old forest status in the interim.

#### *Significance*

Project-specific effects to mature and old forest are adverse, moderate in magnitude, local in extent and far future in duration; therefore, based on this assessment, they are considered to be not significant.

#### *Likelihood of Occurrence*

Thresholds for acceptable losses to mature and old forest have not been developed for the Yukon. The ability for these sites to recover will vary with the natural availability of suitable species to re-colonize a site; the nature, extent and severity of natural disturbance events; and the degree to which the abiotic conditions that created these forests are still present. Therefore, the likelihood of effects occurring as predicted is unknown. Accordingly, the assumptions about project effects are conservative.

### *Wetland and Riparian Vegetation Communities*

#### *Residual Effects*

Based on the assumptions about avoidance measures and mitigations, the residual direct project effects on wetlands and riparian vegetation communities are anticipated to be roughly half of the respective 18% and 12% loss predicted by the full build-out scenario. These residual effects to wetlands and riparian vegetation communities would likely include effects associated with minesite and road construction, with the effects of the road occurring primarily at crossings. It is assumed that application of vegetation mitigations (Section 9.2), including the establishment of appropriate riparian reserves will mitigate a large proportion of the predicted effects.

#### *Ecological and Cultural Context*

The federal government has ‘no net loss’ policy guideline for wetlands (Government of Canada 1991). The Yukon *Timber Harvest Planning and Operating Guidebook* (Yukon Forest Resources 1999) contains a series of recommendations for riparian buffers and management areas, but is not currently being actively used for policy or operational guidance. The Yukon *State of the Environment Report* (Yukon Department of Environment 2002) indicates that wetlands are a key concern for the Yukon Government and that a total of 54 significant wetlands have been identified in the territory, including two wetlands located in close proximity to the project area (Tuchitua West and Tuchitua

East). In addition, wetland inventory work is being carried out by the Yukon Wetlands Technical Committee, Nature Serve Yukon and Ducks Unlimited.

*Reversibility*

Project effects to wetlands are considered reversible if the abiotic conditions that support them (i.e., water table level, water flow, water quality and nutrient status) remain intact and the original vegetation mat remains largely in place. However, in most instances, project disturbance is expected to result in some long-term changes in the composition and structure of wetland vegetation communities.

*Significance*

The residual project-specific effects to wetland and riparian vegetation communities are considered to be adverse, of moderate magnitude, local in extent and far future in duration due to the permanent nature of many of the project infrastructure developments (access road and airstrip). Therefore, based on this assessment, residual project-specific effects to wetlands and riparian vegetation communities are considered to be not significant.

*Likelihood of Occurrence*

The assessment of residual project-specific effects to vegetation is predicated on the assumption that through the application of vegetation mitigations (Section 9.2: Environmental Protection Plan) most of the vegetation loss will be mitigated and the indirect effects (e.g., invasive species establishment, alteration of hydrological regimes) will be minimized. However, given the sensitivity of wetland ecosystems and the potential for alterations in water flow as a result of the project, the likelihood of effects occurring as predicted is unknown.

***Traditional Use Plants/Communities***

*Residual Effects*

The residual project-specific effects to traditional use plants/communities are primarily related to the 15% reduction of moderate productivity berry areas within the RSA.

*Ecological and Cultural Context*

The use of the berry model is based on the assumption that the selected edible berry species are of interest to the affected First Nations from a traditional or contemporary use standpoint. However, the local First Nations have not had any direct input into the development or application of the model, and therefore it should not be interpreted as a reflection of the degree to which their traditional use interests are impacted by the project.

From an ecological standpoint, the model provides an estimate of productivity based on observations and data relating to both the abundance (% cover) and relative productivity of each species within the various project ecosystems. The model is generalized to incorporate data for the full suite of edible berry species encountered during field surveys; therefore, it does not provide specific data about the relative effects of the project on individual species.

*Reversibility*

While it is anticipated that berry-producing shrubs, which are often early and mid-seral pioneers, will repopulate suitable habitats after decommissioning, effects to berry-producing areas are not considered to be reversible from the standpoint of traditional use because of the potential risks to human health (real or perceived) associated with harvesting vegetation grown on reclaimed minesite areas. In addition, as with other vegetation VECCs, only a small portion of the overall project footprint is slated for reclamation and as a result, a large portion of the effects to productive berry areas (vegetation loss) will be permanent losses.

*Significance*

The residual project-specific effects to traditional use plant communities is considered to be adverse, of moderate magnitude, local in extent and far future in duration; therefore, based on this assessment, these effects are considered to be not significant.

*Likelihood of Occurrence*

The level of confidence in the effect prediction for traditional use plants/communities is moderate because of the uncertainties regarding the actual location of project infrastructure and the lack of specific mitigation to address areas of productive berry habitat. The likelihood of effects occurring as predicted is unknown. It is anticipated that the estimation of project effects will overstate actual effects due to the conservative nature of the full build-out scenario.

### 7.9.5 Cumulative Effects

***Residual Cumulative Effects and Significance***

The only other project or activity affecting the abundance, distribution or health of any of the four vegetation VECCs within the vegetation RSA is the disturbance from the exploratory drilling conducted by Atna Resources in 1994. This drilling was a precursor to the existing development and does not include any ongoing or future activities. There are no other existing, ongoing or foreseeable activities or approved projects in the vegetation RSA.

The pre-baseline disturbance associated with the completed Atna Resources exploration activity affects a relatively small area, which will largely fall under the footprint of the proposed mine and as a result does not change any of the conclusions of the assessment of project-specific residual effects. Therefore, the residual project effects to vegetation VECCs do not have substantive spatial or temporal overlap with the effects of any other existing or reasonably foreseeable projects or activities within the RSA. Following from this, it is not considered necessary or relevant to carry the residual project-specific effects forward into an assessment of cumulative effects.

### 7.9.6 Mitigation Measures

Mitigation measures for vegetation should be consistent with the following broad best management principles:

- Conduct detailed inventories of development sites to determine if there are environmentally sensitive areas in or near the planned disturbance.

- Protect identified values through avoidance wherever possible.
- Mitigate impacts through the application of proactive and early preventative measures applied in a manner consistent with the ‘Precautionary Principle’.
- Monitor mitigations in a systematic manner to ensure that impacts are as low as possible and to facilitate refinement of mitigation strategies and techniques through a process of adaptive management.
- Follow up on mitigation results to improve mitigation methods and the ability to address similar situations in a more environmentally benign manner in the future.

Specific mitigation measures to address identified project effects for VECCs are included in table 7.9-25.

### Table 7.9-25 Mitigation Measures for Effects on Vegetation

| Potential Project Effect | Mitigation Measures |
|---|---|
| Loss of uncommon vegetation communities due to clearing | • Avoid ‘extremely high’ conservation status polygons through amendment of project design as necessary<br>• Avoid other uncommon vegetation communities wherever feasible |
| Changes in composition/structure of uncommon vegetation communities due to increased windthrow at edges | • Align cutting area boundaries to a windfirm edge such as rock bluffs, non-merchantable timber, or soil type change. Buffer high-value stands adjacent to clearings<br>• Leave a buffer at least 20 m wide of well-drained, deep soils between areas of poorly drained or shallow soils in riparian areas and at the edge of the harvested opening<br>• Where no natural windfirm features are available, consider widening the management zone to a moderate to low windthrow risk stand and align the boundary so that it is at an angle or parallel to the prevailing storm winds<br>• Feather the outer edge of the opening by removing trees prone to windthrow. Preference should be given to removing unsound trees |
| Changes in composition/structure of uncommon communities due to dustfall | • Minimize road dust by applying water to high-traffic gravel roads as necessary |
| Introduction of invasive species | • Minimize areas of soil disturbance during construction and maintenance of roads<br>• Re-establish vegetation on disturbed areas as soon as possible. Disturbed sites should be seeded within two weeks of disturbance, if possible, and checked the year following disturbance to ensure colonization with desirable species has occurred<br>• Ensure all equipment brought on site is thoroughly cleaned prior to arrival, including undercarriage<br>• Ensure the gravel used for a road construction contains no invasive plant seed or rhizomatous plant parts<br>• Ensure equipment yards and vehicle storage facilities are free of invasive plants<br>• Follow best management practices for reclamation, using northern seed varieties (see Kennedy 1993)<br>• Salvage organic materials to be replaced as the ground surface layer during backfill operations without incremental reclamation seeding<br>• If prevention measures fail and alien invasive plants establish on new sites, the plants must be destroyed prior to setting seed. If plants are hand-pulled, all propagules must be removed from the site and disposed of in a way that does not allow the spread of seeds (i.e., burned not composted). The site must be visited the following year to ensure that the treatment measures were successful |

## Table 7.2-25 Mitigation Measures for Effects on Vegetation (cont'd)

| Potential Project Effect | Mitigation Measures |
|---|---|
| Loss of mature and old forests due to clearing | • Avoid mature and old forest wherever feasible. |
| Indirect loss of mature and old forests due to windthrow at edges | • Align cutting area boundaries to a windfirm edge such as rock bluffs, non-merchantable timber, or soil type change Buffer high-value stands adjacent to clearings<br>• Leave a buffer at least 20 m wide of well-drained, deep soils between areas of poorly drained or shallow soils in riparian areas and at the edge of the harvested opening<br>• Where no natural windfirm features are available, consider widening the management zone to a moderate to low windthrow risk stand and align the boundary so that it is at an angle or parallel to the prevailing storm winds<br>• Feather the outer edge of the opening by removing trees prone to windthrow. Preference should be given to removing unsound trees |
| Changes in composition/structure of mature and old forests due to forest health issues (insect outbreaks, root rot, etc) | • Remove any felled or windthrown spruce from the site to avoid build up of spruce bark beetle populations<br>• For small outbreaks of mountain pine beetle, selectively fell and burn those trees with beetle infestations to prevent further spread. Ensure that all bark is completely burned |
| Loss of wetlands and riparian vegetation communities due to clearing and construction | • Avoid wetlands and riparian vegetation communities wherever possible |
| Changes in abiotic conditions for vegetation development of wetlands due to altered site drainage | • Minimize the linear extent of roads dissecting or paralleling wetlands<br>• Avoid diversion of streamcourses<br>• Properly culvert all roadways<br>• Schedule any construction in sensitive wetland and riparian areas to occur during frozen ground conditions |
| Changes in composition/structure of wetlands from increased sediment/pollutant influx | • Establish buffers (reserve zones) around all wetlands to preserve wetland function<br>• Establish buffers (reserve zones) surrounding all areas of riparian vegetation to reduce the influx of sediment into stream courses<br>• Use sediment control measures to mitigate against sediment input into streams and wetland areas |

## 7.9.7 Monitoring and Follow-up

### 7.9.7.1 Follow-up Studies

Based on current baseline information and the assessment of project-specific effects, no follow up studies have been identified.

### 7.9.7.2 Monitoring Programs

***Monitoring of Trace Elements in Vegetation***

Monitoring trace elements in vegetation is important for early identification of any project effects on the level of trace elements (e.g., metals) entering the environment and the food chain. Species sampled at baseline should be sampled as part of the reclamation monitoring plan.

#### *Invasive Species Monitoring*

Monitoring vegetation communities proximal to project disturbance is recommended throughout the construction, operations and closure phases of the projects. This will ensure that populations of invasive pant species are promptly identified as they become established and that appropriate control measures are applied in a timely manner to ensure the best possible chances of successful eradication. This approach will ensure that vegetation VECCs and associated values are protected from the effects of invasive species establishment and dispersal and will mitigate against the minesite acting as a source area for dispersal of invasive species to other areas of the Yukon.

It is assumed that invasive plant monitoring will be included as a component of the reclamation monitoring; however, the approach that should be followed includes measures related to the inventory, prevention and control of invasive species.

### Table 7.9-26 Monitoring and Follow-up Programs for Vegetation

| Potential Project Effect | Monitoring Programs |
|---|---|
| • Potential increase in trace element levels in minesite vegetation | • Monitor trace element concentration in vegetation against baseline data as part of the reclamation monitoring plan |
| • Potential introduction of invasive plant species resulting in changes to composition and structure for VECCs | • Monitor invasive species as part of the reclamation monitoring plan |

### 7.9.8 Summary of Effects

Project effects on vegetation are summarized in Table 7.9-27.

## Table 7.9-27 Program Effects on Vegetation

| Potential Effect | Level of Effect[1] | | | | | | Effect Rating[2] | |
|---|---|---|---|---|---|---|---|---|
| | Direc-tion | Magni-tude | Extent | Duration/ Frequency | Reversibility | Likelihood | Project Effect | Cumulative Effect |
| **Full Build-out** | | | | | | | | |
| Loss of uncommon vegetation communities due to clearing and construction | Negative | Moderate | Local | Far future | Unkown | Irreversible | Not significant | N/A |
| Loss of mature and old forests due to clearing and construction | Negative | Moderate | Local | Far future | Unkown | Irreversible | Not significant | N/A |
| Loss of wetlands due to clearing and construction | Negative | Moderate | Local | Far future | Unkown | Irreversible | Not significant | N/A |
| Loss of productive berry areas due to clearing and construction | Negative | Moderate | Local | Far future | Unkown | Irreversible | Not significant | N/A |

**Notes:**
1 Based on criteria in Table 7.9-9
2 Based on criteria in Section 7.9.4.2.
N/A = not applicable