Coffee Gold Mine

YESAB Project Proposal

Appendix 15-B Vegetation Valued Component Assessment Report

VOLUME III

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
AKEPIC	Alaska Exotic Plants Information Clearinghouse
ALP	Alpine
AMSL	Above mean sea level
ARD	Acid rock drainage
BC	British Columbia
BCW	British Columbia Wild
BEM	Broad Ecosystem Mapping
BMP	Best Management Practice
BOH	Boreal High
BOL	Boreal Low
c.	Chapter (with respect to Statutes and Revised Statutes of the Yukon)
CCME	Canadian Council of Ministers of the Environment
CEA	Cumulative Effects Assessment
CEQG	Canadian Environmental Quality Guidelines
Coffee Project	Coffee Gold Project (Coffee Project interchangeable with Project)
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWF	Canadian Wildlife Federation
EA	Environmental and socio-economic assessment
EDRR	Early Detection and Rapid Response
EDI	Environmental Dynamics Inc.
ELC	Ecosystem and Landscape Classification
EMCBC	Environmental Mining Council of BC
ESOD	Earth Observation for Sustainable Development Land Cover Data
FNNND	First Nation of Na-cho Nyäk Dunn
HLF	Heap Leach Facility
ICMC	International Cyanide Management Code
IPCBC	Invasive Species Council of British Columbia
Kaminak	Kaminak Gold Corporation
LAA	Local Assessment Area
LSA	Local Study Area
M	Million
NAR	Northern Access Route
NEF	National Ecological Framework of Canada
NO_x	Nitrogen oxides

Acronym / Abbreviation	Definition
NWF	National Wildlife Federation
Project	Coffee Gold Project (Project interchangeable with Coffee Project)
RAA	Regional Assessment Area
RISC	Resource Inventory Standards Committee
ROM	Run-of-mine
RSY	Revised Statue of the Yukon
SARA	*Species at Risk Act*
SC	Statues of Canada
SFN	Selkirk First Nation
SO_2	Sulphur dioxide
SUB	Subalpine
TH	Tr'ondëk Hwëch'in
TK	Traditional Knowledge
TSP	Total Suspended Particulates
USEPA	U.S. Environmental Protection Agency
USDC	U.S. Department of Commerce
USFWS	U.S. Fish and Wildlife Service
UTV	Utility Task Vehicle
VC	Valued Environmental or Socio-economic Component
WHO	World Health Organization
WRFN	White River First Nation
WRSF	Waste Rock Storage Facility
YBF	Yukon Bioclimate Framework
YESAA	*Yukon Environmental and Socio-economic Assessment Act*
YESAB	Yukon Environmental and Socio-economic Assessment Board
YEWG	Yukon Ecoregions Working Group
YG	Yukon Government
YISC	Yukon Invasive Species Council
VMP	Vegetation Management Plan
YT	Yukon Territory
Yukon CDC	Yukon Conservation Data Centre
YWTC	Yukon Wetland Technical Committee
YWB	Yukon Water Board

UNITS AND MEASUREMENTS

Abbreviation	Measurement
%	Percent
g	Gram
ha	Hectare
hr	Hour
km	Kilometre
km²	Square Kilometre
m	Metre
m²	Square Metre
m³	Cubic Metre
mg	Milligram
Mt	Million Tonnes
t	Tonne
tpd	Tonnes per day
µm	Micrometre
V	Volt
W	Watt

1.0 INTRODUCTION

This report provides an assessment of the potential Project-related and cumulative effects of the proposed Coffee Gold Mine Project (the Project) on the Valued Component (VC) Vegetation. Vegetation subcomponents and indicators are used to focus the assessment on information known to be important to First Nations, government, and other technical reviewers. The report identifies and characterizes potential interactions between the Project and Vegetation, and describes the mitigation measures, management and protection plans that Kaminak Gold Corporation, a wholly owned subsidiary of Goldcorp Inc., (the Proponent) will implement to eliminate, reduce, or otherwise control adverse Project-related effects on Vegetation.

This report is structured so that reviewers can find the information required to review the assessment of the Project's potential effects on Vegetation. The Introduction section provides the rationale for the selection of Vegetation as a VC, explains the selection of Vegetation subcomponents, and describes the scope of the assessment. It also identifies the indicators used to quantitatively and qualitatively assess the potential effects of the Project on Vegetation. The spatial, temporal, and technical boundaries of the Vegetation assessment are identified.

The Assessment Methods section describes the quantitative and qualitative approaches used in assessing potential Project-related and cumulative effects. The methods focus on using the best available information, analysis, and environmental assessment best practice for predicting effects on Vegetation. While general methods of the overall assessment are described in **Section 5.0** of **Volume 1**, the methods described in this section are specific to Vegetation.

The Existing Conditions section describes baseline conditions for Vegetation within the region surrounding the Project that are relevant to potential Project interactions and set the context for the effects assessment. The section includes a summary discussion of the regulatory context in which the Proponent assessed potential effects and proposed management and mitigation actions to reduce effects on Vegetation. There is a summary section describing how traditional knowledge (TK), scientific and other information, and the results of baseline studies conducted for the Project informed the description of existing conditions.

The Assessment of Project-Related Effects section provides the technical details that describe the potential effects of the Project on Vegetation. The section identifies the potential Project interactions with Vegetation, identifies mitigation measures that are implemented at the Project design level, and outlines other Vegetation-specific measures that can be used by the Proponent in the design and management of the Project. The section describes the commitments that the Proponent makes to reduce or eliminate interactions or disturbances to Vegetation prior to a determination of significance of those potential effects. The technical details of the effects on Vegetation subcomponents are provided in subsections.

Assessment of Cumulative Effects section provides a broader overview of the potential combined effects of past, present, and reasonably foreseeable future projects and disturbances. The section characterizes the combined residual Project-related effects (i.e., those effects that cannot be completely avoided) with other effects potentially having occurred, currently occurring, or likely to occur to Vegetation. A list of those projects and disturbances considered in the cumulative effects assessment are identified in this section. Where necessary, and if separate from Project-related effects, mitigation measures to address potential cumulative effects are described.

The Summary of Effects Assessment section provides an overview of the technical assessments described in the Project-related Effects, and Cumulative Effects assessment sections.

The Effects Monitoring and Adaptive Management section describes the actions that the Proponent will implement during the Project's Construction, Operation, Reclamation and Closure, and Post-closure phases. The section describes the approach that the Proponent will take to verify effects assessment findings and the effectiveness of mitigation measures, and to actively respond to and manage unexpected effects as the Project proceeds. It identifies how mitigation measures may be modified in the event of unexpected Project-related or cumulative effects and provides for continued collaboration with First Nations and regulators during Project monitoring and effects management decision-making. It demonstrates the Proponent's commitment to regular monitoring and re-assessment, and willingness to implement changes necessary to effectively mitigate Project-related effects or cumulative effects.

1.1 ISSUES SCOPING

The scope of this assessment is based on various guidelines provided by the Yukon Environmental and Socio-economic Assessment Board (YESAB) and by input from regulatory agencies. Available information regarding other existing and proposed quartz mining projects in the Yukon and other parts of northern Canada, including environmental assessments were reviewed. Issues and concerns were also identified through consultation and engagement activities with communities, stakeholders and First Nations, and the professional judgement and experience of the Project team.

The scope of assessing Vegetation considered the Project's potential direct and indirect effects, residual effects, and cumulative effects associated with Construction, Operation, Reclamation and Closure, and Post-closure phases. The initial step in the effects assessment process was the completion of a Terrestrial Vegetation Baseline Report (**Appendix 15-A**). The baseline report characterizes the existing Vegetation conditions upon which the Project may have an effect.

As a part of Project scoping, the specific objectives, as identified in YESAB's *Proponents Guide to Information Requirements for Executive Committee Project Proposal Submissions* (2005), were reviewed. The YESAB guidelines recommend that Vegetation be considered as a candidate VC since "*Vegetation is valued for many reasons, including but not limited to aesthetics, wildlife habitat, various uses as a*

renewable resource, and diverse ecological processes" (YESAB 2005). The guidelines further recommend that the identification of interactions between the Project and identified VCs include, among others, consideration of:

- Loss of rare, endangered, or valued components
- Reduction in species diversity
- Loss of critical or productive habitats.

The Proponent has undertaken an engagement and consultation process, as defined under Section 50(3) of the *Yukon Environmental and Socio-economic Assessment Act* (YESAA), to support the scoping of issues for the Project (Refer to **Volume I, Section 3.0 — Consultation**). The Proponent continues to consult and engage with affected First Nations and communities, government agencies, and persons and/or other stakeholders who may be interested in the Project and its related activities. This consultation and engagement process included meetings with First Nations and government departments (e.g., YG and EC), community meetings, one-on-one and small group meetings, and ongoing communications such as print communication, newsletter, and website updates, including specific presentations and discussions regarding Vegetation and exploration of Vegetation as a candidate VC. The consultation and engagement process also included the establishment of the Tr'ondëk Hwëch'in (TH) Technical Working Group (TWG) which was formed during the Project scoping stage to provide the Proponent with ongoing advice and detailed information to better inform their environmental baseline and effects assessment programs for the Project. Comments received through the consultation and engagement process from the TH TWG, YG, EC, and Project stakeholders were generally supportive of the identification of Vegetation as a VC for the Project. Review of available TK also highlighted the importance of the natural environment and the various plant and animal species that it contains (e.g., Na-Cho Nyak Dun 2008, Tr'ondëk Hwëch'in 2012a, Bates and DeRoy 2014).

While the comments received were supportive of the identification of Vegetation as a VC, several specific concerns about certain Vegetation communities or specific species were also raised during the consultation and engagement process. Environment Yukon expressed concerns regarding potential Project-related effects on rare plants (M. Suitor, Environment Yukon. Pers. Comm. 2015). Communication received from the TH TWG during the consultation and engagement process noted that while "*…it is important to note that Tr'ondëk Hwëch'in feels that all species and habitats play an important role in ecological function* the *Tr'ondëk Hwëch'in do have specific concerns about some key species and habitats*." The TH TWG highlighted the importance of wetland habitats and habitats associated with rare plants and the need to limit Project effects on these areas (Becker, Pers. Comm. 2015). Discussions with the TH TWG also highlighted concerns about potential effects on Vegetation health as a result of Project emissions and dust deposition, and stressed the importance of considering Project-related effects on 'traditional and medicinal plants' within the Project Proposal. In response, the Proponent committed to adding 'traditional and medicinal

plants' as a subcomponent to the Vegetation VC (April TH TWG Meeting, Pers. Comm. 2016). No specific concerns associated with merchantable trees were raised. Specifically, tree density and volumes were not scoped in because no concerns were raised and most of the mine site does not include areas of merchantable wood. Areas that do have the potential for salvageable timber (Access Route) are a substantial distance from communities.

1.2 VEGETATION AS A VALUED COMPONENT

The selection of Vegetation as a VC followed the process set out in **Volume I, Section 5.1.1 — Selecting Intermediate Components and Valued Components**. Vegetation was selected as a VC due to the potential for the Project to adversely affect individual plants and plant habitat. Vegetation is a component of biodiversity, is a key component of wildlife habitat, and is valued by First Nations and other local people who may rely on certain species as a subsistence and economic resource.

1.2.1 CANDIDATE VCS

Vegetation was identified as a VC because the Project occurs in a vegetated area of Yukon's boreal forest region. There are distinct interactions between clearing required for the Project footprint and loss of Vegetation cover. Vegetation forms an importation component of wildlife habitat, and during engagement meetings was identified as important to First Nations, regulators, and to Yukon's Conservation Data Centre. The Project's potential effects on Vegetation can be measured and there are distinct pathways of effects of Project components on loss of or disturbance to Vegetation (**Table 1.2-1**). There are also some protection measures and guidelines in place to protect and maintain Vegetation cover in Yukon (relevant measures described further in **Section 3.1** — **Regulatory Context**). Vegetation as a VC will also encompass multiple effects to plant species and their habitat such as plant loss, potential increase in trace metals in plants, and loss of rare, traditional, and medicinal plants.

An assessment on the effects on Vegetation supports information needs for the assessment of effects on Wildlife and Wildlife Habitat (**Section 16**), Birds and Bird Habitat (**Section 17**), Social Economy (**Section 21**), Land and Resource Use (**Section 24**), and Community Health and Well-being (**Section 25**).

Table 1.2-1 Candidate Valued Components for Vegetation – Evaluation Summary

Candidate VC	Project Interaction			Third Party Input		Supports the Assessment of Which Other VC?	Selected as a VC?	Decision Rationale
	Interaction?	Project Phase / Project Component / Activity	Nature of Interaction	Source	Input			
Vegetation	Yes	Construction, Operation, Reclamation and Closure, Post-closure	Vegetation removal from land clearing and adjacent effects on habitat from dust deposition and emissions	YESAB guidance documents, YG, TH	Concerns regarding risk of invasive species introduction and spread, concerns about wetlands and habitats containing rare plants	Wildlife and Wildlife Habitat Birds and Bird Habitat Social Economy Land and Resource Use Community Health and Well Being	Yes	Encompasses multiple potential effects
Ecological communities	Yes	Construction, Operation, Reclamation and Closure	Vegetation removal from land clearing and adjacent effects on habitat from dust deposition and emissions	YG	YG is developing an Ecological Land Classification system for use in land use planning and effects assessment.	Wildlife and Wildlife Habitat Birds and Bird Habitat Social Economy Land and Resource Use Community Health and Well Being	No, identified as a subcomponent of Vegetation	Ecological communities are largely defined by Vegetation cover characteristics.
Wetland habitats	Yes	Construction, Operation, Reclamation and Closure,	Potential disturbances to existing wetlands, changes to drainage from project infrastructure	YG, TH	Potential effects on wetland habitats were identified as of concern by YG in other YESAB Executive Committee assessments and by TH during Project consultation	Wildlife and Wildlife Habitat Birds and Bird Habitat Social Economy Land and Resource Use Community Health and Well Being	No, identified as a subcomponent of Vegetation	Wetland habitats largely defined by Vegetation cover characteristics.

Candidate VC	Project Interaction			Third Party Input		Supports the Assessment of Which Other VC?	Selected as a VC?	Decision Rationale
	Interaction?	Project Phase / Project Component / Activity	Nature of Interaction	Source	Input			
Traditional and medicinal plants	Yes	Construction, Operation, Reclamation and Closure	Vegetation removal from land clearing and adjacent effects on habitat from dust deposition and emissions	TH	Plants that are used for traditional and medicinal purposes are known to exist in the area.	None	No, identified as a subcomponent of Vegetation	Traditional and medicinal plants occurrence defined by Vegetation cover characteristics.
Rare plants	Yes	Construction, Operation, Reclamation and Closure	Vegetation removal from land clearing and adjacent effects on habitat from dust deposition and emissions	EC, YG, TH	YG Conservation Data Centre maintains a Track-list of potentially rare plant species in Yukon.	None	No, identified as a subcomponent of Vegetation	An assessment of potential effects on individual species of rare plants would provide unnecessary detail for Project mitigation of effects.
Invasive plant species	Yes	Construction, Operation, Reclamation and Closure	Equipment and supplies transported to site, and materials used for reclamation have potential to introduce invasive plant species	TH, EC, YG	YG Conservation Data Centre, Yukon Invasive Species Council (YISC)	None	No treated as a subject of note.	The introduction of invasive plants is a potential adverse effect of the Project on Vegetation and is better treated as a subject of note with a potential adverse effect on ecological communities.

Candidate VC	Project Interaction			Third Party Input		Supports the Assessment of Which Other VC?	Selected as a VC?	Decision Rationale
	Interaction?	Project Phase / Project Component / Activity	Nature of Interaction	Source	Input			
Vegetation health	Yes	Construction, Operation, Reclamation and Closure	Vegetation adjacent to Project footprint may experience metals uptake from dust deposition and emissions.	TH, YG	Concerns about "contamination" in regional Vegetation and importance of forage to wildlife	Birds and Bird Habitat Wildlife and Wildlife Habitat Community Health and Well Being	No, identified as a subcomponent of Vegetation	Health of Vegetation in habitat adjacent to project activities reflects management of on-site dust and emissions.

1.2.2 VEGETATION SUBCOMPONENTS

Subcomponents were identified to further structure and focus the assessment. Species or groups were chosen as subcomponents for their ability to represent other species or groups that are similar in nature, found in similar habitats, occupy similar ecological niches, or could be similarly affected by Project activities. In selecting VC subcomponents, consideration was also given to Vegetation identified as of importance by government agencies, First Nations, local communities, and the public, as identified through a review of available information, including TK, and through the Project's consultation and engagement program (see **Section 3.0 Consultation**).

Five Vegetation subcomponents were identified and are described in detail below and summarized in **Table 1.2-2**:

- Ecological communities
- Wetland habitats
- Traditional and medicinal plants
- Rare plants
- Vegetation health.

Ecological communities — Ecological communities have a key role in the maintenance of wildlife habitat, biodiversity, carbon sequestration, nutrient cycling, and productivity. Terrestrial ecosystems provide habitat for culturally important and harvestable plants, lichens, and at-risk components of regional, territorial, federal, or global biodiversity.

Wetland habitats — Wetlands are important ecosystems because of their ecological, hydrological, biochemical, and habitat function role. Wetlands are known to play an important role in maintaining water quality and regulating water flow. Wetlands also provide habitat for a variety of flora and fauna, potentially including listed rare species.

Traditional and medicinal plants — Almost all major groups of wild plants in the Yukon have edible members that are reported to have been used by First Nations. Many plant species found in the Project area are currently, or have been previously, used by local First Nations as a source of food, or for medicinal and spiritual use while others have more practical or decorative uses. Plant and tree species of cultural value are closely linked to the ecological communities defined in the Project Area.

Rare plants — Rare plants are important because the consequence of losing a rare species is poorly known. Loss of a species can influence ecosystem functioning if those species possess traits that directly or indirectly influence ecosystem function. Rare species may be at risk because of low abundances, small geographic ranges, and greater susceptibility to environmental effects. At least four plant species from the

Yukon Watch-list occur close to the Northern Access Route (NAR) footprint in areas of existing roads (summarized in Vegetation Baseline Report, **Appendix 15-A**).

Vegetation health — Vegetation health was selected as a valued subcomponent because plants may be sensitive to disturbances, in particular the effects of dust deposition and the uptake of metals. Vegetation health is also closely linked to harvestable plants and plants eaten by wildlife where the uptake of trace metals and link to food chains is a concern.

Table 1.2-2 Vegetation Subcomponents

Subcomponent	Representative of:	Rationale for Selection
Ecological communities	Vegetation abundance found in proximity to the Project	Culturally important, Regulator and First Nation Interest Potential for interaction with clearing and construction within the Project footprint Potential changes in plant composition and possible loss of native plant species due to introduction of invasive species
Wetland habitats	Wetlands are often considered sensitive ecosystems this subcomponent is representative of sensitive ecosystems.	Regulator and First Nation Interest Potential for interaction with clearing and construction within the Project footprint
Traditional and medicinal plants	Plants that area considered culturally important to First Nations as they are considered harvestable plants.	Proponent commitment to TH TWG Potential for interaction with clearing and construction within the Project footprint
Rare plants	Species at risk or Yukon Watch-list species found in proximity to the Project	Species at risk (SARA), Regulator and First Nation Interest
Vegetation health	Possible response to change in trace metal concentrations in indicator plant species due to Project related activities (dust deposition)	Potential for interaction with Project activities that increase dust deposition on plants in the LAA, RAA, and First Nation interest

1.2.3 VEGETATION INDICATORS

Indicators are quantitative or qualitative measures that can be compared against baseline values or conditions to evaluate potential Project-related effects and cumulative effects on Vegetation. The indicators identified for each Vegetation subcomponent are summarized in **Table 1.2-3**.

For ecological communities, wetland habitat, traditional and medicinal plants, and rare plants, the indicator is the area of known or likely occurrence within the Local Assessment Area (described below). The indicator quantifies existing area in relation to Project infrastructure and activities to determine changes in habitat from baseline conditions. Area of traditional and medicinal plants is based on likely occurrences within mapped ecological units (i.e., berry-producing communities). For rare plants, areas are estimated using location and distribution of rare or Yukon Watch-list plant species within mapped ecological units.

The indicator for Vegetation health is the possible increase in dust deposition which could lead to an increase of metals uptake in selected plants, and is assessed both quantitatively and qualitatively. The assessment involves the modeling of dust depositions and a discussion around the overall health of Vegetation in the context of tolerance thresholds (dust and trace metals). Presently there are no known metal uptake or dust deposition threshold standards or guidelines for plants.

Table 1.2-3 Vegetation Indicators

Indicator	Rationale for Selection
Ecological communities	
Area (ha) of ecological communities that will be lost and calculated as a percent loss	Provides a measure of the loss of each ecological community due to the Project activities (habitat loss)
Wetland habitat	
Area (ha) of wetland habitats that will be lost and calculated as a percent loss	Provides a measure of the loss of each wetland type due to the Project; wetlands are known to contain rare plant communities and are sensitive to hydrological changes (change in habitat and possible loss of habitat)
Traditional and medicinal plants	
Area (ha) of berry-producing ecological communities that will be lost and calculated as a percent loss	Provides a measure of the loss of berry-producing ecological communities, ranked by berry-producing potential, due to the Project; berry-producing species are important traditional and medicinal plant species harvested in the Coffee Creek area
Rare plants	
Area (ha) of potential rare plant habitat based on ecological community classes (potential occurrence) that will be lost and calculated as a percent loss	Provides a measure of the potential loss of rare plants, protected under federal legislation under Species at Risk Act (for listed species) and addresses information needs of Yukon Conservation Data Centre (Yukon CDC)
Vegetation health	
Risk of increased concentration of trace metals in selected plant species due to dust deposition and other emissions	An increase in trace metals in selected plant species in habitat adjacent to the Project is representative of potential Vegetation health effects from dust and other emissions

1.3 ASSESSMENT BOUNDARIES

The spatial and temporal boundaries encompass the area within, and times during which, the Project is expected to interact with Vegetation. The administrative and technical boundaries represent any constraints that may be placed on the effects assessment due to political, social, and economic realities (i.e., administrative boundaries), or limitations in predicting or measuring changes (i.e., technical boundaries).

1.3.1 SPATIAL BOUNDARIES

The **Project footprint** is the area in which ground will be disturbed and Project activities will occur, as described fully in **Volume 1, Section 2.0** of the **Project Description**.

The **Local Assessment Area** (**LAA**) includes the proposed mine site and the proposed NAR to the junction with the North Klondike Highway. Around the mine site, the LAA is delineated based on the height of land while encompassing a minimum buffer of 1 km radius around the proposed mine footprint. Along the access route, the LAA includes a 1 km radius buffer from the centreline of the proposed or existing road (**Figure 1.3-1**). The LAA defines the boundaries in which Project-related effects on Vegetation may occur.

The **Regional Assessment Area** (**RAA**) encompasses the LAA. The RAA also encompasses the area within which the residual effects of the Project are likely to interact with the residual effects of other past, present, or future projects or activities, and therefore defines the boundaries of the cumulative effects on Vegetation. The RAA was delineated using a combination of features. The entire northern section (north of the Yukon River) of the RAA follows an approximately 10 km buffer of the proposed access road and the mine site footprint. The RAA boundary intersects with the Klondike Highway at its most north-easterly point and follows the alignment of the highway toward Dawson City where the boundary deflects in a southward direction. The western sections of Henderson Creek and Indian River on the western boundary have been excluded as they flow west toward the Yukon River and away from the 10 km buffer. The Bonanza Creek, Maisy May Creek, Ballarat Creek, Black Hills Creek, Eureka Creek, Hunker Creek, Sulphur Creek, and Barker Creek drainages are all located within the RAA. The majority of the Dominion Creek drainage is within the RAA except for the upper reaches which are situated outside of the 10 km buffer. The section of the RAA located south of the Yukon River follows a less constrained boundary. The eastern boundary leaves the 10 km buffer and travels from the Yukon River southward to the Project. From that point it trends westward to encompass all of the Coffee Creek drainage and some of the upper reaches of Doyle Creek to the south. It then loosely follows the height of land (forming an arc along its southern edges) and drops down into the valley of Independence Creek. The boundary continues down the creek valley to the Yukon River where it once again assumes an approximate 10 km buffer along the proposed access road route. The spatial boundaries used for the Vegetation effects assessment are summarized in **Table 1.3-1** and illustrated in **Figure 1.3-1**.

Table 1.3-1 Vegetation Effects Assessment Spatial Boundaries

Spatial Boundary	Description of Assessment Area
Local Assessment Area (LAA)	Proposed Project Area with a minimum 1 km radius buffer plus a little bit more around the mine site area (in general to height of land) as shown in Figure 1.3-1.
Regional Assessment Area (RAA)	The majority of the RAA follows an approximately 10 km buffer of the proposed route and project footprint. The RAA encompasses the following drainages: Coffee Creek, Bonanza Creek, Maisy May Creek, Ballarat Creek, Black Hills Creek, Eureka Creek, Hunker Creek, Sulphur Creek, and Barker Creek. Parts of the following drainages are found within the RAA: Henderson Creek, Indian River, Dominion Creek, and Doyle Creek. A portion of the Independence Creek valley is also found within the RAA.
Cumulative Effects Assessment Area	Same as RAA

1.3.2 TEMPORAL BOUNDARIES

The temporal characteristics of the Project's Construction, Operation, Reclamation and Closure, and Post-Closure phases are described in **Volume I**, **Section 2.0 Project Description**. The temporal boundaries established for the assessment of Project effects on Vegetation encompass these Project phases. Potential Project effects on Vegetation subcomponents are assessed for the Project at the maximum disturbance level. Maximum disturbance includes the most extensive footprint disturbance (i.e. habitat loss) as a result of Project activities.

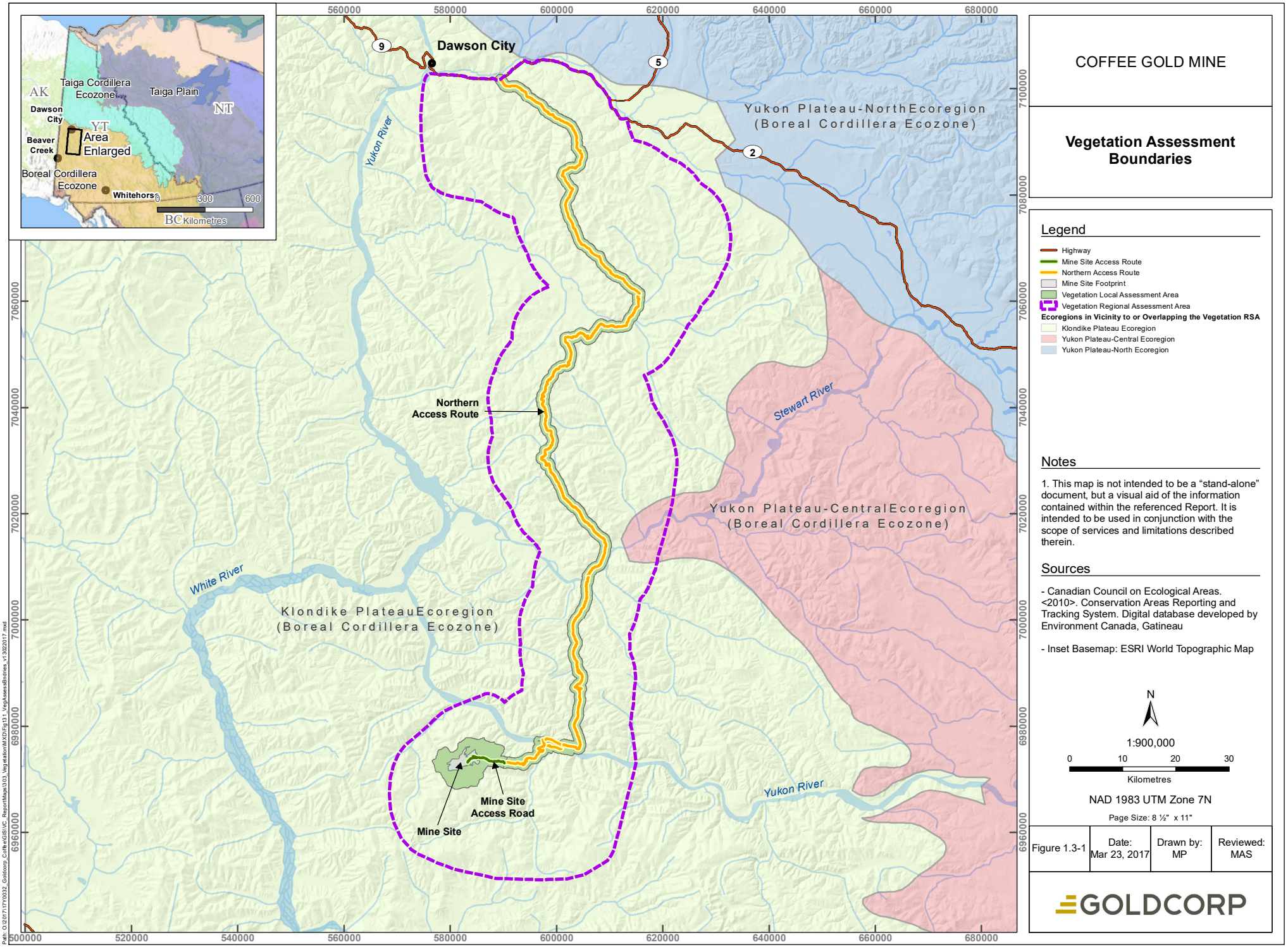
1.3.3 ADMINISTRATIVE BOUNDARIES

No administrative boundaries were identified for the Vegetation assessment.

1.3.4 TECHNICAL BOUNDARIES

Rare plant surveys were completed in areas considered to have a high potential of rare plant occurrences. Rare plant surveys were not completed throughout the whole LAA. There is a possibility that a rare plant or a Watch-list plant could still be found within the Project footprint.

Ecological classification for the region is only defined to the subzone level and not to the ecological community (ecosites and Vegetation association) level. Due to map information limitations it is not possible to compare ecological community mapping to other adjacent sites since ecosites and Vegetation associations are not standardized. Also due to limited ecological mapping in Yukon as a whole, it is not possible to discuss effects on possible rare ecological communities or ecological communities of concern since this information is not currently included in the Yukon CDC or other databases.



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COFFEE GOLD MINE

Vegetation Assessment Boundaries

Legend

- Highway
- Mine Site Access Route
- Northern Access Route
- Mine Site Footprint
- Vegetation Local Assessment Area
- Vegetation Regional Assessment Area

Ecoregions in Vicinity to or Overlapping the Vegetation RSA

- Klondike Plateau Ecoregion
- Yukon Plateau-Central Ecoregion
- Yukon Plateau-North Ecoregion

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Canadian Council on Ecological Areas. <2010>. Conservation Areas Reporting and Tracking System. Digital database developed by Environment Canada, Gatineau

- Inset Basemap: ESRI World Topographic Map

N

1:900,000

0 10 20 30

Kilometres

NAD 1983 UTM Zone 7N

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Figure 1.3-1	Date: Mar 23, 2017	Drawn by: MP	Reviewed: MAS

GOLDCORP

2.0 ASSESSMENT METHODS

The methods used to identify and assess potential Project-related and cumulative effects on Vegetation address assessment requirements identified in the YESAA and YESAB guidance documents (e.g., YESAB 2005). The assessment was conducted in accordance with the general methods identified in **Volume I, Section 5.0 Assessment Methodology**. As described in each section of the report, the assessment was informed by input provided during consultation and engagement with Yukon Environment, potentially affected First Nations and the public, and a review of TK, scientific, and other information.

Potential Project-related effects on Vegetation were assessed by considering effects within the entire footprint. The overall effects of the total footprint are presented within the result tables. The result tables also summarize the data by the mine site and the NAR effects. Within the NAR area the potential Project-related effects are all associated with the construction and operation of the road which is a long linear feature while within the mine site the potential Project-related effects are not all associated with one feature but with many different features such as different infrastructure, open pit mines, and access roads.

The assessment of Project-related effects on Ecological Communities used Ecological and Landscape Classification (ELC) and Broad Ecosystem Mapping (BEM) units developed for the Vegetation Baseline Report (**Appendix 15-A**). Ecosystem mapping is typically used as a method of describing Vegetation across a landscape. By grouping plant species into communities it facilitates describing possible effects such as loss of Vegetation and loss of Vegetation habitat. Ecosystems of the Project area were mapped at two levels: ELC and BEM. The more detailed ELC mapping was completed around the proposed mine site and along new sections of the NAR. The more general BEM mapping was completed along the proposed NAR in areas that that were described as existing road. In the Vegetation Baseline Report (**Appendix 15A**) approximately 23,844 ha was mapped following ELC methods and approximately 36,582 ha was mapped following the BEM methods.

Quantifiable components of the effects assessment were based on an overlay of the Project footprint with the mapped polygons from the ELC and BEM mapping. This intersection of the footprint and the ELC and BEM data provided the proportion of each mapped unit within the Project footprint relative to the extent of mapped units (the LAA).

The Project's ecosystem mapping extent was limited to a 1 km buffer surrounding the NAR and expanded to the height of land surrounding the mine site to provide detailed mapping to support mitigating site-specific locations of ecosystems such as wetlands, and rare plant habitat and to inform future reclamation activities on site. Detailed ELC or BEM within the RAA does not exist for comparison. Although Earth Observation for Sustainable Development (EOSD) land cover data are available for the region, the data are different Vegetation types and at such a coarse scale it is not possible to derive meaningful comparisons with respect to the ecological communities identified for the Project.

This assessment places the effects of loss of Vegetation within the Project footprint, including ecological communities, wetland habitats, and potential rare and traditional and medicinal plant habitat, in the context of habitat availability regionally. It is assumed, and generally observed by the experienced Project personnel that conducted the assessment, that the ecological communities described by the Project's ecosystem mapping are not unique to the LAA, and also occur in the surrounding region. Although there is no detailed regional level ecosystem mapping to verify this, the region surrounding the Project is within the same Subalpine, Boreal High, and Boreal Low Bioclimate zones of the Klondike Plateau Ecoregion. The LAA thus is comprised of very similar physiography and ecological responses to climate, including broadly similar Vegetation with similar overall floristic composition.

The same methods were used to assess Project-related effects on potential traditional and medicinal plant habitat and potential rare plant habitat. Ecological communities contain rare, and traditional and medicinal plants, thus all ecological communities were rated for berry-producing potential (traditional and medicinal plants) and rare plant potential using published species information, baseline survey data and professional opinion.

The Project`s potential effects on Vegetation health was assessed by considering the potential for metals uptake from fugitive dust deposition. Quantifiable components of the effects assessment were based on an intersection of predicted dust deposition amounts and thresholds for plant health derived from available literature (see **Section 4.4.7** for details).

3.0 EXISTING CONDITIONS

A summary of existing regulatory and baseline conditions is provided to provide local context and to enable the reviewer to identify and understand the potential interactions between the Project and Vegetation. Existing conditions are described based on available information, including the following:

- Federal, territorial, First Nation, and local government jurisdictions, mandates, agreements, and interests of specific relevance to Vegetation, including the legislation and/or policy through which regulation and management occurs, and any associated reports or plans that are or may be developed (e.g., Recovery Strategy under the federal *Species at Risk Act* (SARA))
- Baseline reports describing desktop and field studies, including the collection, analysis, and documentation of data and its treatment according to appropriate territorial or federal guidelines and standards
- Subject to any confidentiality constraints that may apply, available TK relevant to Vegetation, including the source and an explanation of how it informed the understanding of existing conditions
- Scientific and other information, including existing reports in popular, grey, or published literature, databases, remote sensing imagery and data, monitoring programs, and previous environmental assessments or associated technical reports, including a discussion of the quality and relevance of the information.

The descriptions refer to the quality and reliability of the baseline data and its applicability for the purpose used, including any uncertainty or gaps in knowledge associated with existing Vegetation conditions.

3.1 REGULATORY CONTEXT

The following legislation and regulations may be relevant to the management and conservation of Vegetation in the Project area, and in some circumstances may supersede the commitments made in this assessment.

3.1.1 FEDERAL GOVERNMENT

3.1.1.1 Yukon Act (SC 2002, c.7)

The *Yukon Act* gives authority to Yukon Legislature to make laws in relation to the conservation of wildlife habitat within Yukon, other than in a federal conservation area.

3.1.1.2 Yukon Environment and Socio-economic Assessment Act (SC 2003, c.7)

The YESAA gives authority and rules to the YESAB to administer the assessment process that applies to all lands within Yukon. The Board's mission is to protect the environment and social integrity of Yukon, while fostering responsible development. The YESAB information requirements and evaluation process guidelines identify the need to document ecological communities and site quality for areas that may be disturbed as a result of development. Also identified in the guidelines is the inclusion of all proposed environmental protection, contingency, and monitoring plans including Vegetation management and monitoring.

3.1.1.3 Species at Risk Act (SC 2002, c.29) and Committee on the Status of Endangered Wildlife in Canada

The *Species at Risk Act* (SARA) implements in part Canada's obligations under the United Nations Convention of Biological Diversity. It provides for the legal protection of plant and wildlife species and the conservation of their biological diversity. Under SARA, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), an independent body of experts, is responsible for identifying and assessing plant and wildlife species considered at risk, which may then qualify for legal protection and recovery under SARA. Once listed under SARA, species plans are legal requirements to secure the necessary actions for species recovery and management. The schedules of the Act were used to identify SARA listed species in the Project area that are of particular conservation concern, which may require additional levels of protection. There are no SARA-listed or COSEWIC-assessed species at risk known to exist in the assessment areas.

3.1.1.4 Convention on Wetlands

The Convention on Wetlands (1971) commits the federal government to maintain the ecological character of wetlands of international significance and to plan for the sustainable use of all wetlands. The Federal Policy on Wetland Conservation was established in 1991 in response to the convention. The policy provides goals, guiding principles and strategies for conserving wetlands on federal lands and those of significance to Canadians. Although the policy was considered initially in scoping, there are no wetlands of territorial importance, as defined by the Yukon Wetland Technical Committee (YWTC, Environment Yukon 1999) within the assessment areas.

3.1.2 TERRITORIAL GOVERNMENT

3.1.2.1 Environment Act (RSY 2002, c.50)

Yukon's *Environment Act* and regulations provide for the protection of land, water, and air. It applies on lands throughout Yukon, including private property, Crown lands, lands within municipal boundaries, and First Nation settlement lands where the First Nation has not developed equivalent laws. This Act is primarily used for regulations related to air quality, waste, recycling, spills and contaminated sites, however, the act provides for natural resource planning and management, and conservation easements for conserving and enhancing Vegetation communities that provide habitat for wildlife.

3.1.2.2 Yukon Conservation Data Centre

The Yukon CDC provides information on species and ecosystems at risk in Yukon. The Yukon CDC is part of a network of data centres around the world and is coordinated by NatureServe International. The goal of the Yukon CDC is to gather, maintain, and distribute information on all Yukon animals, plants, and ecological communities and map the known localities of those that are of conservation concern.

The Yukon CDC maintains a list of all plants known to occur in Yukon with their corresponding conservation ranks at the global, national, and territorial levels. There are two types of lists in Yukon: Track-list and Watch-list. The Track-list is a complete list of all species of conservation concern with conservation status ranks. The list is composed of vascular plants that information is actively tracked and all known locations are mapped.

The Watch-list is a list of species for which there is not enough information to determine whether they are of conservation concern. The Yukon CDC does not map those species but actively seeks reports on known populations so that, in the future, they may be able to make informed assessments of their conservation status. Species on this list could eventually be placed on the Track-list or be removed from the Watch-list as more populations are reported.

3.1.2.3 Yukon Invasive Species Council

The Yukon Invasive Species Council (YISC) is a registered non-profit society formed to prevent the introduction and manage the spread of invasive species in Yukon. The society includes representatives from municipal, territorial, federal, and First Nation governments, non-profit organizations, farming, industry, and private citizens. The YISC strategic plan is to improve territory-wide guidance on invasive species management; support, develop, and complement ongoing activities in invasive species management; and protect Yukon's environment and economy by minimizing the adverse effects caused by the introduction, establishment and spread of invasive species.

3.1.3 FIRST NATION GOVERNMENTS

The Coffee Project is primarily located on Yukon Commissioner's Land, within the traditional territory of the TH and the asserted traditional territory of the White River First Nation (WRFN). Sections of the proposed NAR also overlap the traditional territory of the Selkirk First Nation (SFN) and the First Nation of Na-cho Nyäk Dun (FNNND).

The TH, SFN and the FNNND are self-governing First Nations and have land management rights on settlement lands and land-use rights within the Project area as defined in their Final Agreements and the Umbrella Final Agreement. The White River First Nation has not yet established legislation for the management and administration of settlement lands and wildlife.

3.1.4 OTHER RELEVANT GUIDELINES / DOCUMENTS

Tr'onëk Hwëch'in Best Practices for Heritage Resources (Tr'ondëk Hwëch'in 2011) — Provides the TH perspective on working with heritage resources in TH Traditional Territory and outlines the relevant legislative framework, cultural context and standard mitigations for land-based heritage resources, including harvestable plants.

The Environmental Code of Practice for Metal Mines (Environment Canada 2009) — The Environmental Code of Practice describes operational activities and associated environmental concerns of metal mines. The document outlines recommendations to mitigate identified environmental concerns, including clearing of Vegetation, throughout the life of the mine, from design and construction to operations and mine closure.

Yukon Mineral and Coal Exploration Best Management Practices and Regulatory Guide (Yukon Chamber of Mines 2010) — The document is a practical overview to implementing Best Management Practices (BMPs) when planning and conducting exploration projects; from preliminary stages through to the advanced exploration stage. Environmental BMPs including Vegetation considerations are identified for a variety of project construction elements including airstrip and road construction.

Managing Weeds and Invasive Plants — Information for producers, rural property owners, hobby farmers, and land developers in the Yukon (Yukon Invasive Species Council 2015a) — This document provides general information on weeds and invasive plants in the Yukon, describes best practices to reduce the introduction and spread of weeds and invasive plants, how to dispose of invasive plants, and explains how to report invasive species to YISC.

Best Management Practices for Works Affecting Water in Yukon (Environment Yukon 2011) — This document provides Yukon-specific BMPs that prescribe practical work-site guidelines to help planners and developers protect water resources. The BMPs provide information that can be used across a broad range of work activities to control erosion, sedimentation, and contamination. Guidelines on Vegetation management and revegetation and techniques for preserving natural Vegetation and encouraging natural revegetation are included.

Yukon Revegetation Manual: Practical Approaches and Methods (Matheus and Omtzigt 2013) — This manual describes methods for planning and implementing revegetation projects in Yukon, written in collaboration with practitioners, planners, and managers in industry and the government. The manual addresses a range of revegetation sites and application techniques, from borrow pits and mine sites, to highway rights-of-way, and transmission lines and pipeline corridors.

3.2 BACKGROUND INFORMATION AND STUDIES

Existing conditions information for the Vegetation VC was drawn from reviews of TK, other scientific studies, and Project-specific baseline studies.

3.2.1 TRADITIONAL KNOWLEDGE

As a part of Project data collection, available TK from TH, SFN, FNNND, and WRFN was compiled (i.e., the Project TK database). This TK was reviewed for this assessment and relevant information was incorporated into the VC report and the associated Vegetation Baseline Report (**Appendix 15-A**).

Many plant species found in the RAA and LAA are currently, or have been previously, used by local First Nations as a source of food, or for medicinal and spiritual use. Both TH and WRFN members report harvesting berries and other edible plants from the Coffee Creek area which would supplement harvested meat and fish (Tr'ondëk Hwëch'in 2012a, Bates and DeRoy 2014). According to the Coffee Creek Traditional Knowledge Survey (Tr'ondëk Hwëch'in 2012a):

> *"Harvesting berries was also an important activity in the Coffee Creek area, where high bush and low bush cranberries could be found. Blueberries were picked in the flats and soap berries were plentiful. William also mentioned gooseberries, which Roland thought to be mossberries"*

Similarly, WRFN members report picking Blueberries, Highbush Cranberries, and Blackberries in the Project area (Bates and DeRoy 2014). TK also contains accounts of the continued importance of berries to local First Nations:

> *"Among the plants still collected and consumed today [within NND traditional territory] are largely berries such as Low-bush Cranberries, Blueberries, Black Currants, Raspberries, Stone Berries, and High Bush Cranberries"* (InterGroup Consultants Ltd. 2009).

Plants in the RAA and LAA have also been harvested for medicinal use such as the pitch from trees and the root or leaves of certain species (Tr'ondëk Hwëch'in 2012a, Bates and DeRoy 2014, Popadynec 2009):

> *"Some of the leaves are good, certain leaves are good for medicines…some you make salves. Some are plants. Some are the flowers and all that"* (W01 18-Aug-2014 in Bates and DeRoy 2014).
>
> *"As the spruce gum is chewed it produces a juice which is swallowed to treat a sore throat. When boiled, spruce gum tea is also used to treat colds. The sticky gum can be used as a salve on cuts or to help remove slivers. Other parts of the spruce tree, such as the cones, the inner bark and the young spruce tips may be used for medicine as well."* (p.30 Popadynec 2009).
>
> *Some plants were traditionally collected for medicinal purposes by the Na-cho-Nyäk Dunn (NND). These plants included yarrow, spruce, pine, balsam, Labrador tea, caribou horn (lichen) and puffballs (fungi)... Most of the medicinal plants used in the area are commonly found throughout the boreal forest."* (p.15 InterGroup Consultants Ltd. 2009).

Labrador Tea (*Rhododendron groenlandicum*) and Bear Root (*Hedysarum alpinum*) are other commonly harvested plants (Tr'ondëk Hwëch'in 2012a, Bates and DeRoy 2014, Popadynec 2009).

In addition to plants harvested for food or medicine, plants were harvested for making tools and equipment, such as baskets, sleds, and snowshoes (Bates and DeRoy 2014, Popadynec 2009). White River First Nation members report having collected birch bark in the areas around Coffee Creek for use in basket making (Bates and DeRoy 2014).

3.2.2 SCIENTIFIC AND OTHER INFORMATION

Prior to field work, a desktop review of Vegetation species expected to be present in the Vegetation baseline Local Study Area (LSA) was conducted for species of potential conservation concern listed under the SARA, COSEWIC, and the Yukon CDC. The Vegetation baseline LSA is larger than the LAA since it included a 1 km buffer around various road alignments options that were initially considered prior to the current alignment.

Records of known plants of conservation concern in the LSA were compiled from Yukon CDC Track-list and Watch-list species with reference to west-central Yukon (Yukon CDC 2014, 2015) and from known locations in the *Flora of the Yukon Territory* (Cody 2000). Records indicated that approximately 41 plant species from the Track-list and 30 plants from the Watch-list could occur within the LSA, based on the likelihood that similar habitat may be found. The compiled list of potential plants of conservation concern can be found in Appendix D of the Vegetation Baseline Report (**Appendix 15-A**).

Prior to field work, a desktop review of plant species expected to be present in the Vegetation baseline LSA was conducted for invasive plants recognized by the Government of Yukon, Environment Yukon (YG), and YISC. The survey focused on non-native invasive plant species. Records of known invasive plants in Yukon are stored on the Alaska Exotic Plants Information Clearinghouse (AKEPIC) data portal. Database search efforts and consultation with YG and YISC found no known records of invasive plants in the LSA. This is likely due to a lack of survey effort in Yukon and subsequent reporting. The invasive plant survey was the first of its kind in the LSA, providing important baseline information for Yukon.

3.2.3 BASELINE STUDIES

The Vegetation Baseline Report (**Appendix 15-A**) provides a comprehensive overview on all previous field surveys and Project-specific knowledge on Vegetation species and communities within the region surrounding the Project area. Vegetation condition is described for four components: ecological plant communities (including wetland plant communities), rare plants, exotic and invasive plants, and trace metals in plants (**Table 3.2-1**).

No surveys were designed to capture information on tree density, volume and age because most of the proposed mine site does not contain merchantable wood (treeless or sparse black spruce, *Picea mariana*, trees) or presently regenerating stands due to fire disturbances (trees in seedling or sapling stages). The ecological community information provides a more detailed description of baseline Vegetation conditions than would the tree density information. The ELC coordinator from the Yukon Government provided direction to assist with the development of ecological community surveys. Additional information on the development of ecological community surveys is provided in the Terrestrial Vegetation Baseline Report (**Appendix 15-A**). Relevant baseline information specific to each subcomponent is provided in **Section 3.3**.

Table 3.2-1 Summary of Desktop and Field Studies Related to Vegetation

Study Name	Study Purpose, Duration, and Spatial Boundaries
Ecosystem Mapping	The purpose of the ecosystem mapping was to provide information and document plant communities including wetlands and other land cover types. This study was initiated in the spring of 214 and completed in February 2016. The ecosystem mapping and survey extent included the proposed mine site area, the existing road between Coffee Camp and the deposit (i.e., the mine site access road), the current airstrip and Coffee Camp, the proposed NAR to the junction with the Klondike Highway, as well as a few previous road alignment options including the previous Casino road option and alternate alignments through the Dawson Goldfields. Around the mine site, the mapping and survey extent is delineated based on the height of land while encompassing a minimum buffer of 1 km around the proposed development. Along the various road alignments, the mapping and survey extent includes a 1 km buffer on either side of the road.
Rare Plant Survey	The purpose of the rare plant survey was to identify rare, sensitive, and/or endangered plant species that occur within or adjacent to the LAA. The rare plant surveys were completed from July 5 to 9, 2014, August 12 to 18, 2015 and July 4 to 8, 2016. The rare plant survey extent was defined by areas of high rare plant potential within 500 m of the proposed Project development footprint.
Exotic and Invasive Plant Survey	The purpose of the exotic and invasive plant survey was to collect presence of any exotic and invasive plant species and to calculate the density distribution. This survey was completed in two phases: Phase 1 was conducted August 8 to 11, 2015 along the existing road accessible by truck in the northern portion of the LAA; and, Phase 2 was conducted August 12 to 18, 2015 along existing road accessible by foot and UTV in the southern portion of the NAR. The 2015 exotic and invasive plant survey boundary was defined as the extent of existing roads within the different potential alignments from the North Klondike highway south to Coffee Camp and the existing airstrip. In 2016, the survey area was extended to include the Java Road from the Coffee airstrip to the proposed mine site, including all existing disturbed areas around the proposed mine site.
Trace Metal Analysis	The purpose of the trace metal study was to collect and establish information on baseline amounts of trace metals in soils and selected plant species found at various distances from the mine site. Plant and soil collection was conducted in July of 2014 around the proposed mine site and Coffee Camp and conducted in July and August of 2015 along the proposed NAR and July and August 2016 in the proposed mine footprint. Site selection often corresponded with ELC plot locations. This analysis will also support the assessment of the Human Health and Well Being VC**.**

3.3 EXISTING CONDITIONS

Pre-Project conditions for each subcomponent are described specifically within the LAA and whenever possible, described conceptually for the RAA. Pre-project conditions are defined as conditions prior to interaction with the Project and are summarized for each subcomponent based on regulatory context, TK, scientific and other information, and baseline studies undertaken for the Project. This information is provided in detail in the Vegetation Baseline Report (**Appendix 15-A**).

3.3.1 ECOLOGICAL COMMUNITIES

The LAA is located within the Klondike Plateau Ecoregion and the RAA also includes a small portion of the Yukon Plateau-Central Ecoregion — both of which are within the Boreal Cordillera Ecozone (**Figure 1.3-1**). The baseline plant surveys documented 411 different plant species including seven tree, 60 shrub, 188 forb, 63 grass, 18 fern/horsetail/clubmoss, 2 aquatic, 36 mosses/liverworts, and 37 lichens (a complete list of all species can be found in the Vegetation Baseline Report, **Appendix 15-A**). Many of the species documented

during the different surveys are considered traditional and medicinal plants including such plants as Bear Root, Raspberry (*Rubus ideaus*) or High-Bush Cranberry (*Vibernum edule*) among others.

The LAA contains the Boreal and Subalpine Bioclimate Zones. Approximately 92% of the LAA occurs in the Boreal Bioclimate zones, while the remaining 8% occurs within Subalpine Bioclimate zone (**Table 3.3-1**).The LAA does not extend into the Alpine Bioclimate Zone and does not contain any alpine ecological communities.

Within the ELC mapping extent in the LAA, the most abundant Boreal Bioclimate Zone ecosite mapped is the 01 (approximately 34% of the LAA). Wildfire is a common natural disturbance in the region and this is well depicted by the proportions of Vegetation associations mapped within ecosite 01. Shrub-dominated early successional stage zonal communities and mixedwood stands (01-WSw: Alaska birch – White spruce – Labrador tea – Lowbush cranberry – Feathermoss) are the most abundant zonal Vegetation associations with each comprising approximately 30% of the ecosite total. Coniferous-dominated (01-Sw: White spruce – Rose – Bastard toadflax – Feathermoss; 01-Sw(Sb): Spruce – Labrador tea – Lowbush cranberry – Feathermoss) and deciduous-dominated zonal stands (01-A: Aspen – Soapberry – Purple reedgrass; 01-W: Alaska birch – Labrador tea – Tall bluebells – Step moss) each represent about 20% of the ecosite. The second most abundant boreal ecosystem mapped in the ELC survey extent is ecosite 32 (Black spruce – Labrador tea – Cloudberry – Sedge) which comprises approximately 5% of the overall LAA. Riparian ecosystems with the ELC survey extent, including low, mid and high bench floodplains, account for less than 3% of the LAA. Grasslands within the ELC survey extent are restricted to moderate-to-steep, dry, southerly slopes and account for less than 2% of the overall area. These areas are very dry during the summer and because of their position on steep slopes, are susceptible to erosion. The broad subalpine ridges (Subalpine Bioclimate Zone) within the LAA are dominated by the ecosite 01 (Scrub Birch – Lowbush Cranberry – Feathermoss), which accounts for approximately 4% of the LAA, but 50% of the subalpine area. This ecosite typically supports a dense shrub layer and has a medium moisture and nutrient regime. Also common in the subalpine, but of low overall abundance within the LAA, is the sparely forested ecosite 31 (Spruce – Scrub Birch – Feathermoss) and the cool, sloping, permafrost influenced ecosite 32 (Black Spruce – Labrador Tea – Lowbush Cranberry – Sedge).

Within the BEM survey extent of the LAA, upland/closed canopy forests dominate the survey extent (70%) and account for approximately 40% of the overall LAA. Stunted coniferous forests are the next most abundant ecosystem and comprise about 4% of the LAA. Riparian ecosystems, shrub and tree-dominated ecosystems, account for less than 3% of the LAA. Approximately 28% of the BEM survey extent was burned within the last 35 years and is currently in an herb- or shrub-dominated state.

The most abundant non-vegetated community throughout the LAA is disturbance created by placer mining (5.7%), which is mapped exclusively along the NAR. Placer mining is a common anthropogenic disturbance in the region and correspondingly, many of the valley bottoms through which the NAR passes are disturbed by placer mining. Aside from waterbodies (e.g., Yukon and Stewart rivers) all other non-vegetated communities account for less than 1% of the overall area of the LAA.

Table 3.3-1 Ecological Community Area within the LAA

Mapped Feature	Code	LAA (ha)	% LAA
Boreal Ecological Communities			
Purple Reedgrass – Lichen	20Capu	137	0.3
Kinnikinnick	20Aruv	142	0.3
Aspen – Kinnikinnick – Purple Reedgrass	21	1,201	2.5
Aspen – Soapberry – Purple Reedgrass	01A	360	0.8
Alaska Birch – Labrador Tea – Tall Bluebells – Step Moss	01W	1,321	2.8
Alaska Birch – White Spruce – Labrador Tea – Lowbush Cranberry – Feathermoss	01WSw	2,383	5.0
White spruce – Rose – Bastard Toadflax – Feathermoss	01Sw	293	0.6
Spruce – Labrador Tea – Lowbush Cranberry – Feathermoss	01Sw(Sb)	1,349	2.8
Spruce – Feathermoss (early successional sites due to fire)	01	2,402	5.1
Black spruce – Labrador Tea – Reindeer Lichen	30	930	2.0
Spruce – Birch – Lowbush Cranberry – Feathermoss	31	1,048	2.2
Black spruce – Scrub birch – Labrador Tea - Cloudberry	32Sb1	190	0.4
Black spruce – Labrador Tea – Cottongrass	32Sb2	134	0.3
Black spruce – Labrador Tea – Cloudberry – Sedge	32	2,012	4.2
Black spruce – Labrador Tea – Sedge – Brown Moss – Reindeer Lichen	33	603	1.2
White spruce – Horsetail	40	529	1.1
Balsam Poplar – Rose – Horsetail	41	349	0.7
Alaska Birch – Alder – Reedgrass	42	174	0.4
Tall shrub Balsam Poplar – Willow	43	71	0.1
Total Area of upland Boreal Ecological Communities		**15,627**	**33**
Subalpine Ecological Communities			
Tors	10	0.5	0.0
Felsenmeer	11	0.6	0.0
Scrub Birch – Mountain Avens - Lichen	12	90	0.2
Scrub Birch – Crowberry – Lowbush Cranberry	13	190	0.4
Scrub Birch – Willow – Mountain Avens	14	79	0.2
Scrub Birch – Lowbush cranberry - Feathermoss	01	1,825	3.9
Scrub Birch – Sedge - Feathermoss	30	318	0.7
Spruce – Scrub Birch - Feathermoss	31	610	1.3
Black Spruce – Labrador Tea – Lowbush Cranberry – Sedge	32	473	1.0
Willow – Horsetail – Peatmoss	40	55	0.1
Total Area of upland Subalpine Ecological Communities		**3,641**	**7.7**

Mapped Feature	Code	LAA (ha)	% LAA
Broad Ecological Communities			
Felsenmeer	Fe	0.0	0.0
Subalpine / Alpine Shrub	Ss	74	0.2
High Elevation Sparse Coniferous Forest	Fcs	842	1.8
High Elevation Shrubby Riparian	HSr	0.0	0.0
Grassland	Gg	281	0.6
Upland / Closed Canopy Forest	UpF	18,815	39.7
Riparian Forest	RF	1,002	2.1
Stunted Coniferous Forest	Stcs	1,838	3.9
Low Elevation Shrubby Riparian	LSr	256	0.5
Total Area of upland Broad Vegetation Communities		**23,108**	**49**
Wetland Habitats			
Spruce – Willow – Labrador Tea – Sedge Fen	F1	255	0.5
Spruce – Red Bearberry – Brown Moss Fen	F2	65	0.1
Birch – Leatherleaf – Sedge Fen	F3	194	0.4
Willow – Horsetail Swamp	S1	206	0.4
Willow – Reedgrass Swamp	S2	12	0.0
Beaked Sedge Marsh	M1	6	0.0
Horsetail – Sedge Marsh	M2	1	0.0
Marsh	M	27	0.1
Bog	B	0.0	0.0
Fen	F	412	0.9
Swamp	S	11	0.0
Total Area of Wetland Habitats		**1,190**	**2.5**
Non-vegetated/Anthropogenic Communities			
Anthropogenic	An	56	0.1
Gravel Bar	Gb	20	0.0
Placer Mine	Mp / Pm	2,770	5.9
Pond	Pd	4	0.0
Placer mining pond	Ppd	160	0.3
Road surface	Rd	49	0.1
River	Ri	693	1.5
Rock	Ro	68	0.1
Talus	Rt	37	0.1
Total Area of Non-Vegetated / Anthropogenic		**3,856**	**8**
Total Area (ha)		**47,422**	**100**

3.3.2 WETLAND HABITATS

Wetlands are found scattered across the region but no detailed wetland mapping or classification is available regionally. The most common wetland type found within the LAA was fens (approximately 926 ha scattered across the LAA in pockets of various sizes), and swamps (approximately 230 ha of willow-dominated (*Salix spp.*) swamps were mapped within the LAA). No bogs were mapped within the LAA and few small marshes were mapped throughout the LAA.

Less than 4% of the overall ELC survey extent was mapped as wetland ecosystems (codes F1, F2, F3, S1, S2, M1 and M2 in **Table 3.3-1**). Floodplains are found throughout the ELC survey extent of the LAA, and make up 6% of the area mapped. Wetlands within the BEM survey extent are infrequent and account for less than 2% of the area mapped due to the high proportion of valley bottom placer mining disturbance (codes B, F, S and M in **Table 3.3-1**). Very small pockets of natural wetland communities are likely to exist within the matrix of heavy placer mining activity.

3.3.3 TRADITIONAL AND MEDICINAL PLANTS

Berry-producing plants were selected to represent traditional and medicinal use plants as berries are a diverse and important food source and were reported to be harvested in the Coffee Creek area by members of the Tr'ondëk Hwëch'in and White River First Nation (Tr'ondëk Hwëch'in 2012a, Bates and DeRoy 2014) and continue to be an important source of food for local First Nations (InterGroup Consultants Ltd. 2009):

> *"…The women and children picked a variety of fruit, including blueberries, lowbush and highbush cranberries, rosehips, mossberries, raspberries, soapberries, currants and stoneberries (kinnikinnick). The berries were stored in birchbark containers, which were covered by lids stiched on with spruce roots…" (Dobrowolsky, D. 2014).*

> *"Harvesting berries was also an important activity in the Coffee Creek area, where high bush and low bush cranberries could be found. Blueberries were picked in the flats and soap berries were plentiful. William also mentioned gooseberries, which Roland thought to be mossberries."* (Tr'ondëk Hwëch'in 2012a)

Additionally, many of the berry-producing species traditionally harvested by First Nation communities are present in one or more of the ecological communities surveyed in the Project area and are used as indicator species.

The occurrence of plants important for traditional and medicinal use was quantified the ELC and BEM Vegetation community classification mapping, and quantified as sites likely to contain important berry-producing plants. Edible berry-producing species, including Bog Blueberry (*Vaccinium uliginosum*), Lowbush Cranberry (*Vaccinium vitis-idaea*), Crowberry (*Empetrum nigrum*), High-Bush Cranberry, Bog Cranberry (*Vaccinium oxycoccos*), Cloudberry (*Rubus chamaemorus*), currants and gooseberries (*Ribes* spp.), and Soapberry (*Shepherdia canadensis*) were commonly found throughout the LAA during baseline

Vegetation studies. The majority of ecosystems identified within the LAA support at minimum one berry-producing species, and commonly support multiple species. All identified ecosystems in the LAA were rated for berry-producing potential using five categories (high, medium, low, very low, and nil potential). **Table 3.3-2** lists the berry-producing sites within the LAA that are considered having high and moderate potential by zone.

Table 3.3-2 Area of High and Moderate Potential Berry-producing Sites within the LAA

Traditional Use Berry Potential Class	Ecological Communities (Code)	LAA (ha)
Boreal Zone		
High Potential	Spruce – Birch – Lowbush Cranberry – Feathermoss (31); Black Spruce – Scrub Birch – Labrador Tea – Cloudberry (32Sb1)	1,238
Moderate Potential	Alaska Birch – Labrador Tea – Tall Bluebells – Step Moss (01W); Alaska – Birch – White Spruce – Labrador Tea – Lowbush Cranberry – Feathermoss (01WSw); Spruce – Labrador Tea, Lowbush Cranberry – Feathermoss (01Sw(Sb)); Spruce – Feathermoss (01); Black Spruce – Labrador Tea – Reindeer Lichen (30); Black Spruce – Labrador Tea – Cottongrass (32Sb2); Black Spruce – Labrador tea – Cloudberry – Sedge (32); Spruce – Willow – Labrador Tea – Sedge (F1); Birch – Leatherleaf – Sedge (F3); Willow – Horsetail (S1); Willow – Reedgrass (S2)	11,198
Subalpine Zone		
High Potential	Scrub Birch – Crowberry – Lowbush Cranberry (13); Shrub Birch – Lowbush Cranberry – Feathermoss (01); Scrub Birch – Sedge – Feathermoss (30); Spruce – Scrub Birch – Feathermoss (31); Black Spruce – Labrador Tea, Lowbush Cranberry – Sedge (32)	3,416
Moderate Potential	Scrub Birch – Willow – Mountain Avens (14); Willow – Horsetail – Peatmoss (40)	134
Broad Ecosystems		
High Potential	Subalpine / Alpine Shrub (Ss); High Elevation Sparse Coniferous Forest (Fcs); Stunted Coniferous Forest (Stcs)	2,754
Moderate Potential	Upland/Closed Canopy Forest (UpF); Low Elevation Shrubby Riparian (LSr); Fen (F); Swamp (S)	19,494
	Total (ha)	**38,233**

3.3.4 RARE PLANTS

No COSEWIC or SARA-listed plant species were observed during rare plant surveys; however, populations of four territorial Watch-list plant species were found. Watch-list plant species found during rare plant surveys included:

- Coffee Creek Scorpionweed (*Phacelia mollis*; S3S4)
- Spotted Lady's Slipper (*Cypripedium guttatum*; S2S3)
- Small Enchanter's Nightshade (*Circaea alpina* ssp. *alpina*; S2S3)
- Dry-spike sedge (*Carex siccata*, S2S3).

Coffee Creek Scorpionweed has been found at a number of locations in western Yukon; however, the global population of this species is found only within Yukon and Alaska. Within Yukon, there is some uncertainty about whether it is considered Vulnerable or Apparently Secure, due to the range in habitats and the habitats where it has been located. Within the LAA, the species was found growing in undisturbed open, Trembling Aspen (*Populus tremuloides*) to mixed forest, as well as disturbed exposed soil areas (**Table 3.3-3**). It appears that it is able to colonize disturbed areas and may be present at other human-disturbed sites. Given its range in habitat preference and potential to exist in previously disturbed areas, the concern for the species is low. The species has recently been found at a number of sites (including disturbed habitats), which may potentially lead to a down-listing for this species (B. Bennett, Yukon CDC. Pers. Comm. 2016).

Spotted Lady's Slipper has been found at several sites within central and northern Yukon; however, there is some uncertainty whether this species is considered Imperiled or Vulnerable in Yukon. In the LAA, the species was found at one site in 2014 and five additional sites in 2015 (**Table 3.3-3**) on south-facing, moderate slopes, with the exception of one site where a small population was found growing along the existing road on a south-facing slope. Spotted Lady's Slipper has never been found in habitats where Labrador Tea occurs. Species composition appears to be important in predicting the presence or absence of Spotted Lady's Slipper. Preferred habitat consists of open, Trembling Aspen forest and few scattered White Spruce. The understory was consistently dominated by Kinnikinnick (*Arctostaphylos uva-ursi*) with varying amounts of Purple Reedgrass (*Calamagrostis purpurascens*), False Toadflax (*Geocaulon lividum*), and other shrubs. The combination of species composition, slope, and aspect appear to play a strong role in dictating suitable habitat for Spotted Lady's Slipper. Although soil descriptions were not part of the rare plant surveys, it is likely that soil type and soil moisture also play a strong role in supporting suitable habitat for this species.

Previous to rare plant surveys conducted in 2015, Small Enchanter's-nightshade was only known from southeast Yukon. Although this species is circumpolar from Newfoundland to Alaska and in the northern United States, it is likely that Yukon is at the edge of this species' range. The lack of observed occurrences of this species may also be due to lack of suitable habitat in the Yukon, and there is some uncertainty whether it is considered Imperiled or Vulnerable in Yukon. In the LAA, Small Enchanter's-nightshade was found growing in transitional habitat between upland and sedge meadow (**Table 3.3-3**, with locations illustrated in Figure 3-2 in the Vegetation Baseline Report, **Appendix 15-A**). Partial shading from a canopy of deciduous shrubs created a moist, cool microclimate and apparent suitable habitat for this species.

Dry-spike sedge is listed as S2S3 in Yukon which indicates uncertainty whether this species is considered Imperiled or Vulnerable in the territory. Prior to rare plant surveys in 2016, dry-spike sedge was only known from four sites in Yukon. This finding represents the fifth collection in Yukon and provides important information on the overall distribution of dry-spike sedge at present. Discussions with the Yukon CDC

determined that all known sites in Yukon are widely distributed and threats to occurrences are currently low. This finding also represents the most northern site of dry-spike sedge known in Yukon. Dry-spike sedge is typically found in open, sandy pine forests, but a variety of upland sites have also been recorded including open, dry willow dominated, black spruce, white spruce, and aspen forests

Table 3.3-3 Locations, Abundance, and Habitat where Watch-list Plant Species were found in the LAA

Site[1]	Species Name	Abundance and Distribution	Habitat
PM-1	Coffee Creek Scorpionweed	2 individuals in a patch	Open mixed forest on a moderate slope with well-developed dwarf shrub/forb understory and tufted grasses
PM-2	Coffee Creek Scorpionweed	1 patch of 4 individuals	Disturbed, exposed soil along the edge of adjacent forest
PM-3	Coffee Creek Scorpionweed	1 individual	Disturbed, exposed soil along the edge of adjacent forest
PM-4	Coffee Creek Scorpionweed	6 individuals scattered linearly for 80 m	Open Trembling Aspen forest on moderate slope with well-developed dwarf shrub/forb understory and some leaf litter
PM-5	Coffee Creek Scorpionweed	24 individuals scattered linearly for 100 m	Disturbed, exposed soil with few associated forb species
PM-6	Coffee Creek Scorpionweed	17 individuals in a patch of approximately 20 m radius	Open Trembling Aspen forest on a moderate slope with dwarf shrub/forb understory and high leaf litter
CG-1	Spotted Lady's Slipper	4 scattered patches each with 11 individuals	Edge of open, Trembling Aspen forest at the crest of the bank with well-developed dwarf shrub/forb understory and tufted grasses
CG-2	Spotted Lady's Slipper	Approximately 3000 individuals in several patches within a larger patch about 1318 m^2	Open Trembling Aspen forest on moderate slope with well-developed dwarf shrub/forb understory and tufted grasses
CG-6	Spotted Lady's Slipper	Approximately 3,000 individuals in two patches	Open Trembling Aspen forest on moderate slope with well-developed dwarf shrub and forb understory and tufted grass.
CA-1	Small Enchanter's Nightshade	1 patch, 1 m^2 of approximately 150 individuals	Transitional habitat between upland and sedge meadow, moist shaded area below deciduous shrubbery
CS-1	Dry-spike sedge	Approximately 100 individuals scattered within a somewhat linear patch about 600m in length	Open Trembling Aspen to mixedwood forest on flat to moderate slope with well-developed shrub and forb understory.

[1]Site number is unique to the species name proceeded by a number. For example, "CA" = Circaea alpina ssp. alpina and "1" = site 1.

3.3.5 VEGETATION HEALTH

As a baseline assessment of Vegetation health, trace metal levels in soil and plants was sampled. Sampling for trace metals focused on four plant species or species groups: Willow, Lowbush Cranberry, Horsetail (*Equisetum arvense, Equisetum pratense*, and *Equisetum sylvaticum*), and Reindeer Lichens (*Cladina mitis* and *Cladina rangiferina*). The plant species were chosen based on importance to First Nations (Bates and DeRoy 2014; Mishler and Simeone 2004), value as wildlife forage, and comparability to other studies.

Vegetation and soil sample collection sites were based on variable distance from the proposed Project footprint: Adjacent (100 m), Near (1,000 m), Far (5.5 to 7.5 km), and Control (≥15 km) sites. Adjacent sites are expected to fall within the Project footprint, while control sites represent locations unaffected by Project activities. From 2014 2016, the total number of vegetation and soil trace metals sample sites visited was 89. Seventy-seven soil sites where located in the Coffee Area including 68 willow, 61 lichen, 61 lowbush cranberry, and 22 horsetail sites. Twelve soil sites were located along the Northern Access Route including 10 willow, 5 lichen, 8 lowbush cranberry, and 9 horsetail sites. Vegetation and soil samples were analyzed for total metal concentrations using inductively coupled plasma mass spectrometry (ICP-MS). The analysis tested for the presence and concentration of a large range of metals, but a subset of metals was selected based on site conditions, the potential as a source of contamination in soil and vegetation, and the level of risk associated with each element. Only the trace metal concentrations in soil were compared to the Canadian Council of Ministers of the Environment (CCME) soil quality guidelines. No CCME guidelines currently exist for trace metals in vegetation (details provided in the Vegetation Baseline Report, **Appendix 15-A**).

The soil and vegetation baseline samples were separated into two parts for analysis: the Coffee Area (which includes the proposed mine site, mine site access road, existing Coffee Camp and the proposed Casino Connector (no longer considered) and the proposed NAR. Trace metal concentrations in soil were low with the exception of arsenic and chromium. Arsenic and chromium concentrations were above CCME soil quality guidelines in 24 (27%) and 4 (4%) samples, respectively. Arsenic samples above CCME guidelines were generally found within close proximity to the proposed mine site including adjacent (100 m) and near (1000 m) distances from the proposed Project footprint. These high background levels could be due to the presence of arsenic associated with complex ores, mined primarily for their copper, lead, zinc, silver, and gold content (CCME 1997), which may be present in the Coffee Area.

Chromium samples above CCME guidelines were found at near (1000 m) and control sites (≥15 km) relative to the proposed Project footprint. Chromium rarely occurs naturally, and is often introduced to the environment through anthropogenic sources (CCME 1999).

All other trace metals consistently showed concentrations in soil well below the CCME guidelines. Relatively few soil samples reported mercury and selenium above the laboratory RDL. pH was below the recommended range in 71 (79%) samples at various distances from the proposed Project footprint.

Soil samples collected along the NAR contained low concentrations of all but two of the targeted trace metals — the concentration of arsenic was higher than CCME guidelines in one out of 12 sites sampled and selenium was found in concentrations higher than CCME guidelines in three out of 12 sites sampled. All three sites are near areas with existing anthropogenic disturbances. All other trace metals were consistently present at concentrations well below the CCME guidelines.

3.3.6 INVASIVE PLANT SPECIES

Invasive plants found during field surveys are ranked in degree of invasiveness (i.e., concern) from high priority (1) to least concern (7). Yukon ranks are based on general abundance, persistence, invasiveness rank in neighbouring jurisdictions, climate projections, and expert opinion of the Yukon CDC (YG 2012). High priority species are those that are of most concern to the economy, environment, and human health (YISC 2015b). During field surveys, populations of five rank 1 invasive plants were found (**Table 3.3-4**) including:

- Smooth Brome (*Bromus inermis*)
- Narrow-leaved Hawksbeard (*Crepis tectorum*)
- Perennial Sow-thistle (*Sonchus arvensis ssp. uliginosus*), southern portion only
- White Sweetclover (*Melilotus albus*)
- Yellow Sweetclover (*Melilotus officinalis*), northern portion only.

Locations within the survey extent where invasive plants were found included roadsides, pullouts, junctions and previously disturbed areas. In general, concentrations of invasive plants were less frequent in the southern portion (NAR south of Stewart River including mine site) of the survey extent compared to the northern portion (north of Stewart River to Klondike Highway). Prior to the Proponent's exploration work, human habitation at Coffee Creek (i.e., farming) led to relatively few invasive plant introductions, such as Smooth Brome and other lower priority species. Narrow-leaved Hawksbeard and Perennial Sow-thistle are high priority species and were found in the vicinity of Coffee Camp, but appear to be relatively new introductions because of the few plants found in single locations.

A common observation made along existing roads in the northern portion of the survey extent was that in areas where the road ditch was absent or narrow and native Vegetation (e.g., alder, willow) was found growing on the edge of the roadside, invasive plants were not found. Invasive plants were found in areas previously disturbed, where an open niche was present for seed establishment and there is a vector for seed dispersal. Along the edges of the road where only a narrow band of disturbance was present, there were fewer invasive plants than in wider ditches.

Table 3.3-4 Rank 1 Invasive Plant Species Located during Project Baseline Field Surveys

Invasiveness Rank[1]	Species Name	Common Name	Habitat	General Location		
				Northern Portion[2]	Southern Portion[2]	
				Existing Roads / Disturbance	Existing Roads Outside of Coffee Property	Coffee Property
1	*Bromus inermis*	Smooth Brome	Roadside, Clearing	√		√
1	*Crepis tectorum*	Narrow-leaved Hawksbeard	Roadside, Clearing	√	√	√
1	*Melilotus albus*	White Sweetclover	Roadside, Clearing	√	√	
1	*Melilotus officinalis*	Yellow Sweetclover	Roadside	√		
1	*Sonchus arvensis spp. uliginosus*	Perennial Sow-thistle	Clearing			√

1 Yukon invasiveness rank (YG 2012).

2 For invasive plant surveys the study area was divided into two areas: the Northern Portion which included existing roads accessible by truck, north of the Stewart River, and the Southern Portion which included existing roads accessible by foot or UTV between the Stewart River and the current Coffee airstrip

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4.0 ASSESSMENT OF PROJECT-RELATED EFFECTS

This section identifies potential Project interactions, evaluates potential Project-specific effects, and describes proposed mitigation actions to reduce or eliminate effects. Based on the anticipated effectiveness of these measures, residual effects and potential effects to Vegetation are characterized. For Vegetation, the significance and likelihood of each predicted residual effect is identified. The analysis of change and assessment of effects involved the following steps:

- **Section 4.1**: Identification of potential Project-related interactions with Vegetation, with reference to interactions for subcomponents
- **Section 4.2**: Introduction to potential Project-related effects on Vegetation
- **Section 4.3**: Identification of mitigation measures relevant to all Vegetation subcomponents
- **Section 4.4**: For each subcomponent, identification of residual effects and determination of significance of residual effects
- **Section 4.5**: Discussion of a subject of note: introduction and spread of invasive species.

4.1 POTENTIAL PROJECT-RELATED INTERACTIONS WITH VEGETATION

Potential Project-related interactions between Vegetation and Project activities were considered and rated using the terms defined in **Table 4.1-1**. The rating of each Project-related interaction is shown in **Table 4.1-2**. Most interactions were assessed at the overall Vegetation VC level because subcomponents are expected to experience similar effects. When a potential interaction applies uniquely to a particular Vegetation subcomponent, it is indicated **Table 4.1-2** (i.e., right hand column, “Nature of Interaction and Potential Effect”). The potential effects of these interactions are discussed further in **Section 4.2**

Table 4.1-1 Definitions of Potential for an Interaction between Vegetation and the Project

Term	Definition
No Interaction	Project activity will not interact with or have effects on Vegetation.
Negligible Interaction	Interaction with the Project activity will not have a substantive influence on the short or long-term integrity of Vegetation (i.e., not measurable / not detectable using the identified indicator).
Potential Interaction	Interaction between the Project activity and Vegetation may have a substantive influence on the short- or long-term integrity of Vegetation (i.e., measurable or detectable using the identified indicator). The potential effect(s) of the interaction is considered further in the effects assessment.

Table 4.1-2 Potential Project Interactions with Vegetation

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Construction				
Overall Mine Site	C-0	Confirmatory geotechnical drilling in select areas at the mine site, as necessary	Potential Interaction	Areas in which geotechnical drilling will occur overlap spatially with vegetated habitat and adverse effects include loss of habitat within the geotechnical drilling selected areas.
	C-1	Mobilization of mobile equipment and construction materials	Potential Interaction	Adverse effects include possible changes to Vegetation health in adjacent areas due to emissions and dust deposition and possible introduction of invasive species into new areas.
	C-2	Clearing, grubbing, and grading of areas to be developed within the mine site	Potential Interaction	Areas in which clearing and grubbing will occur overlap spatially with vegetated habitat and adverse effects include loss of habitat within the Project footprint areas and possible changes in Vegetation health in adjacent areas due to dust deposition and possible introduction and spread of invasive species.
	C-3	Material handling	No Interaction	This activity should not have any effects on Vegetation.
Open Pits	C-4	Development of Latte pit and Double Double pit	Potential Interaction	Adverse effects include loss of habitat within pit development areas, and possible changes to Vegetation health in adjacent areas as a result of emissions, and dust during the development of the open pits.
	C-5	Dewatering of pits (as required)	No Interaction	No Project-related changes to vegetated areas are anticipated from this activity within the footprint of the mine site.
Waste Rock Storage Facilities	C-6	Development and use of Alpha WRSF	Potential Interaction	Adverse effects include loss of habitat, and possible changes to Vegetation health in adjacent areas as a result of emission and dust deposition during development and use of WRSF.
Stockpiles	C-7	Development and use of temporary organics stockpile for vegetation and topsoil	Potential Interaction	Potential positive effects from storage of growth medium for reclamation activities. Adverse effects include loss of habitat, possible introduction and spread of invasive species on organic/topsoil piles, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the development and use of stockpiles.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	C-8	Development and use of frozen soils storage area	Potential Interaction	Potential positive effects from storage of growth medium for reclamation activities. Adverse effects include loss of habitat, possible introduction and spread of invasive species frozen soil piles, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the development and use of storage area.
	C-9	Development and use of run-of-mine (ROM) stockpile for temporary storage of ROM ore	Potential Interaction	Adverse effects include loss of habitat and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the development and use of stockpiles.
Crusher System	C-10	Construction and operation of crushing circuit	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust during construction and operation of crushing circuit.
	C-11	Construction and operation of crushed ore stockpile	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust during construction and operation of crushed ore stockpile.
Heap Leach Facility	C-12	Staged heap leach facility (HLF) construction, including associated event ponds, rainwater pond, piping, and water management infrastructure	Potential Interaction	Adverse effects include loss of habitat, and changes to Vegetation health in adjacent areas as a result of emissions and dust during construction of the facility.
	C-13	Heap leach pad loading	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust associated with heap leach pad loading.
Plant Site	C-14	Construction and operation of process plant	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the construction and operation activities.
	C-15	Construction and operation of reagent storage area and on-site use of processing reagents	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the construction and operation activities.
	C-16	Construction and operation of laboratory, truck shop, and warehouse building	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the construction and operation activities.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	C-17	Construction and operation of power plant	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the construction and operation activities.
	C-18	Construction and operation of bulk fuel/LNG storage and on-site use of diesel fuel or LNG	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the construction and operation activities.
Camp Site	C-19	Construction and operation of dormitories and kitchen, dining, and recreation complex buildings; mine dry and office complex; emergency response and training building; fresh (potable) water and fire water systems; and sewage treatment plant	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the construction and operation activities.
	C-20	Construction and operation of waste management building and waste management area	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the construction and operation activities.
Bulk Explosive Storage Area	C-21	Construction of storage facilities for explosives components and on-site use of explosives	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the construction activities and on-site use of explosives.
Mine Site and Haul Roads	C-22	Upgrade, construction, and maintenance of mine site service roads and haul roads	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the construction and maintenance of roads.
Site Water Management Infrastructure	C-23	Development and use of sedimentation ponds and conveyance structures, including discharge of compliant water	Potential Interaction	Adverse effects include loss of habitat, and possible introduction and spread of invasive species associated with the development of sedimentation ponds and conveyance structure.
Ancillary Components	C-26	Upgrade of existing road sections for Northern Access Route (NAR), including installation of culverts and bridges	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the upgrade of existing road sections.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	C-27	Construction of new road sections for NAR, including installation of culverts and bridges	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the construction of new road sections.
	C-28	Development, operation, and maintenance of temporary work camps along road route	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the development, operation and maintenance of camps.
	C-29	Vehicle traffic, including mobilization and re-supply of freight and consumables	Potential Interaction	Adverse effects include possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with vehicle traffic.
	C-30	Development, operation, and maintenance of barge landing sites on Yukon River and Stewart River	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the development, operation and maintenance of the barge landings.
	C-31	Barge traffic on Stewart River and Yukon River, including barge mobilization of equipment for NAR construction	No Interaction	River travel does not interact with Vegetation.
	C-32	Annual construction, operation, maintenance, and removal of Stewart River and Yukon River ice roads	Potential Interaction	Areas in which clearing will occur overlap spatially with Vegetation and adverse effects include loss of Vegetation within the footprint, changes to Vegetation health in areas adjacent to the footprint as a result of emissions and dust, possible introduction and spread of invasive species associated with the annual construction, operation and maintenance of ice roads.
	C-33	Annual construction and operation of 4.1 km winter road on the south side of the Yukon River	Potential Interaction	Areas in which clearing will occur overlap spatially with Vegetation and adverse effects include loss of Vegetation within the footprint, changes to Vegetation health in areas adjacent to the footprint as a result of emissions and dust, possible introduction and spread of invasive species associated with the annual construction, operation and maintenance of ice roads.
	C-34	Construction, operation, and maintenance of permanent bridge over Coffee Creek	Potential Interaction	Areas in which clearing will occur overlap spatially with Vegetation habitat and adverse effects include loss of Vegetation within the footprint, changes to Vegetation health in areas adjacent to the footprint as a result of emissions and dust, possible introduction and spread of invasive species associated with the annual construction, operation and maintenance of bridge over Coffee Creek.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	C-35	Construction and maintenance of gravel airstrips	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition and possible introduction and spread of invasive species associated with construction and maintenance of airstrip.
	C-36	Air traffic	Potential Interaction	Adverse effects could occur in adjacent areas and could include possible changes to Vegetation health due to emissions and dust deposition and possible introduction and spread of invasive species associated with take-off and landings.
	C-37	Use of all laydown areas	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the use of laydown areas.
	C-38	Use of Coffee Exploration Camp	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the use of Coffee Exploration Camp.
Operation				
Overall Mine Site	O-1	Material handling	No Interaction	Material handling does not interact with Vegetation.
	O-2	Excavation of contaminated soils followed by on-site treatment or temporary storage and off-site disposal	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition associated with excavation of contaminated soils.
	O-3	Progressive reclamation of disturbed areas within mine site footprint	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with the progressive reclamation of disturbed areas. Positive effects include reestablishment of Vegetation in reclaimed areas.
Open Pits	O-4	Development of Kona pit and Supremo pit and continued development of Double Double pit and Latte pit	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition associated continued development of all pits.
	O-5	Cessation of mining at Double Double pit, Latte pit, Kona pit, and Supremo pit	Potential Interaction	Adverse effects include loss of habitat within the mine pits. Reduced activities in the pits will reduce emissions and dust generated could have had an effect on adjacent Vegetation habitat.
	O-6	Partial backfill of Latte pit and Supremo pit	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition associated with backfill activities.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	O-7	Backfill of Double Double pit and Kona pit	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition associated with backfill activities.
	O-8	Dewatering of pits (as required)	No Interaction	No Project-related changes to vegetated areas are anticipated from this activity within the footprint of the mine site.
Waste Rock Storage Facilities	O-9	Continued development and use of Alpha WRSF	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition associated with development WRSF sites.
	O-10	Development and use of Beta WRSF	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition associated with development WRSF sites.
Stockpiles	O-11	Continued use of temporary organics stockpile for vegetation and topsoil	Potential Interaction	Potential positive effects from storage of growth medium for reclamation activities. Adverse effects include loss of habitat, possible introduction and spread of invasive species on organic/topsoil piles, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the development and use of stockpiles.
	O-12	Continued use of frozen soils storage area	Potential Interaction	Potential positive effects from storage of growth medium for reclamation activities. Adverse effects include loss of habitat, possible introduction and spread of invasive species frozen soil piles, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the development and use of storage area.
	O-13	Continued use of ROM stockpile for temporary storage of ROM ore	Potential Interaction	Adverse effects include loss of habitat and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the development and use of stockpiles.
Crusher System	O-14	Crusher operation	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition associated with crusher operations.
	O-15	Continued use of crushed ore stockpile	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust during construction and operation of crushed ore stockpile.
Heap Leach Facility	O-16	Continued staged HLF construction, including related water management structures and year-round operation	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition associated with staged HLF construction.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	O-17	Progressive closure and reclamation of HLF	Potential Interaction	Adverse effects include possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition associated with reclamation activities Positive effects include decrease in continued loss of habitat associated with progressive development of early seral stage Vegetation.
Plant Site	O-18	Process plant operation	No Interaction	Activities within an enclosed structure will not interact with Vegetation.
	O-19	Continued on-site use of processing reagents	No Interaction	No Project-related changes to vegetated areas are anticipated from this activity within the footprint of the mine site.
	O-20	Continued on-site use of diesel fuel or LNG	No Interaction	No Project-related changes to vegetated areas are anticipated from this activity within the footprint of the mine site.
Camp Site	O-21	Continued use of facilities	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition and possible introduction and spread of invasive species associated with continued use of facilities.
Bulk Explosive Storage Area	O-22	Continued on-site use of explosives	Potential Interaction	Adverse effects include loss of habitat and possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition due to continued use of explosives.
Mine Site and Haul Roads	O-23	Use and maintenance of mine site service roads and haul roads	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition and possible introduction and spread of invasive species associated with operation and maintenance of service and haul roads.
Site Water Management Infrastructure	O-24	Continued use of sedimentation ponds conveyance structures	No Interaction	No Project-related changes to vegetated areas are anticipated from this activity within the footprint of the mine site.
	O-25	Ongoing use of site contact water (i.e., precipitation, stored rainwater) as HLF process water	No Interaction	No Project-related changes to vegetated areas are anticipated from this activity within the footprint of the mine site.
	O-26	Installation and operation of water treatment facility for HLF rinse water	No Interaction	No Project-related changes to vegetated areas are anticipated from this activity within the footprint of the mine site.
Ancillary Components	O-27	NAR road maintenance (e.g., aggregate re-surfacing, sanding, snow removal)	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition and possible introduction and spread of invasive species associated with road maintenance.
	O-28	NAR vehicle traffic, including mobilization and re-supply of freight and consumables	Potential Interaction	Adverse effects could occur in adjacent areas and could include possible changes to Vegetation health due to emissions, dust deposition from traffic, and potential for spread of invasive plant species at roadsides.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
	O-29	Operation and maintenance of barge landing sites on Stewart River and Yukon River	No Interaction	Operation and maintenance will occur within previously disturbed footprint.
	O-30	Barge traffic on Stewart River and Yukon River	No Interaction	River travel does not interact with Vegetation.
	O-31	Annual construction, operation, maintenance, and removal of Stewart River and Yukon River ice roads	No Interaction	Effects of ice crossings on Vegetation occurred during the initial Construction phase.
	O-32	Annual construction and operation of winter road on the south side of the Yukon River	No Interaction	Effects of construction and operation of winter road on Vegetation occurred during the initial Construction phase.
	O-33	Operation and maintenance of gravel air strips	No Interaction	Effects of construction and operation of winter road on Vegetation occurred during the initial Construction phase.
	O-34	Air traffic	Potential Interaction	Adverse effects could occur in adjacent areas and could include possible changes to Vegetation health due to emissions and dust deposition and possible introduction and spread of invasive species associated with take-off and landings.
	O-35	Use of all laydown areas	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the use of laydown areas.
	O-36	Use of Coffee Exploration Camp	Potential Interaction	Adverse effects include loss of habitat, possible introduction and spread of invasive species, and potential change to Vegetation health in adjacent areas due to possible increase in emissions and dust associated with the use of Coffee Exploration Camp.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Reclamation and Closure				
Overall Mine Site	R-1	Reclamation of disturbed areas within mine site footprint	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with the progressive reclamation of disturbed areas. Positive effects include reestablishment of Vegetation in reclaimed areas.
	R-2	Excavation of contaminated soils followed by on-site treatment or temporary storage and off-site disposal	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with vehicles.
Open Pits	R-3	Reclamation of Double Double pit, Latte pit, Supremo pit and Kona pit	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with reclamation of pits. Positive effects include reestablishment of Vegetation in reclaimed areas.
Waste Rock Storage Facilities	R-4	Reclamation of Alpha WRSF	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with reclamation of Alpha WRSF. Positive effects include reestablishment of Vegetation in reclaimed areas.
	R-5	Reclamation of Beta WRSF	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with reclamation of Beta WRSF. Positive effects include reestablishment of Vegetation in reclaimed areas.
Stockpiles	R-6	Reclamation of temporary organics stockpile, frozen soils storage area, and ROM stockpile	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with reclamation of stockpiles and storage areas. Positive effects include reestablishment of Vegetation in reclaimed areas.
Crusher System	R-7	Dismantling and removal of crusher facility and stockpile	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with dismantling activities.
Heap Leach Facility	R-8	Closure of HLF and related water management structures	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with the closure of HLF and related structures.
Plant Site	R-9	Dismantling and removal of process plant, reagent storage area, laboratory, truck shop and warehouse building, power plant, and bulk fuel storage	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with dismantling activities.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Camp Site	R-10	Dismantling and removal or dormitories and kitchen, dining, and recreation complex buildings, mine dry and office complex, emergency response and training building, fresh (potable) water and fire water systems, sewage treatment plant, and waste management building	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with dismantling activities.
Bulk Explosive Storage Area	R-11	Dismantling and removal of explosives storage facility	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with dismantling activities.
Mine Site and Haul Roads	R-12	Decommissioning and reclamation of mine site service roads and haul roads	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with decommissioning and reclamation of the roads. Positive effects include reestablishment of Vegetation in reclaimed areas.
Site Water Management Infrastructure	R-13	Decommissioning and reclamation of selected water management infrastructure, construction of long term water management infrastructure, including water deposition to creek systems	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with decommissioning and reclamation activities. Positive effects include reestablishment of Vegetation in reclaimed areas.
	R-14	Operation and maintenance of HLF water treatment facility	No Interaction	No Project-related changes to vegetated areas are anticipated from this activity within the footprint of the mine site.
	R-15	Decommissioning and removal of HLF water treatment plant	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with decommissioning and removal of HLF water treatment facility.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect
	#	Description		
Ancillary Components	R-16	NAR road maintenance (e.g., aggregate re-surfacing, sanding, snow removal)	Potential Interaction	Adverse effects include loss of habitat, possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition and possible introduction and spread of invasive species associated with road maintenance activities.
	R-17	NAR vehicle traffic	Potential Interaction	Adverse effects include possible changes to Vegetation health in adjacent areas as a result of emissions and dust deposition and possible introduction and spread of invasive species associated with vehicle traffic.
	R-18	Operation and maintenance of barge landing sites on Stewart River and Yukon River	No Interaction	Effects of barge landings on Vegetation will occur during the Construction phase. Operation and maintenance occurs within existing footprint.
	R-19	Annual resupply of consumables and materials for active closure via barge on the Yukon River	No Interaction	River travel does not interact with Vegetation.
	R-20	Annual construction, maintenance, and decommissioning of Stewart River and Yukon River ice roads	No Interaction	Likely no additional loss of habitat
	R-21	Decommissioning of new road portions	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with reclamation of new road portions Positive effects include reestablishment of Vegetation in reclaimed areas.
	R-22	Air traffic	Potential Interaction	Adverse effects could occur in adjacent areas and could include possible changes to Vegetation health due to emissions and dust deposition and possible introduction and spread of invasive species associated with take-off and landings.
	R-23	Decommissioning and reclamation of airstrip	Potential Interaction	Adverse effects could occur in adjacent areas and include possible changes to Vegetation health due to emissions and dust deposition associated with decommissioning and reclamation of airstrip. Positive effects include reestablishment of Vegetation in reclaimed areas.
	R-24	Re-opening and operation of pre-existing Yukon River exploration camp and airstrip to support post-closure monitoring activities	Potential Interaction	Adverse effects could occur in adjacent areas and could include possible changes to Vegetation health due to emissions and dust deposition and possible introduction and spread of invasive species associated with operation of exploration camp and airstrip.
Post-closure Phase				
Overall Mine Site	P-1	Long-term monitoring	No Interaction	No Project-related changes to vegetated areas are anticipated from occasional site visits within the footprint of the mine site.

4.2 POTENTIAL PROJECT-RELATED EFFECTS

Potential Project-related adverse effects on Vegetation were identified based on Project-related interactions (**Table 4.1-2**). The potential effects are described below as they relate to the subcomponents: ecological communities, wetland habitat, rare plants, traditional and medicinal plants, and Vegetation health. Where potential effects only relate to some of these components, those are identified. The phases during which each potential effect is expected to occur are identified. Effects assessments were completed specifically for each subcomponent as described in **Section 4.4**.

Based on the timing and nature of the interactions, consideration was given to the following effects that could occur on Vegetation resources:

- **Habitat loss** — includes loss of existing areas of vegetated habitat/ecological communities, wetland communities, and areas that could provide suitable conditions for traditional, medicinal and rare plants.
- **Change in Vegetation Health due to Dust deposition** — includes changes related to potential increase in emissions such as dust which could result in a change in trace metal concentrations in plants and potentially affect Vegetation health.
- **Risk of introduction and spread of invasive plant species** — includes the introduction or spread of non-native plant species that could displace native Vegetation.

4.2.1 HABITAT LOSS

Habitat loss will result from the ground clearing and Vegetation removal required within the Project footprint during the Construction phase and the continued development of Waste Rock Storage Facilities (WRSFs), during the Operation phase. Habitat loss is considered a potential Project-related effect for all Vegetation subcomponents except for Vegetation health. Most of the area within the LAA has the potential to support harvestable plants including traditional and medicinal plants such as spruce trees, Bear Root, blueberries, cranberries, and Labrador Tea. The majority of the loss of harvestable plants and rare plants will occur as a result of clearing activities within the mine site and areas of road construction. Effects to traditional and medicinal plants and rare plants are incorporated within the effects assessment for ecological communities and wetland habitats since these species are part of the plant assemblages associated with the individual ecological communities or wetlands. Most traditional and medicinal plants are readily found throughout the boreal forest.

Note: Since the assessment of Project effects to Vegetation was completed, minor shifts in the location of Project infrastructure at the proposed Mine Site have occurred. The final Project footprint differs from the assessed footprint by:

- 0.26 km^2 assessed as loss no longer overlap the Project footprint
- 1.73 km^2 not assessed as loss are now located within the footprint.

The affected areas overlap the boreal high – subalpine transition zone and are primarily located within zonal and nutrient poor sites dominated by Scrub Birch, Black Spruce, White Spruce and other shrub species. Review by VC report authors indicated that the minor shifts in Project infrastructure would not alter the Project effects assessment in any meaningful way for any of the Vegetation Subcomponents assessed.

4.2.2 DUST DEPOSITION

Project interactions with plants could cause a change in Vegetation health. This change in Vegetation health could potentially occur through an increase in trace metal uptake by soil and plants associated with fugitive dust and other emissions associated with Project activities. An increase in dust deposition is a potential Project-related effect during Construction, Operation, Closure and Reclamation, and Post-closure phases.

Degradation to roadside Vegetation may result from road dust associated with the use of new and upgraded road sections. Increased traffic volume could increase the amount of dust along roads. Dust transported by wind carries many elements that could be either detrimental or influential to the growth of Vegetation. Depending on road materials, this could include: calcium, potassium, sodium, phosphorous, aluminum, chromium, and iron (Forman et al. 2003).

Dust can affect the health of Vegetation depending on the amount and frequency of dusting, the chemical properties of dust, and the receptor plant species. The effects of dust on Vegetation include blocking respiration, transpiration, and photosynthesis. Dust effects are typically higher in areas such as gravel road sides with high traffic rates (Padgett et al. 2008). The chemical effects of deposited dust often have a greater effect than the quantity of dust (Farmer 1993). The amount of dust produced depends on particle size, climate conditions such as precipitation and wind, the frequency of disturbances, and in some incidences, vehicle size. The distance particulate matter can travel from sources is based on the particle size distribution and climate conditions.

Studies have shown that more than 80% of the dust generated by vehicle movements is greater in size than 10 µm and concentrations decreased within 30.5 m of a roadway (Golder Associates 2010). But in high wind conditions, particles of all sizes will travel further. Larger particles (> 100 µm) can settle out within six to nine meters of the road, while particles 30 to 100 µm in size can settle out within around 100 m of the road, and even finer particles (< 30 µm) will travel further (Golder Associates 2010). Walker and Everett (1987) state that regardless of particle size, 70 to 75% of the total dust load is deposited in the first 10 m, 93% deposited within 30 m, and approximately 97% deposited within 125 m.

It has been shown that in winter, the main effect of dust is to decrease albedo which can cause melting and surface exposure up to 14 days before the general melt off that initiates stream flow. This possible early snowmelt typically occurs within 100 m of the road and depending on site conditions, it is possible that ground thaws earlier and plant growth can be initiated before those further from the road (Walker and Everett 1987).

Dust deposited on foliage or other tissues, or metals uptake through fine roots from the soil can affect plant growth. The growth may be positively or adversely affected through changes in soil pH, nutrient availability, radiation absorption, and leaf temperature and chemistry (Eller 1977, McCune 1991, Walker and Everett 1991, Farmer 1993). Evergreen shrubs may experience greater cumulative dusting than deciduous shrubs as they retain leaves from year to year (Auerbach et al. 1997). Chemically active dusts that are alkaline, acidic, or bio-available will have the largest effects on Vegetation (Grantz et al. 2003). Heavy metal concentrations and the amount of vehicle traffic are related and have been observed 200 m or more from a road (Dale and Freedman 1982).

Vegetation baseline studies for the Project included an assessment of baseline trace metals concentrations in soil and Vegetation. Trace metals include elements that may also be considered micronutrients because the uptake of these elements from the environment is a natural and required process for some plants (Barbour et al. 1998, Adriano 2001). Mining activities and processes may increase the amount of trace metals in soil and plants in the area through fugitive dust deposition or emissions of fossil fuel combustion. Arsenic, cadmium, chromium, mercury, lead, uranium, and zinc were found during baseline trace metals sampling and/or in the ore or waste rock. The potential pathway of uptake from Project related activities and potential effects on vegetation health are summarized in **Table 4.2-1**. Each plant species reacts differently to amount and frequency of metal uptake or deposit. The CCME Canadian Environmental Quality Guidelines outline the "…*numerical concentrations that are recommended as levels that should result in negligible risk to biota, their functions or any interactions that are integral to sustaining the health of ecosystems*" (CCME 2006). Presently there are no quality guidelines that have determined toxic concentrations of trace metals in Vegetation; however, trace metal concentrations can be compared over time to assess the effects of mine operations on Vegetation.

Table 4.2-1 Pathways and Effects of Potentially Harmful Elements to Vegetation Health

Element	Potential Uptake Pathway	Potential Effect	References
Arsenic	Dependent on plant species, temperature, and solubility of arsenic. As the solubility increases, arsenic becomes more bioavailable. Dust and residue from mining ores are the main contributors to the movement of arsenic.	Amount of arsenic found in Vegetation is rarely larger than the amount found in the associated soils; only some species of higher plants have recorded bioaccumulation of arsenic.	CCME 1997; Adriano 2001
Cadmium	Varies depending on plant species; those that do have been found to store it in their roots or leaves. Mobility in soils is influenced by wind erosion, leaching, fluvial transport, and biotic uptake.	Willow has been observed to uptake cadmium, resulting in higher concentrations in some species of Yukon wildlife.	CCME 1999a; Gamberg 2000
Chromium	Found naturally in plants; uptake from soils and translocation to plant cells is very low.	Concentrations in the edible portions of the plant remain low, even when growing on chromium-contaminated soils. At high concentrations, chromium toxicity can occur in plants resulting in chlorosis, stunted growth, curled and discoloured leaves, and poorly developed root systems.	CCME 1999b
Copper	Strongly attached to soil particles resulting in limited mobility.	Bioaccumulation of copper can occur, but is often on a small scale. Copper is also an essential nutrient and is required in low levels as a constituent in several plant enzymes. At high concentrations, copper toxicity can occur in plants resulting in physical deformities and a reduction in plant growth.	CCME 1999c; Adriano 2001
Cyanide	Levels in cyanogenic plants are partially determined by nutrient availability, the growth stage of the plant, and physical stressors. pH, high negative soil charges, and low clay content determine the behavior and mobility in the soil.	Once bioaccumulated in a plant and ingested by wildlife, cyanide poisoning may occur, but this is more prevalent under drought conditions. This is a result of animals being less selective of forage during droughts and enhanced plant production of cyanogenic glycosides under stressful conditions.	CCME 1999d
Mercury	Can occur through the soil, or in some plant species (e.g., lichens), through absorption of mercury vapour in the atmosphere. pH, organic matter, and clay content, determine the behaviour and mobility in the soil.	Mercury toxicity can cause physical deformities and inhibit photosynthesis.	CCME 1999e; Adriano 2001
Lead	Primarily pH levels (low pH leads to higher uptake). Uptake can occur through the soil or through absorption from atmospheric content.	Very high concentrations of lead cause deformities and a reduction of photosynthesis in plants. Once it has bio-accumulated in a plant and is ingested, lead can be very toxic to wildlife, causing organ failure and death.	CCME 1999f; Adriano 2001

Element	Potential Uptake Pathway	Potential Effect	References
Selenium	Dependent on the form and concentration in the soil, as well as soil characteristics such as pH, amount of organic matter, and soil texture.	There are several species of selenium-accumulating plants that can tolerate high concentrations of selenium, and use it as a deterrent for foraging herbivores; some studies suggest that *Equisetum* spp. (horsetail) may have this ability. It may influence shoot height and weight, but selenium toxicity can cause physical deformities, such as stunted growth or yellowing leaves, and decreased biomass.	CCME 2009; Patorczyk-Pytlik 2009
Uranium	Dependent on a combination of soil properties such as water saturation, carbonate content, soil texture, and pH. Anthropogenic sources include fuel combustion, ore production, and solid waste disposal from mining operations.	Bioaccumulation of uranium does not occur in plants. High concentrations of uranium can occur naturally in soils, water, and stream sediment, originating from mantle rocks and released through weathering. Uranium toxicity is species dependent and usually causes chemical-related toxicity, not radiation-related toxicity.	CCME 2007
Zinc	Bioavailability of zinc is determined by the amount of soluble zinc in the soil.	Zinc is an essential element in plant nutrition and it is required for several biological processes in both plants and wildlife, but only in very small amounts. An increase in phosphorous may create zinc deficiencies in plants, while high levels of zinc may reduce the lead levels in plants. While zinc deficiencies are more common, zinc toxicity can cause reduction of growth and physical deformities.	CCME 1999g; Adriano 2001

Based on current knowledge, lichens are the most affected Vegetation in roadside environments, especially soil lichens such as *Cladina* species and *Peltigera* species. In the Walker and Everett (1987) study, one site within 10 m of the road had a heavy lichen kill of *Cladina* species and other ground lichens with most mosses also being dead. At 25 m from the road, lichens were infrequent with *Stereocaulon* species beginning to occur at distances greater than 25 m. In that study, the ground cover did not regain its normal character until beyond 70 m of the road (Walker and Everett 1987). Mosses are also particularly affected by road dust. Walker and Everett (1987) explain that a reduction and, in extreme cases, elimination of mosses occurs in the 0 to 10 m zone adjacent to roads and the effects are most severe for acidophilous taxa such as *Sphagnum*. In some cases, the abundance of *Sphagnum* decreased but the amount and species composition of other mosses increased. However, most mosses are affected by desiccation and smothering effects of dust deposits. In areas of high dust deposit concentrations, all mosses may be eliminated within a few meters of roads (Walker and Everett 1987).

Overall, effects on vascular plants are less well-known, more subtle, and in many cases difficult to document because long-term monitoring is required in zones of high dust deposition. In the Walker and Everett (1987) study, Arctic White Heather appeared to be particularly susceptible to dust and was killed in most of the high dust areas. They also noted dead and dying ericaceous plants including Labrador Tea and Bog Blueberry, in lichen woodlands with high dust cover. They further noted that in some cases thick dust covered needles of spruce trees and in some areas of particularly high dust cover, the dust potentially contributed to mortality in spruce trees.

4.2.3 RISK OF INTRODUCTION AND SPREAD OF INVASIVE PLANT SPECIES

Construction activities have the potential to create suitable disturbed conditions for both the introduction and spread of invasive plant species. Vehicles of any size (e.g., heavy machinery to all-terrain vehicles) travelling into Yukon to the Project, and along the NAR and mine site access road could inadvertently transport plant propagules in tires, the undercarriage, or in mud containing plant material on the vehicle to previously unaffected areas.

Baseline invasive plant surveys recorded the presence of Rank 1 invasive species scattered along the NAR and some locations on the Coffee Property. Road segments with existing Rank 1 invasive species are areas that have the potential of increasing the spread of invasive species. Road segments with higher density distribution classes have the greatest probability for spreading the extent of existing Rank 1 invasive species.

The mechanism for the introduction and spread of invasive plant species includes clearing that may create favourable growth conditions for invasive non-native plant species from seed sources already on or near site. Trucks coming to site from various locations may contain fugitive non-native seeds in tire treads or other areas of the vehicles. Also, if not planned appropriately, revegetation efforts may inadvertently introduce non-native plant species if seed is used that is not supplied from a native seed source.

4.3 MITIGATION MEASURES

The Proponent recognizes that there will be disturbances to and effects on Vegetation as a result of construction, operation and closure of the Project. This section describes the planning and actions taken to mitigate (i.e., reduce or eliminate) Project effects on Vegetation. It describes components of Project design that address disturbance to vegetated areas; general mitigation measures relevant to Vegetation that will be part of on-site conduct; cross-reference to relevant management plans; and where necessary, mitigation measures specific to Vegetation subcomponents or indicators.

The Proponent has committed to a number of mitigation actions, some of which are general and apply to all Project phases and all Vegetation subcomponents, and some that are phase or subcomponent specific. Vegetation mitigation actions have been in place during the exploration stage of the Project and are implemented in Project development planning. The Proponent expects that some of the mitigation actions will be modified through the life of the Project as part of the adaptive management approach that is described in **Section 8.0 — Effects Monitoring and Adaptive Management**.

To inform the Proponent, First Nations, regulators, and stakeholders about mitigation effectiveness and Project effects, the mitigation framework is supported by a Project effects monitoring framework, also described in **Section 8.0**. A Vegetation Management Plan will be developed and will detail the mitigation

actions, compliance, and follow-up monitoring relevant to reducing effects on Vegetation and will be used and updated as an operational document as the Project moves through construction, operation and closure.

The applicable mitigation measures are listed from general Project design elements that are applicable to each Project development phase, to more specific mitigation measures that deal with specific effects such as habitat loss, potential loss of rare plant habitat, effects of dust, and the potential introduction and spread of invasive species. Each section provides a brief list of the pertinent mitigation measures and makes reference to relevant management plans where details are provided. The core mitigation measures for Vegetation will be provided in the Vegetation Management Plan. The following documents also have components that provide mitigation measures that will minimize effects on Vegetation:

- Conceptual Reclamation and Closure Plan (**Appendix 31-C**) — provides guidance and best practices for revegetation and reclamation of ecological communities, including the removal and decommissioning of infrastructure, progressive reclamation of the mine site starting in Year 2 of Operation, and research into reclamation and revegetation practices most suitable to the Project area (including reclamation techniques, target species for revegetation, soil amendment trials, and greenhouse trials).
- Access Route Construction (**Appendix 31-A**) and Access Route Operational (**Appendix 31-B**) Management Plans — provide details on the construction and operations of the NAR including mitigation and monitoring for dust control measures, and Vegetation management along the proposed road alignment.
- A dust management plan will include controls on dust that might settle on vegetation. Reducing effects to adjacent Vegetation health involves controls on dust and emissions that may settle on Vegetation and soil, and either affect plant growth and productivity, change plant community composition, or increase the probability of metals uptake in some plants.
- An erosion and sediment control plan will provide details on what types of erosion and sediment control measures will be used and where and when they will be applied. Erosion and sediment control measures will be implemented and maintained throughout the Project to ensure the protection of Vegetation, including riparian areas and wetlands, adjacent to the Project footprint. Procedural controls include minimizing new clearing; clearly marking clearing limits for machine operators; where possible, timing clearing to occur after peak rainfall periods (i.e., complete clearing in the fall/winter); and establishing perimeter controls to contain surface run-off and direct run-off into ditches and catchment ponds.

4.3.1 PROJECT DESIGN

Mitigation through Project design is one of several approaches the Proponent is proposing to avoid, control, or reduce potential Project-related effects on Vegetation. The Project design includes several elements that will help to mitigate effects to Vegetation subcomponents, which are described below:

- Phased mine development and progressive reclamation of disturbed areas including contouring, backfilling and re-vegetating areas no longer needed for mining during active operations, where practicable

- WRSF site selection to minimize haul distances and extent of ground disturbance
- Backfilling of pits to create causeways that shorten the ore haul distance to the crusher and to minimize contact water catchment area
- WRSF stability to ensure that the permafrost soils remain frozen avoiding a potential slope failure;
- Use of modular structures where units will be constructed off-site, thus reducing site disturbance that would be associated with construction and decommissioning
- Minimize vehicle traffic along the NAR by having most personnel on a fly-in – fly-out basis.

4.3.2 MINIMIZE HABITAT LOSS

The majority of the predicted effects on Vegetation subcomponents, except for Vegetation health, will occur during the Construction phase. Vegetation will be removed for the construction of the mine and associated infrastructure (e.g., camp, airstrip, WRSF, access roads). Land clearing is the most substantive and long-term effect on Vegetation within the Project footprint. Proper clearing, grubbing, and top soil removal is required to meet progressive reclamation and closure revegetation commitments.

A plan for overall site clearing and stripping will be developed prior to construction for; brush, Vegetation mat material, topsoil, and overburden stockpiles to ensure these materials are properly stored for later use in reclamation of the site.

To minimize the effects of habitat loss on Vegetation subcomponents (not including Vegetation health) during clearing activities:

- Clearing will be restricted to the defined footprint and prior to construction works, the Project footprint boundaries will be clearly defined on site plans to reduce potential for effects such as unnecessary Vegetation removal.
- Riparian Vegetation will be retained wherever possible; trees or shrubs in or adjacent to watercourses will not be destroyed, removed, or cleared to an extent greater than is permitted for the performance of the work. In riparian areas, reduce clearing widths to 10 m, or 3 m beyond extent of the cut or fill slopes, whichever is greater (compared to a 30-m-wide corridor in other areas).
- To minimize disturbance to wetland habitats and rare plants, where Project design allows, Project infrastructure and laydowns will be constructed outside of these identified environmentally sensitive areas (wetland habitats, south-facing grassy slopes). Prior to construction buffer zones will be established. Natural vegetation buffer zones of at least 100 m will be retained, wherever possible, adjacent to bodies of water and between cleared areas (Environment Canada 2009).
- To minimize plant loss and habitat loss, existing roads will be used to the extent possible. Where possible, new roads will be designed to avoid environmentally sensitive areas, such as wetlands and rare plant locales, and the number of stream crossings will be kept to a minimum to reduce adverse effects to riparian Vegetation.

- To prevent process solution (contact water) from adversely affecting adjacent ecological communities, wetland habitats, rare plants and traditional and medicinal plants, a redundant system of liners, drainage layers, leak detection, and monitoring systems will be in place for the Heap leach facility.

The Operation phase is the longest Project phase, with regular mining activities occurring throughout. To minimize the effect on Vegetation subcomponents during the Operation phase:

- All mechanical movement of personnel and equipment, aside from monitoring activity needs, will be restricted to the Project footprint.
- Snow melt and runoff within the Mine Site will be controlled to prevent the potential release of metal-contaminated runoff from entering the vegetation adjacent to the Project footprint.
- Appropriate erosion and sediment control measures will be monitored and maintained to ensure the protection of vegetation and watercourses adjacent to the Project footprint.
- The Proponent will engage in progressive reclamation of mine site infrastructure during the Operations phase, to the extent feasible. This may also include revegetating roads which are no longer used and areas affected during earlier activities, such as drill pads established during exploration. For detailed information on revegetation and reclamation procedures, refer to the Conceptual Reclamation and Closure Plan (**Appendix 31-C**).

4.3.3 LIMIT ACTIVITIES TO PROJECT FOOTPRINT

Project activities will be restricted to the defined Project footprint. All Project activities during all phases, including vehicle use, will be restricted to surveyed and approved areas. The Operation phase is the longest Project phase, with regular mining activities occurring throughout. Once operational, all movement of personnel and equipment, aside from monitoring activity needs, will be restricted to the Project footprint. An on-site Environmental Monitor will ensure that Project activities remain within the Project footprint.

4.3.4 MINIMIZE DUST AND EMISSIONS

Dust and emission reduction and suppression are important because fugitive dust and particles emitted into air can cover local Vegetation and potentially affect plant function (Spatt and Miller 1981). Plants can uptake metals in dust either directly through tissue or through roots in the soil (Adriano 2001). The most likely areas of long term dust generation will be from road traffic near the pit, ore placement and spreading on heap leach pad, crushing facilities, waste rock, and ore stockpiling activities. Minimizing dust is an effective mitigation tool for mitigating the effects on Vegetation health because it is a key pathway of effect.

A dust management plan will provide detailed measures to reduce dust. The goals of this plan are to reduce dust generation from Project activities during all Project phases. The Access Route Construction (**Appendix 31-A**) and Access Route Operational (**Appendix 31-B**) Management Plans also have measures for reducing dust production and deposition.

The following mitigation measures will assist in the reduction of the effect to Vegetation health from dust and other emissions created by Project activities during all Project phases:

- Water trucks and dust suppressants will be used to suppress fugitive dust dispersal by maintaining sufficient surface moisture.
- The airstrip and road surfacing will be comprised of coarse gravels whenever possible; fine materials with the potential to create dust during the summer months will be avoided.
- Appropriate erosion and sediment control measures will be up kept to ensure the protection of watercourses and/or wetlands adjacent to the Project footprint.

Topsoil and overburden stockpiles will be constructed to prevent or limit erosion by wind or rainfall, and subsequent cover of adjacent Vegetation, through:

- Managing stockpile size and configuration
- Vegetating and/or covering overburden stockpiles as soon as practical
- Placing frozen soils in the appropriate stockpile areas.

4.3.5 REDUCE FIRE HAZARDS TO ADJACENT VEGETATION

Project activities during all Project phases will engage in measures to reduce fire hazards with consideration for wildfire danger ratings. Construction activities may be curtailed when danger ratings are extreme.

4.3.6 PROTECT RARE PLANTS

Although no SARA, COSEWIC or Track-listed plants were identified in the LAA during baseline surveys, it is recognized that baseline surveys alone could not rule out the existence of rare species (Lancaster 2000). Four territorial Watch-list plant species were identified during baseline surveys. Species on the Watch-list require more information on their distribution and abundance before a conservation status can be determined (Yukon CDC 2015). The following mitigation measures will be implemented to increase the possibility of protecting possible rare plant occurrences:

- During the Construction phase of the Project, when clearing needs to occur in ecological communities deemed to have high potential for supporting rare plants, pre-clearing rare plant surveys will be conducted by qualified individuals prior to disturbance.
- If a plant species of potential conservation concern listed under SARA, COSEWIC and the Yukon CDC Track-list is found, the Environment Department will be contacted to design and implement a mitigation plan to minimize potential adverse effects. The plan will be tailored to the identified rare plant (design on a case by case scenario). Findings will be reported to the Yukon CDC.
- If Watch-list species are observed within the Project footprint during construction or operation they will be avoided wherever possible. The sighting(s) will be reported to the Yukon CDC.

The ranking of the four territorial Watch-list species observed in the Project LAA will be reviewed annually, as part of project annual reporting and if any are up-listed and determined to be at risk or of conservation concern during the Project's Construction or Operation phases, a mitigation plan will be designed to minimize potential adverse effects.

4.3.7 MINIMIZE RISK OF INTRODUCTION AND SPREAD OF INVASIVE PLANTS

The most effective, economical, and ecologically sound approach to managing invasive species, and the risk that that introduction poses to existing native Vegetation, is to prevent their invasion in the first place (CIPM 2003; IPCBC 2010; UAF 2014; YISC 2015a). By following practical and proactive mitigation and management recommendations, limited resources can be spent efficiently to control infestations (i.e., targeted removal) and detect new invasions when infestations are small and controllable (i.e., annual monitoring program).

Invasive plant species are present within the Project footprint, particularly along the NAR. The spread of invasive plant species could threaten existing ecological communities by outcompeting naturally occurring plants. Given the extent of the Pre-Project invasive plant species distribution, the Proponent's management of invasive plant species will differ between the mine site and the NAR, although some mitigation measures for invasive plants will be universal across the Project area including:

- Minimize disturbance of native Vegetation and exposed soil along roadsides, trails and waterways;
- To the extent possible, avoid disturbing areas that are high-risk sites for the potential spread of invasive species (i.e., within or adjacent to existing infestations).
- Equipment bound for the mine site will be inspected prior to accessing the NAR to ensure it is free of soil, invasive plant parts and seed.
- A dedicated NAR off-road truck fleet will be used, when operational conditions allow, to transport most materials and equipment from a logistics centre near Dawson.
- Initiate progressive reclamation as soon as practical to limit soil exposure; where practical, this will include salvaging non-infested topsoil and placing it on disturbed areas (healthy topsoil contains nutrients, microorganisms and native plant propagules that promote native plant revegetation).
- If sourcing gravel to be used on-site, the gravel will be inspected to ensure that is weed-free prior to being brought to site.
- Straw matting or similar tools to be used for erosion control purposes will only be used if they can be certified to be weed free.
- Revegetation protocols will target locally collected native seed sources. If additional seed is necessary, it will be limited to certified weed free seed mixes.
- Employee education and awareness training (described further below) that includes plant identification and reporting procedures to assist in early detection of invasive species.

In addition to the above mitigation measures for invasive plants, within the mine site area, the Proponent will actively manage for invasive plants. The following mitigation actions will be taken to prevent invasive species spread south of the Yukon River during all Project phases:

- Conduct annual monitoring of high-risk areas, such as disturbed or bare ground, roadsides, parking, and staging areas to spot invasive species early. This is known as early detection and rapid response (EDRR).
- Where rank 1 invasive species are found within the mine site area in small or moderate patches, targeted removal will be carried out using mechanical (i.e., hand pulling or mowing) or chemical means to remove or destroy the plants. The decision to hand-pull, mow, or apply chemicals will depend on the species, size of the patch, and location of the patch. Chemical treatment will only be considered where invasive plant patches exceed 25 individuals and are more than 30 m from a waterbody. All chemical treatment will abide by the Pesticide Regulations under the Yukon Environment Act, RSY 2002, c.76.
- All plant parts collected during picking will be bagged and incinerated.

Along the NAR, the Proponent will focus on limiting the continued spread of invasive species along the road as a result of Project activities through the following mitigation actions:

- Inspect quarry and borrow sites for invasive species; to the extent practicable, avoid using materials from quarry and borrow sources with an existing infestation in areas currently free of invasive species.
- To the extent possible, avoid disturbing areas within or adjacent to existing infestations; if work must occur in these areas, wherever possible, conduct activities in advance of seed development to avoid spreading seeds.

More detailed information, including mitigation to prevent invasive species spread and control methods for removal will be provided in the Vegetation Management Plan.

4.3.8 PROJECT PERSONNEL AWARENESS ORIENTATION

Project personnel awareness programs will help to mitigate potential effects on Vegetation by increasing personnel awareness of the Proponent's commitment to Vegetation management in the Project area. Personnel will receive a Project orientation that will include important Vegetation-related information relevant to the Project. Project personnel will be expected to comply with the direction provided by the mine management team. Direction will be given such that due care will be taken by all personnel to avoid excessive and unnecessary disturbance to existing Vegetation during all Project phases. Training components will include:

- Invasive species identification and observation protocol for site Environment Department staff.
- Road driving directives: posted speed limits assist in minimizing spread of fugitive dust.

- Awareness training regarding the importance of avoiding sensitive vegetation features (e.g., known rare plant occurrences and wetlands).
- Awareness of fire prevention practices and periods of increased fire potential.

4.3.9 SUMMARY OF MITIGATION MEASURES

Table 4.3-1 provides a summary of mitigation measures that are proposed to minimize potential Project interactions and reduce potential effects on Vegetation.

Table 4.3-1 Summary of Potential Effects and Mitigation Measures for Vegetation

Summary of Potential Effect	Project Components	Contributing Project Activities	Proposed Mitigation Measure	Applicable Subcomponent	Detectable / Measurable Residual Effect (Yes / No)
Construction Phase					
Habitat loss	Mine Site	Clearing, grubbing, and grading	• Project Design • Minimize Habitat Loss • Reduce Fire Hazards to Adjacent Vegetation • Protect Rare Plants • Project Personnel Awareness Training	• Ecological Communities • Wetland Habitats • Traditional and Medicinal Plants • Rare Plants	Yes
	Northern Access Route	Upgrade of existing road and construction of new road sections	• Project Design • Minimize Habitat Loss • Reduce Fire Hazards to Adjacent Vegetation • Protect Rare Plants • Project Personnel Awareness Training	• Ecological Communities • Wetland Habitats • Traditional and Medicinal Plants • Rare Plants	Yes
Dust deposition and metals uptake	Mine Site	Clearing, grubbing, and grading	• Minimize Dust and Emissions • Reduce Fire Hazards to Adjacent Vegetation	• Vegetation Health	No
	Northern Access Route	Upgrade of existing road and construction of new road sections	• Minimize Dust and Emissions	• Vegetation Health	No
Risk of introduction and spread of invasive species	All	Equipment transport to site	• Minimize Risk of Introduction and Spread of Invasive Plants	• Subject of Note	Yes

Summary of Potential Effect	Project Components	Contributing Project Activities	Proposed Mitigation Measure	Applicable Subcomponent	Detectable / Measurable Residual Effect (Yes / No)
Operation Phase					
Habitat loss	Project footprint (including NAR)	Development of open pits Waste rock storage facilities Stockpiles	• Limit Activities to Project Footprint • Reduce Fire Hazards to Adjacent Vegetation • Project Personnel Awareness Orientation	• Ecological Communities • Wetland Habitats • Traditional and Medicinal Plants • Rare Plants	Yes
Dust deposition and metals uptake	Mine site	Site maintenance	• Minimize Dust and Emissions	• Vegetation Health	No
		Dust or emission producing activities	• Minimize Dust and Emissions	• Vegetation Health	Yes
	Northern Access Route	Road maintenance	• Minimize Dust and Emissions	• Vegetation Health	Yes
		Dust or emission producing activities	• Minimize Dust and Emissions	• Vegetation Health	
Risk of introduction and spread of invasive species	All	Equipment transport to site	• Minimize Risk of Introduction and Spread of Invasive Plants	• Subject of Note	Yes
Reclamation and Closure Phase					
Dust deposition and metals uptake	Mine site	Site closure	• Minimize Dust and Emissions	• Vegetation Health	No
		Dust or emission producing activities	• Minimize Dust and Emissions	• Vegetation Health	Yes
	Northern Access Route	Road maintenance	• Minimize Dust and Emissions	• Vegetation Health	Yes
		Dust or emission producing activities	• Minimize Dust and Emissions	• Vegetation Health	
Risk of introduction and spread of invasive species	All	Equipment transport to site	• Minimize Risk of Introduction and Spread of Invasive Plants	• Subject of Note	Yes

4.4 RESIDUAL EFFECTS AND SIGNIFICANCE OF RESIDUAL EFFECTS

Project-related residual effects were assessed for each subcomponent based on potential interactions identified in **Table 4.1-2**, and in relation to the indicators listed in **Table 1.2-3**. Following the successful implementation of all mitigation measures described in **Section 4.3**, habitat loss due to the Project footprint applies to all Vegetation subcomponents, except for Vegetation health. Vegetation health will be adversely affected by the potential residual effect of dust deposition from Project emissions.

The proponent recognizes the risk of the introduction and spread of invasive plants, which is an effect universal to Yukon, and not a Project-specific effect. No attempt is made in this effects assessment to characterize specifically for this Project the magnitude or significance of that adverse effect. Invasive plants are a nationally recognized concern with guidelines developed federally. There is no legislation or regulation specific to invasive species in Yukon. In the absence of formal guidelines, the Yukon Invasive Species Council (YISC) provides general mitigation measures for resource developers with reference to the "Why Should I Care" brochure available online. For this Project, YISC guidance is considered, and the risk of introduction and spread of invasive species is addressed specifically as a mitigation measure (**Minimize Risk of Introduction and Spread of Invasive Species** — **Section 4.3**), and discussed further as a **Subject of Note** — **Section 4.5**.

4.4.1 RESIDUAL EFFECTS CHARACTERISTICS

Residual effects are characterized based on the criteria defined in **Table 4.4-1**. The characterization of residual effects is based on the following and when available: published regulatory or industry standards, non-regulated but widely-recognized standards, TK, or professional judgement. As the thresholds differ for each indicator used for assessment of Vegetation subcomponents, a detailed rationale for effects characterization is provided where relevant.

Table 4.4-1 Effect Characteristics Considered when Determining the Significance of Residual Effects on Vegetation

Residual Effect Characteristic	Definition	Rating
Direction	Identifies whether the residual effect will be adverse or positive.	• Adverse • Positive
Magnitude	Size or severity of the residual effect — generally measured in terms of the proportion of the subcomponent indicator affected within the LAA, relative to availability within the LAA (i.e., extent of detailed ecological mapping). For Ecological Communities, Wetland Habitats, Rare Plants and Traditional and Medicinal Plants, the magnitude of the effect was assessed using the following thresholds for predicted loss in habitat: • Low: less than 10% loss of units mapped within the LAA as defined by % of mapped community loss from the total LAA or less than 10% loss of Vegetation in the total RAA • Moderate: 10 to 50% loss of units mapped within the LAA as defined by % of mapped community loss from the total LAA or 10 to 50% loss of Vegetation in the total RAA • High: more than 50% loss of units mapped within the LAA as defined by % of mapped community loss from the total LAA or a greater than 50% loss of Vegetation in the total RAA For Vegetation health, the magnitude of the effect of an increase in dust deposition was assessed based on modelled threshold value range that covered the most area: • Low: threshold value = 0.027 to 0.126 mg/dm²/day • Moderate: threshold value = 0.126 to 1.37 mg/dm²/day • High: threshold value = > 1.37 mg/dm²/day The selected thresholds are based on values used in other environmental assessments as well as professional judgement.	• Low • Moderate • High
Geographic Extent	Spatial scale over which the residual effect is expected to occur. Direct effects to Vegetation occur within the Project footprint and possible changes to Vegetation habitat extend into the LAA/RAA.	• Site (specific location within Project footprint) • Project footprint • Local (limited to LAA) • Regional (limited to RAA)
Timing	Occurrence of the residual effect with respect to a temporal attribute important to Vegetation	• Not applicable (loss no matter the timing) • Growing season
Frequency	How often the residual effect is expected to occur, taking into account Vegetation-specific temporal characteristics. • Infrequent: effect is confined to one discreet event or occurs rarely and at sporadic intervals. • Frequent: effect occurs on a regular basis • Continuous: effect occurs constantly	• Infrequent • Frequent • Continuous
Duration	Length of time over which the residual effect is expected to persist, taking into account temporal characteristics associated with Vegetation indicators	• Short-term • Long-term • Permanent

Residual Effect Characteristic	Definition	Rating
Reversibility	Whether or not the residual effect can be reversed once the activity causing the residual effect ceases. Irreversible effects are considered to be permanent	• Fully reversible • Partially reversible • Irreversible
Likelihood	Likelihood that the predicted residual effect will occur, taking into account how probable it is that a disturbance will actually be caused by the Project or that a specific mitigation will be successful	• Likely • Unlikely
Context	The extent to which each Vegetation subcomponent has been affected by past and present environmental processes and conditions, its potential sensitivity to the Project-related residual effect, and its ability to recover from that effect (i.e., resilience). • **Low**: Vegetation (individual plant species or community) has a low resilience to imposed stresses, and will not easily adapt to the effect • **Moderate**: Vegetation (individual plant species or community) has a neutral resilience to imposed stresses and may be able to respond and adapt to the effect • **High**: Vegetation (individual plant species or community) has a high natural resilience to imposed stresses, and can respond and adapt to the effect	• Low • Moderate • High

4.4.2 SIGNIFICANCE DEFINITION

When determining significance, each of the ratings used to characterize the residual effect are considered to inform the final decision. The level of each residual effect will be rated as “Significant” or “Not Significant” as follows:

Significant Residual effects determined to be “Significant” are those that would result in a measurable adverse effect that would pose a risk to the long-term persistence and viability of Vegetation subcomponents at the regional level (i.e., RAA). The level at which the combination of effects characteristics would represent a significant adverse effect varies depending on the subcomponent/indicator. Residual effects determined to be “Significant” are carried forward to the cumulative effects assessment.

Not Significant Residual effects determined to be “Not Significant” are those that are greater than “negligible” but that do not meet the definition of “Significant”. Residual effects determined to be “Not Significant” are still carried forward to the cumulative effects assessment.

The level of confidence in the significance determination is rated as low, medium, or high as follows:

Low A low level of confidence is assigned to effects predictions with little or no empirical site-specific data and little to no published information or examples from similar assessments or project effects monitoring programs.

Medium A moderate level of confidence is assigned to effects predictions that are based on published literature and empirical site-specific data from other projects of a similar scale with similar Vegetation indicators; however, baseline data may not be entirely sufficient for the Project.

High A high level of confidence is assigned to effects predictions that have direct, site-specific quantitative data to support the prediction, either from the Project or existing similar projects with similar Vegetation indicators. Baseline data are also considered sufficient for the Project.

Since no threshold or standards currently exist for the Vegetation subcomponent indicators, the significance of changes in the measurable parameters is determined using informed professional opinion and experience with similar projects.

4.4.3 ECOLOGICAL COMMUNITIES SUBCOMPONENT

This section describes the nature of Project-related residual effects identified for ecological communities, including an assessment of significance.

4.4.3.1 Potential Project-related Effects

Some ecological community habitat will be lost from direct effects of clearing and grubbing of land required to be disturbed for the Project's footprint, and the disturbance will occur mostly during the Construction phase. Vegetation will be removed for the construction of the mine and associated infrastructure (e.g., camp, airstrip, waste rock storage facilities, access roads). Land clearing is the most substantive and long-term effect on ecological communities within the Project footprint.

An indirect effect of any remaining exposed surface could potentially be a reduction in the remaining soil's capacity to absorb water, capture and channel surface runoff, and the modification of subsurface flow pathways (MacKenzie and Shaw 2000, Sayers et al. 2002). Each potential effect to soils could result in changes to the moisture regime and other soil characteristics, affecting soil fertility with resulting effects on Vegetation. For the purposes of the effects assessment, the soil within the Project footprint is considered lost and equals habitat loss throughout the mine and new sections of the NAR footprint area.

4.4.3.2 Mitigation Measures

The potential adverse effects of the Project on Vegetation are addressed by a combination of mitigation measures as described in **Section 4.3**. To minimize the effects of habitat loss on ecological communities during the Construction phase, mitigation is identified in **Section 4.3** and includes: Project Design, Minimize Habitat Loss, Minimizing Dust and Emissions, and Project Personnel Awareness Orientation. During the Operation phase, activities will be limited to the Project footprint (**Section 4.3.3**), and other mitigations such

as Minimizing Dust and Emissions (**Section 4.3.4**), Reduce Fire Hazards to Adjacent Vegetation (**Section 4.3.5**), and Project Personnel Awareness Orientation (**Section 4.3.7**) will be implemented. Additionally, commencing in the Operation phase, progressive reclamation activities will reintroduce natural vegetation to much of the disturbed area, thus initiating a return of habitat self-sustaining ecosystems. These mitigations will be effective because they follow known best management practices, concentrate activities to the Project footprint, and minimize effects to adjacent Vegetation.

4.4.3.3 Project-related Residual Effects and Significance of Residual Effects

The loss of ecological communities was carried through as a residual effect for the Project because it is expected that mitigation efforts will not return the area of ecological communities to baseline levels after closure. Management and mitigation measures will help avoid and minimize adverse effects, however, direct effects of Vegetation clearing cannot be fully mitigated and thus residual effects are anticipated for the ecological communities subcomponent.

The assessment of residual effects on ecological communities was completed by assessing effects to the on the entire LAA. The quantification of the effect used the interaction of the Project footprint with the ecological community mapped information collected in the baseline study. Residual effects on wetland habitats are assessed in **Section 4.4.4**.

Clearing and grubbing will remove approximately 2,718 ha of existing ecological communities (excluding wetlands and anthropogenic features) from the LAA, including 717 ha of subalpine communities, 1,070 ha of boreal communities and 931 ha of broad ecological communities (**Table 4.4-2**). The most abundant (by area) ecological communities within the Project footprint are the Upland/Closed Canopy Forest (21%), the 01 Boreal ecosite (01W, 01WSw, 01Sw, 01Sw(Sb) and 01, 17%) and the 01 Subalpine ecosite (Scrub Birch – Lowbush Cranberry – Feathermoss, 12%). The greatest loss to clearing and grubbing by percent of mapped community loss to the Project footprint occur in the following ecological communities: Black Spruce – Scrub Birch – Labrador Tea – Cloudberry (64%), Scrub Birch – Crowberry – Lowbush Cranberry (34%), Scrub Birch – Sedge – Feathermoss (27%), and Scrub Birch – Lowbush Cranberry – Feathermoss (21%; **Table 4.4-2**). Only the Upland/Closed Canopy Forest (1.4%) ecological communities will have more than 1% of mapped community lost from the total LAA area (**Table 4.4-2**).

Four ecological communities (Tors, Felsenmeer, Subalpine/Alpine Shrub, High Elevation Sparse Coniferous Forest) are not located within the Project footprint, hence no loss of habitat is expected (**Table 4.4-2**).

Overall, approximately 4% of mapped boreal and subalpine ecological communities will be lost from the total LAA area (**Table 4.4-2**) due to activities within the Project footprint. Approximately 2% of mapped BEM ecological communities will be loss from the total LAA area due to the clearing and grubbing associated with the construction of the NAR (**Table 4.4-2**).

Table 4.4-2 Summary of Ecological Communities in the LAA and Project Footprint

Mapped Feature	Code	LAA (ha)	% LAA	Project Footprint (ha)	% of Project Footprint	% of Mapped Community Loss to Project Footprint	% of Mapped Community Loss from Total LAA Area
Boreal Subzone							
Purple Reedgrass – Lichen	20Capu	137	0.3	3	0.1	2.0	0.0
Kinnikinnick	20Aruv	142	0.3	3	0.1	1.9	0.0
Aspen – Kinnikinnick – Purple Reedgrass	21	1,201	2.5	50	1.5	4.1	0.1
Aspen – Soapberry – Purple Reedgrass	01A	360	0.8	46	1.4	12.8	0.1
Alaska Birch – Labrador Tea – Tall Bluebells – Step Moss	01W	1,321	2.8	96	2.9	7.2	0.2
Alaska Birch – White Spruce – Labrador Tea – Lowbush Cranberry – Feathermoss	01WSw	2,383	5.0	183	5.6	7.7	0.4
White spruce – Rose – Bastard Toadflax – Feathermoss	01Sw	293	0.6	37	1.1	12.6	0.1
Spruce – Labrador Tea – Lowbush Cranberry – Feathermoss	01Sw(Sb)	1,349	2.8	110	3.4	8.2	0.2
Spruce – Feathermoss (early successional sites due to fire)	01	2,402	5.1	94	2.9	3.9	0.2
Black spruce – Labrador Tea – Reindeer Lichen	30	930	2.0	21	0.6	2.3	0.0
Spruce – Birch – Lowbush Cranberry – Feathermoss	31	1,048	2.2	92	2.8	8.8	0.2
Black Spruce – Scrub Birch – Labrador Tea - Cloudberry	32Sb1	190	0.4	123	3.8	64.4	0.3
Black Spruce – Labrador Tea – Cottongrass	32Sb2	134	0.3	21	0.6	15.6	0.0
Black Spruce – Labrador Tea – Cloudberry – Sedge	32	2,012	4.2	102	3.1	5.1	0.2
Black spruce – Labrador Tea – Sedge – Brown Moss – Reindeer Lichen	33	603	1.2	41	1.3	6.8	0.1
White Spruce – Horsetail	40	529	1.1	24	0.7	4.6	0.1
Balsam Poplar – Rose – Horsetail	41	349	0.7	18	0.6	15.6	0.0

Mapped Feature	Code	LAA (ha)	% LAA	Project Footprint (ha)	% of Project Footprint	% of Mapped Community Loss to Project Footprint	% of Mapped Community Loss from Total LAA Area
Alaska Birch – Alder – Reedgrass	42	174	0.4	7	0.2	4.2	0.0
Tall Shrub Balsam Poplar – Willow	43	71	0.1	1	0.0	1.0	0.0
Total Area of Boreal Ecological Communities		**15,627**	**33**	**1,070**	**33**	**6.8**	**2.3**
Subalpine Subzone							
Tors	10	0.5	0.0	0	0.0	0.0	0.0
Felsenmeer	11	0.6	0.0	0	0.0	0.0	0.0
Scrub Birch – Mountain Avens - Lichen	12	90	0.2	7	0.2	7.8	0.0
Scrub Birch – Crowberry – Lowbush Cranberry	13	190	0.4	65	2.0	34.0	0.1
Scrub Birch – Willow – Mountain Avens	14	79	0.2	3	0.1	4.4	0.0
Scrub Birch – Lowbush Cranberry - Feathermoss	01	1,825	3.9	389	11.9	21.3	0.8
Scrub Birch – Sedge - Feathermoss	30	318	0.7	86	2.6	27.0	0.2
Spruce – Scrub Birch - Feathermoss	31	610	1.3	107	3.3	17.6	0.2
Black Spruce – Labrador Tea – Lowbush Cranberry – Sedge	32	473	1.0	57	1.7	12.0	0.1
Willow – Horsetail – Peatmoss	40	55	0.1	3	0.1	5.5	0.0
Total Area of Subalpine Ecological Communities		**3,641**	**7.7**	**717**	**22.0**	**19.7**	**1.5**
Broad Ecological Communities							
Felsenmeer	Fe	0	0.0	0	0.0	0.0	0.0
Subalpine / Alpine Shrub	Ss	74	0.2	0	0.0	0.0	0.0
High Elevation Sparse Coniferous Forest	Fcs	842	1.8	115	3.5	13.6	0.2
High Elevation Shrubby Riparian	HSr	0	0.0	0	0.0	0.0	0.0
Grassland	Gg	281	0.6	8	0.2	2.8	0.0
Upland / Closed Canopy Forest	UpF	18,815	39.7	687	21.1	3.7	1.4
Riparian Forest	RF	1,002	2.1	70	2.1	7.0	0.1

Mapped Feature	Code	LAA (ha)	% LAA	Project Footprint (ha)	% of Project Footprint	% of Mapped Community Loss to Project Footprint	% of Mapped Community Loss from Total LAA Area
Stunted Coniferous Forest	Stcs	1,838	3.9	46	1.4	2.5	0.1
Low Elevation Shrubby Riparian	LSr	256	0.5	6	0.2	2.4	0.0
Total Area of Broad Ecological Communities		23,108	**49**	931	**28.6**	**4.0**	2.0
Total Area (excluding wetlands and anthropogenic)		42,376	**89.4**	2,718	**83.5**	**6.4**	5.7
Total LAA		**47,422**		**3,256**			**6.9**

Clearing and grubbing during the Construction phase results in the adverse effect of the loss of ecological communities. The effect is confined to the Project footprint, removing approximately 6% of all mapped ecological communities from the total LAA area. The magnitude of the effect is low since there is a less than 10% loss of mapped ecological communities' habitat within the total LAA. The duration of the effect is permanent because certain sites will not be reclaimed, but the effect is partially reversible over the long-term once Vegetation can re-establish in areas where site conditions have not been drastically changed. However, it is likely that in certain areas where reclamation or natural regeneration will not occur, such as open pits, the loss of habitat will be permanent. The effect characteristic ratings for ecological communities habitat loss is summarized in **Table 4.4-3**.

It is likely that the ecological communities mapped and assessed within the LAA are also commonly occurring throughout the RAA. The residual effects characterization amalgamates all ecological communities since each ecological community has a percent of mapped community loss from the total LAA area of less than 1%. The potential loss of an individual ecological community (mapped within the footprint) within the LAA will range from 0 to 64% (Black Spruce – Scrub Birch – Labrador Tea - Cloudberry; **Table 4.4-2**); however, none of the communities with a relatively higher proportion of loss are considered rare or at risk in the region. Additionally, the Project footprint is considered a conservative estimate, and the entire area will likely not be cleared.

The context for the residual effects of ecological communities habitat loss is considered moderate. Overall, ecological communities within the LAA are not considered to be rare or at risk, and occur throughout the region. Additionally, these communities have a neutral resilience to imposed stresses and may be able to respond and adapt to the effect within reclaimed areas. Certain areas such as WRSFs and open pits will not be reclaimed and natural regeneration will not occur within this type of habitat. Within these areas Vegetation will not respond or adapt to the effect.

Table 4.4-3 Effect Characteristics Ratings for Ecological Communities – Habitat Loss

Residual Effects Characteristic	Rating	Rationale for Rating
Habitat Loss		
Direction	Adverse	Vegetation will be lost due to clearing within Project footprint
Magnitude	Low	Low since there is a less than 10% loss of mapped ecological communities within the total LAA
Geographic Extent	Project footprint	The loss of ecological community habitat will only occur within the cleared areas
Timing	n/a	Vegetation will be lost regardless of when the clearing activity occurs
Frequency	Infrequent	The effect occurs once.
Duration	Permanent	Not all areas will be reclaimed. There will be a permanent loss of Vegetation due to permanently changed structures of the landscape
Reversibility	Partially reversible	The majority of the Project footprint will be reclaimed or natural regeneration will occur in most areas, except in areas of WRSFs, open pits, or certain road sections
Likelihood	Likely	There will be a loss of habitat

4.4.3.4 Summary of Project-related Residual Effects and Significance of Residual Effects on Ecological Communities

Based on the information presented above and summarized in **Table 4.4-4**, there is a not significant residual effect of habitat loss for ecological communities. In general, the magnitude of habitat loss is low, none of the communities are rare, and they are likely available and distributed throughout the RAA. In consideration of the uncertainty regarding the coarse-scale approach to assessing habitat for ecological communities (i.e., comparable habitat baseline is not available for the larger region) and how individual ecological communities will be affected by habitat loss, confidence in the predictions for habitat loss is moderate.

Table 4.4-4 Summary of Potential Residual Adverse Effects on Ecological Communities

Potential Residual Adverse Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss	• Clearing, grubbing, and grading • Upgrade of existing road and construction of new road section • Road maintenance • Expansion of the WRSFs	• Project Design • Minimize Habitat Loss • Limit Activities to Project footprint • Reduce Fire Hazards to Adjacent Vegetation • Project Personnel Awareness Training • Project Personnel Awareness Training	A	L	PF	n/a	PT	I	P	L	M	NS	M

Note: The following ratings are used for effects characteristics, as defined in **Table 4.4-1**:

Direction: A = Adverse, P = Positive
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: S = Site specific location within Project footprint, PF = Project footprint, L = Local (limited to LAA), R = Regional (limited to RAA)
Timing: n/a = no timing applicable, G = Growing season
Duration: LT = Long-term, ST = Short-term, PT = Permanent-term
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully reversible, P = Partially reversible, I = Irreversible
Context: L=Low, M=Moderate, H=High
Likelihood: L = Likely, U = Unlikely
Significance: NS = Not Significant, S = Significant
Level of Confidence: L = Low, M = Medium, H = High

4.4.4 WETLAND HABITATS SUBCOMPONENT

This section describes the nature of Project-related residual effects identified with respect to wetland habitats, including an assessment of significance.

4.4.4.1 Potential Project-related Effects

Potential effect to wetland habitats is the loss of habitat due to the Project footprint due to clearing activities. The majority of the effects to wetland habitats will occur during the Project's Construction phase. Habitats classed as wetland will be removed for the construction of the mine and associated infrastructure (e.g., camp, airstrip, WRSFs, access roads) and for new road and road upgrades associated with NAR. Land clearing is the most substantive and long-term effect on wetland habitats within the Project footprint.

4.4.4.2 Mitigation Measures

The majority of the predicted effects on wetland habitats will occur during the Project's Construction phase. Vegetation will be removed for the construction of the mine and associated infrastructure (e.g. access roads). Land clearing is the most substantive and long-term effect on Vegetation within the Project footprint. To minimize the effects of habitat loss on wetland habitats during the Construction phase, mitigation is identified in **Section 4.3** and includes: Project Design, Minimize Habitat Loss, Minimizing Dust and Emissions, and Project Personnel Awareness Orientation. Specific to wetland habitats during the Construction phase, a Vegetation Management Plan (VMP) may include statements that during Construction, riparian Vegetation will be retained wherever possible; trees or shrubs in or adjacent to watercourses will not be destroyed, removed, or cleared to an extent greater than is permitted for the performance of the work.

During the Operation phase, activities will be Limited to the Project footprint (**Section 4.3.3**), Dust and Emissions will be Minimized (**Section 4.3.4**), Minimize the Risk of Introduction and Spread of Invasive Plants (**Section 4.3.7**), and a Reduction of Fire Hazards to Adjacent Vegetation (**Section 4.3.5**). Following disturbance and completion of Project activities, reclamation will reintroduce natural Vegetation to much of the disturbed area, thus initiating the return of habitat to the area. These mitigations will be effective because they follow known best management practices, concentrate activities to the Project footprint, and minimize effects to adjacent Vegetation.

4.4.4.3 Project-related Residual Effects and Significance of Residual Effects

This section is a detailed summary of background information to support the residual effects assessment of wetland habitats in regards to habitat loss due to the Project footprint. A footprint analysis was used to identify where the Project could interact with wetlands and to represent the maximum extent of possible disturbances.

The Project could result in a total loss of approximately 70 ha of mapped wetland communities that exist within Project footprint (**Table 4.4-5**). Overall, 2% of the total Project footprint affects wetland communities. The maximum possible wetland habitat loss within the NAR footprint for each wetland community will range from no loss to a 12% loss (Spruce – Red Bearberry – Brown Moss Fen) of mapped wetlands (**Table 4.4-5**). The greatest loss to clearing and grubbing by percent of mapped wetland community loss to the Project footprint occurs in the following ecological communities: marsh (13%), Spruce – Red Bearberry – Brown Moss Fen (12%), Willow – Horsetail Swamp (11%) and Swamp (10%) (**Table 4.4-5**). This equates to an overall 0.1% of mapped wetland community habitat loss from the total LAA. No bog communities were mapped within the LAA.

It is likely that the higher probability of habitat loss will occur where new road sections are proposed and with a smaller probability of habitat loss where road upgrades are proposed.

Table 4.4-5 Summary of Wetland Habitat Communities in the LAA and Project Footprint

Mapped Feature	Code	LAA (ha)	% LAA	Project Footprint (ha)	% of Project Footprint	% Portion of Mapped Community Loss to Project Footprint	% of Mapped Community Loss from Total LAA Area
Wetland Ecological Communities							
Spruce – Willow – Labrador Tea – Sedge Fen	F1	255	0.5	14	0.4	5.5	0.0
Spruce – Red Bearberry – Brown Moss Fen	F2	65	0.1	8	0.2	11.6	0.0
Birch – Leatherleaf – Sedge Fen	F3	194	0.4	3	0.1	1.6	0.0
Willow – Horsetail Swamp	S1	206	0.4	22	0.7	10.8	0.0
Willow – Reedgrass Swamp	S2	12	0.0	0	0.0	0.0	0.0
Beaked Sedge Marsh	M1	6	0.0	0.1	0.0	1.1	0.0
Horsetail – Sedge Marsh	M2	1	0.0	0	0.0	0.0	0.0
Marsh	M	27	0.1	4	0.1	13.3	0.0
Bog	B	0	0.0	0	0.0	0.0	0.0
Fen	F	412	0.9	18	0.6	4.4	0.0
Swamp	S	11	0.0	1	0.0	9.6	0.0
Total Area of Wetland Vegetation Communities		**1,190**	**2.5**	**70**	**2.1**	**5.9**	**0.1**

There will be some proportional loss of wetland communities in the LAA. The majority of wetland community loss will occur within the NAR footprint. The loss of wetland habitat was carried through as a residual effect for the Project because it is expected that mitigation efforts will not return the amount of wetland communities to baseline levels after closure. It is expected that mitigation efforts will avoid any changes in wetland communities.

It is likely that all of the wetland communities mapped in the LAA occur throughout the RAA and are commonly found. The residual effects characterization amalgamates all wetland habitats since each wetland habitat has a percent of mapped community loss from the total LAA area less than 1%. The Project footprint removes approximately 0.1% of all mapped wetland habitats from the total LAA area (**Table 4.4-5**).

Management and mitigation measures will help avoid and minimize adverse effects to wetland functions and extent resulting from the Project's Construction, Operation, and Reclamation and Closure phases. However, direct and indirect effects cannot be fully mitigated because there will be habitat loss to the footprint, and there are residual effects of wetland habitat loss.

Clearing and grubbing during the Construction phase will result in the removal and destruction of wetland habitats, resulting in a residual effect. The effect is adverse as potential wetland habitats will be lost. The effect is site specific, as the clearing will be confined to the Project footprint. The magnitude of the effect on wetland habitats is low since there is a less than 10% loss of mapped wetland habitats within the total LAA. This loss is diminished at a larger scale since patches of these wetland habitats are distributed within the LAA and RAA. The duration of the effect is permanent as certain sites will not be reclaimed, and habitat loss should only occur once, for clearing. The effect is partially reversible over the long-term once Vegetation is allowed to re-establish in areas where site conditions have not been drastically changed but in certain areas where reclamation or natural regeneration will not occur such as roads the loss of habitat will be permanent. The effect characteristics ratings for loss of wetland habitat are summarized in **Table 4.4-6**.

The residual effect of loss of habitat due to the Project Construction phase is not significant. While the magnitude of the effect is low, the context is that the loss does not pose a risk to the long-term persistence and viability of the commonly occurring wetland habitats defined within the LAA. All of the wetland habitats found within the Project footprint are more than likely found throughout the RAA and corresponding ecological zones.

Table 4.4-6 Effect Characteristics Ratings for Wetland Habitats – Habitat Loss

Residual Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	Wetland habitat will be lost due to clearing within the Project footprint
Magnitude	Low	Considered low because there is a less than 10% loss of mapped wetland communities within the total LAA
Geographic Extent	Project footprint	The loss of wetland habitat should only occur within the areas to be cleared
Timing	n/a	Wetland habitat will be lost regardless of when the clearing activity occurs
Frequency	Infrequent	The residual effect is expected to occur once
Duration	Permanent	Not all areas will be reclaimed
Reversibility	Partially reversible	The majority of the Project footprint will be reclaimed or natural regeneration will occur in most areas except in portion of road sections
Likelihood	Likely	There will be a loss of wetland habitat

4.4.4.4 Summary of Project-related Residual Effects and Significance

Based on the information presented above and summarized in **Table 4.4-7**, there is a not significant residual effect of habitat loss for wetland habitats. In general, the magnitude of habitat loss is low, and the context is that none of the wetland communities are rare, and they are likely available and distributed throughout the RAA. In consideration of the uncertainty regarding the coarse-scale approach to assessing habitat for wetland communities (i.e., comparable habitat baseline is not available for the larger region) and how individual wetland communities will be affected by habitat loss, confidence in the predictions for habitat loss is moderate.

Table 4.4-7 Summary of Potential Residual Adverse Effects on Wetland Habitats

Potential Residual Adverse Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat loss	• Clearing, grubbing, and grading • Upgrade of existing road and construction of new road section • Road maintenance	• Project Design • Minimize Habitat Loss • Minimize Dust and Emissions • Project Personnel Awareness Training • Limit Activities to Project footprint • Reduce Fire Hazards to Adjacent Vegetation • Project Personnel Awareness Training	A	L	PF	n/a	PT	I	P	L	M	NS	M

Note: The following ratings are used for effects characteristics, as defined in **Table 4.4-1**:

Direction: A = Adverse, P = Positive
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: S = Site specific location within Project footprint, PF = Project footprint, L = Local (limited to LAA), R = Regional (limited to RAA)
Timing: n/a = no timing applicable, G = Growing season
Duration: LT = Long-term, ST = Short-term, PT = Permanent-term
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully reversible, P = Partially reversible, I = Irreversible
Context: L=Low, M=Moderate, H=High
Likelihood: L = Likely, U = Unlikely
Significance: NS = Not Significant, S = Significant
Level of Confidence: L = Low, M = Medium, H = High

4.4.5 TRADITIONAL AND MEDICINAL PLANTS SUBCOMPONENT

This section describes the nature of Project-related residual effects identified with respect to traditional and medicinal plants, including an assessment of significance.

4.4.5.1 Potential Project-related Effects

The potential effect to traditional and medicinal plants would be habitat loss due to the Project footprint due to clearing activities. Refer to **Section 4.2** for a complete list of potential Project-related effects.

4.4.5.2 Mitigation Measures

The majority of the predicted effects on traditional and medicinal plants will occur during the Project's Construction phase. Vegetation will be removed for the construction of the mine and associated infrastructure (e.g., camp, airstrip, waste rock storage facilities, access roads). Land clearing is the most substantive and long-term effect on Vegetation within the Project footprint. To minimize the effects of habitat loss on traditional and medicinal plants during the Construction phase, mitigation is identified in **Section 4.3** and includes: Project Design, Minimize Habitat Loss, Minimizing Dust and Emissions, and Project Personnel Awareness Orientation.

During the operation phase, activities will be Limited to the Project footprint (**Section 4.3.3**) and other mitigations such as Minimizing Dust and Emissions (**Section 4.3.4**), Reducing Fire Hazards to Adjacent Vegetation (**Section 4.3.5**), and Project Personnel Awareness Orientation (**Section 4.3.7**) will be implemented. These mitigations will be effective because they follow known best management practices, concentrate activities to the Project footprint, and minimize effects to adjacent Vegetation.

4.4.5.3 Project-related Residual Effects and Significance of Residual Effects

The loss of traditional and medicinal plant habitat was carried through as a residual effect for the Project because it is expected that mitigation efforts will not return the amount (area) of ecological communities and by association the amount of traditional and medicinal plants, especially berry producers, to baseline levels after closure.

The berry species included in the analysis were selected from the list of recorded plant species in the LAA cross-referenced with species identified in meetings with First Nations. The berry species selected for the analysis include: Bog Blueberry, Lowbush Cranberry, Crowberry (also called mossberry), High-Bush Cranberry, Bog Cranberry, Cloudberry, currants and gooseberries, and Soapberry. Each mapped ecological community that contains those berry-producing plants was rated for potential occurrence of berry-producing species. Field data were analyzed to generate the ratings by averaging the combined percent cover of all berry-producing species across all plots for each mapped ecosystem and multiplying this average by the frequency of berry-producing species occurrence. The frequency of berry-producing

species occurrence is defined as the number of plots that contained berries divided by the total number of plots sampled for the ecosystem. Based on that analysis, five berry-producing potential classes were created:

- High potential (>20)
- Moderate potential (10 to 20)
- Low potential (5 to 10)
- Very low potential (< 5)
- Nil potential (0).

The ecological community assigned to the berry potential classes are summarized in **Table 4.4-8.** High and moderate potential berry-producing habitat is commonly found throughout the LAA. Direct loss of traditional and medicinal plant habitat was considered primarily as the result of Construction phase. Construction activities such as clearing and grubbing, soil salvage, excavation, crushed ore stockpile, waste rock piles, ponds, and the heap leach pad are expected to result in a loss through direct removal or burial of traditional and medicinal plant habitat under Project infrastructure.

The Project footprint contains approximately 1,079 ha of high potential berry-producing habitat and 1,384 ha of moderate potential berry-producing habitat (**Table 4.4-8**). Clearing and grubbing will remove approximately 44% of the high and 14.5% of the moderate available mapped berry habitat, respectively (**Table 4.4-8**). Overall, clearing in the Project footprint will result in a 2% loss of high potential berry habitat in the total LAA and 3% of moderate potential berry habitat.

Table 4.4-8 Area and Distribution of Berry-producing Sites in the LAA and Project Footprint

Traditional Use Berry Potential Class	Ecological Communities (Codes)	LAA (ha)	% LAA	Project Footprint (ha)	% Project Footprint	% of Mapped Community Loss to Project Footprint	% of Mapped Community Loss from total LAA
Boreal Zone							
High Potential	Spruce – Birch – Lowbush Cranberry – Feathermoss (31); Black Spruce – Scrub Birch – Labrador Tea – Cloudberry (32Sb1)	1,238	2.6	215	6.6	17.3	0.5
Moderate Potential	Alaska Birch – Labrador Tea – Tall Bluebells – Step Moss (01W); Alaska Birch – White Spruce – Labrador Tea – Lowbush Cranberry – Feathermoss (01WSw); Spruce – Labrador Tea – Lowbush Cranberry – Feathermoss (01Sw(Sb)); Spruce – Feathermoss (01); Black Spruce – Labrador Tea – Lichen (30); Black Spruce – Labrador Tea – Cottongrass (32Sb2); Black Spruce – Labrador tea – Cloudberry – Sedge (32); Spruce – Willow – Labrador Tea – Sedge (F1); Birch – Leatherleaf – Sedge (F3); Willow – Horsetail (S1); Willow – Reedgrass (S2)	11,198	23.6	666	20.4	5.9	1.4
Low Potential	Aspen – Kinnikinnick – Purple Reedgrass (21); Black Spruce – Labrador Tea– Sedge – Brown Moss – Lichen (33); White Spruce – Horsetail (40); Spruce – Red Bearberry – Brown Moss (F2); Balsam Poplar – Rose – Horsetail (41); Tall shrub Balsam Poplar – Willow (43); Aspen – Soapberry – Purple Reedgrass (01A)	3,179	6.7	187	5.7	5.9	0.4
Very Low Potential	Purple Reedgrass – Lichen (20Capu); Alaska Birch – Alder – Reedgrass (42); Kinnikinnick (20Aruv); White spruce – Rose – Bastard Toadflax – Feathermoss (01Sw)	571	1.2	42	1.3	7.4	0.1
Nil Potential	Beaked Sedge (M1); Horsetail – Sedge (M2)	19	0.0	2	0.1	11.6	0.0
Total Boreal		**16,205**	**34.2**	**1,112**	**34.2**	**6.9**	**2.3**

Traditional Use Berry Potential Class	Ecological Communities (Codes)	LAA (ha)	% LAA	Project Footprint (ha)	% Project Footprint	% of Mapped Community Loss to Project Footprint	% of Mapped Community Loss from total LAA
Subalpine Zone							
High Potential	Scrub Birch – Crowberry – Lowbush Cranberry (13); Shrub Birch – Lowbush Cranberry – Feathermoss (01); Scrub Birch – Sedge – Feathermoss (30); Spruce – Scrub Birch – Feathermoss (31); Black Spruce – Labrador Tea, Lowbush Cranberry – Sedge (32)	3,416	7.2	703	21.6	20.6	1.5
Moderate Potential	Scrub Birch – Willow – Mountain Avens (14); Willow – Horsetail – Peatmoss (40)	134	0.3	6	0.2	4.9	0.0
Low Potential	Scrub Birch – Mountain Avens – Lichen (12)	90	0.2	7	0.2	7.8	0.0
Very Low Potential	Tors (10)	0.5	0.0	0	0.0	0.0	0.0
Nil Potential	N/A	0	0.0	0	0.0	0.0	0.0
Total Subalpine	-	**3,640**	**7.7**	**717**	**22.0**	**19.7**	**1.5**
Broad Ecological Communities							
High Potential	Subalpine/Alpine Shrub (Ss); High Elevation Sparse Coniferous Forest (Fcs); Stunted Coniferous Forest (Stcs)	2,754	5.8	161	4.9	5.8	0.3
Moderate Potential	Upland/Closed Canopy Forest (UpF); Low Elevation Shrubby Riparian (LSr); Fen (F); Swamp (S)	19,494	41.1	712	21.9	3.7	1.5
Low Potential	Riparian Forest (RF)	1,002	2.1	70	2.1	7.0	0.1
Very Low Potential	Grassland (Gg)	281	0.6	8	0.2	2.8	0.0
Nil Potential	Marsh (M)	15	0.0	1	0.0	9.7	0.0
Total BEM	-	**23,546**	**49.7**	**952**	**29.2**	**4.0**	**2.0**
Total	-	**43,391**	**91.5**	**2,781**	**85.4**	**6.4**	**5.9**

Clearing and grubbing during the Construction phase will result in the loss of traditional and medicinal plants habitat. The effect is adverse as traditional and medicinal plants and their associated habitat will be lost. The effect is site specific, as the clearing will be confined to specific areas within the Project footprint. The magnitude of the effect for traditional and medicinal plants habitat loss is low at the LAA scale since less than 10% of mapped units within the total LAA are lost. This loss will be diminished at a larger scale since greater amounts of the ecological communities associated with high and moderately high potential berry-producing plants are distributed across the entire LAA and the RAA. The duration of the effect is permanent as certain sites will not be reclaimed and traditional and medicinal plant habitat loss should only occur once, for clearing. The effect is partially reversible over the long-term once Vegetation is allowed to re-establish in areas where site conditions have not been drastically changed but in certain areas where reclamation or natural regeneration will not occur such as open pits the loss of habitat will be permanent. The effect characteristic ratings for loss of traditional and medicinal plants and associated habitat are summarized in **Table 4.4-9**.

There are no residual effects from a loss of traditional and medicinal plant habitats associated with the Project operation phase, as loss will occur from Vegetation clearing during the Construction phase and any Vegetation maintenance is not expected to contribute further to this loss.

The context for the residual effects of habitat loss for traditional and medicinal plants is considered moderate. Overall, traditional and medicinal plants have a neutral resilience to imposed stresses and may be able to respond and adapt to the effect within reclaimed areas.

The residual effect to traditional and medicinal plants due to the Project Construction phase is not significant. While the magnitude of the effect is low, the loss does not pose a risk to the long-term persistence, viability and use as traditional and medicinal plant habitat within the LAA. All of the ecological communities found within the Project footprint are more than likely found throughout corresponding ecological zones.

Table 4.4-9 Effect Characteristics Ratings for Traditional and Medicinal Plants – Habitat Loss

Residual Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	Potential lost due to Vegetation clearing within Project footprint
Magnitude	Low	Considered low because there is a less than 10% loss of mapped ecological communities within the total LAA
Geographic Extent	Project footprint	The loss of traditional and medicinal plant habitat will only occur within the cleared areas
Timing	n/a	Vegetation will be lost regardless of when the clearing activity occurs
Frequency	Infrequent	The effect occurs once
Duration	Permanent	Not all areas will be reclaimed. There will be a permanent loss of Vegetation due to permanently changed structures of the landscape
Reversibility	Partially reversible	The majority of the Project footprint will be reclaimed or natural regeneration will occur in most areas except in areas of Waste Rock piles or open pits or certain road sections
Likelihood	Likely	There will be a loss of habitat

4.4.5.4 Summary of Project-related Residual Effects and Significance of Residual Effects on Traditional and Medicinal Plants

Based on the information presented above and summarized in **Table 4.4-10**, there is a not significant residual effect of habitat loss for traditional and medicinal plants. In general, the magnitude of habitat loss is low, none of the assessed traditional and medicinal plants are rare, and they are likely available and distributed throughout the RAA. In consideration of the uncertainty regarding the coarse-scale approach to assessing habitat for traditional and medicinal plants (i.e., comparable habitat baseline is not available for the larger region) and how individual traditional and medicinal plant communities will be affected by habitat loss, confidence in the predictions for habitat loss is moderate.

Table 4.4-10 Summary of Potential Residual Adverse Effects on Traditional and Medicinal Plants

Potential Residual Adverse Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat loss	• Clearing, grubbing, and grading • Upgrade of existing road and construction of new road section • Development of the WRSFs	• Project Design • Minimize Habitat Loss • Minimize Dust and Emissions • Project Personnel Awareness Training • Reduce Fire Hazards to Adjacent Vegetation	A	L	PF	n/a	PT	I	P	L	M	NS	M

Note: The following ratings are used for effects characteristics, as defined in **Table 4.4-1**:

Direction: A = Adverse, P = Positive
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: S = Site specific location within Project footprint, PF = Project footprint, L = Local (limited to LAA), R = Regional (limited to RAA)
Timing: n/a = no timing applicable, G = Growing season
Duration: LT = Long-term, ST = Short-term, PT = Permanent-term
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully reversible, P = Partially reversible, I = Irreversible
Context: L=Low, M=Moderate, H=High
Likelihood: L = Likely, U = Unlikely
Significance: NS = Not Significant, S = Significant
Level of Confidence: L = Low, M = Medium, H = High

4.4.6 RARE PLANTS SUBCOMPONENT

This section describes the nature of Project-related residual effects identified with respect to Rare Plants subcomponent, including an assessment of significance.

4.4.6.1 Potential Project-related Effects

Potential Project interactions with rare plants include mortality of individual plants and the loss of habitat during construction. The primary Project effect on rare plants is expected to include potential loss of habitat. Mortality risk is likely low since the probability of a rare plant occurrence within the Project footprint is low.

4.4.6.2 Mitigation Measures

The majority of the predicted effects on rare plants will occur during the Project's Construction phase. Vegetation will be removed for the construction of the mine and associated infrastructure (e.g., camp, airstrip, waste rock storage facilities, access roads). Land clearing is the most substantive and long-term effect on Vegetation within the Project footprint. To minimize the effects of habitat loss on rare plants during the Construction phase, mitigation is identified in **Section 4.3** and includes: Project Design, Minimize Habitat Loss, Minimizing Dust and Emissions, and Project Personnel Awareness Orientation. Specific to rare plants, the mitigation measures described in the protection of rare plants **(Section 4.3.6**) will be followed.

During the operation phase, activities will be Limited to the Project footprint (**Section 4.3.3**) and other mitigations such as Minimizing Dust and Emissions (**Section 4.3.4**), Reducing Fire Hazards to Adjacent Vegetation (**Section 4.3.5**), and Project Personnel Awareness Orientation (**Section 4.3.7**) will be implemented. These mitigations will be effective because they follow known best management practices, concentrate activities to the Project footprint, and minimize effects to adjacent Vegetation. Additional mitigation measures for rare plants includes pre-disturbance clearing surveys in areas of high rare plant habitat potential which will assist in identifying existence of any rare plants before clearing occurs.

4.4.6.3 Project-related Residual Effects and Significance of Residual Effects

While no SARA, COSEWIC or Yukon Track-listed plants were found during surveys, it is prudent to consider the potential occurrence of Yukon Watch-listed species in the LAA. Four Yukon Watch-list species were recorded in various areas within the LAA. Coffee Creek Scorpionweed was observed adjacent to the existing mine site access road at four different locations and observed approximately 160 m east of a tributary along the proposed route option between Barker and Ballarat Creeks. Spotted Lady's-slipper was observed on the east side of the existing mine site access road and on a slope above the Ballarat Creek floodplain area, north of the Yukon River. Small Enchanter's Nightshade was observed within the Coffee Creek riparian area just north of the area where the proposed winter road section of the NAR crosses Coffee Creek. Dry-spike Sedge was observed at the base of south-facing slope above the lower Ballarat Creek floodplain, north of the Yukon River.

To assess potential rare plant occurrence within the proposed footprint, all 40 Track-listed rare plants that were identified during baseline investigations as potentially occurring within the survey extent were reviewed for habitat characteristics. These habitat characteristics were compared to the ecological communities (ecosites and Vegetation associations) developed for the Project to aid in identifying whether ecological communities within the proposed footprint have the potential to support rare plants. Habitat requirements of rare plants were clarified with the Yukon Government Botanist where necessary (B. Bennett, Yukon CDC. Pers. Comm. 2016). Thirty-five percent of the Track-listed species investigated require habitat characteristics that are not found within the Project footprint. A further 40% are associated with wetland or riparian ecosystems, including ponds and gravel bars. Track-list rare plant occurrences in the Yukon are few; therefore detailed habitat descriptions for these plants within the territory are typically lacking and will be further developed overtime as occurrences are identified. Thus, ecosystems within the Project footprint with the potential to support rare plants were identified based on educated assumptions given available information. A list of potential Yukon Track-listed species that could occur within the LAA, based on possible relationship between habitat characteristics and Project-defined ecological communities, is provided in **Table 4.4-11.**

Table 4.4-11 Yukon Track-list Plant Species that could occur within the LAA

Common Name	Scientific Name	Potential Ecological Community
Idaho Bentgrass	*Agrostis clavata* Trin.	Gravel bar (Gb), Boreal ecosite 01-Sw and 01-Sw(Sb)
Aleutian cress	*Aphragmus eschscholtzianus* Andrz. ex DC.	Nothing appropriate[1]
Yukon Woodworm	*Artemisia laciniata* ssp. *laciniata* Willd.	Boreal ecosite 21
Green Spleenwort	*Asplenium trichomanes-ramosum* L.	Nothing appropriate
Alaska Moonwort	*Botrychium alaskense* W.H. Wagner & J.R. Grant	Nothing appropriate
Linear-leaf Moonwort	*Botrychium lineare* W.H. Wagner	Nothing appropriate
Leatherleaf Grapefern	*Botrychium multifidum* (S.G. Gmel.) Rupr.	Road (Rd)
Weak Sedge	*Carex laxa* Wahlenb.	Possible ecosite F3, marshes
Elk Thistle	*Cirsium foliosum* (Hook.) DC.	Boreal ecosite 41
Alaska Bugseed	*Corispermum ochotense* var. *alaskanum* Mosyakin	Nothing appropriate; I doubt there is much fine alluvial sand in the LAA
Small Yellow Lady's-slipper	*Cypripedium parviflorum* Salisb.	Boreal ecosites 41, 40
Arctic Larkspur	*Delphinium brachycentrum* Ledeb.	Nothing appropriate
Kathul Mountain Draba	*Draba murrayi* G.A. Mulligan	Talus (Rt), Rock outcrop (Ro), possibly 20-Capu
Star-flowered Draba	*Draba stenopetala* Trautv.	Nothing appropriate
Yukon Whitlowgrass	*Draba yukonensis* A.E. Porsild	20-Capu, subalpine ecosites 12 and 13

Common Name	Scientific Name	Potential Ecological Community
Alpine Golden Wild Buckwheat	*Eriogonum flavum* var. *aquilinum* Reveal	Possibly 20-Capu, but nothing else really appropriate
Showy Alpine Forget-me-not	*Eritrichium splendens* Kearney	Nothing appropriate
Pursh's Wallflower	*Erysimum capitatum* var. *purshii* (Durand) Rollins	Boreal ecosite 21, 20-Capu, possibly 20-Aruv
Beach-head Iris	*Iris setosa* Pall. ex Link	Nothing appropriate
Spiny-spored Quillwort	*Isoetes echinospora* Durieu	Pond (Pd)
Maritime Quillwort	*Isoetes maritima* Underw.	Pond (Pd)
Oriental June Grass	*Koeleria asiatica* Domin	Subalpine ecosite 12; 13 (based off of photographs in the Yukon CDC information sheet)
Spiked Saxifrage	*Micranthes spicata* (D. Don) Small	Boreal ecosite 42; possibly ecosite 40
Yukon Goldenweed	*Nestotus macleanii* (Brandegee) R.P. Roberts, Urbatsch & Neubig	Possibly grassland ecosites
Pygmy Waterlily	*Nymphaea tetragona* Georgi	Pond (Pd)
Mertens' Oxytrope	*Oxytropis mertensiana* Turcz.	Gravel bar (Gb);
Northern Beech Fern	*Phegopteris connectilis* (Michx.) Watt	Subalpine ecosite 13
Short Bluegrass	*Poa abbreviata* ssp. *abbreviata* R. Br.	Subalpine ecosite 12; 13
Patterson Bluegrass	*Poa abbreviata* ssp. *pattersonii* (Vasey) Á. Löve, D. Löve & B.M. Kapoor	Possible subalpine ecosite 13
Yukon Podistera	*Podistera yukonensis* Mathias & Constance	Talus (Rt)
Yenisei River Pondweed	*Potamogeton subsibiricus* Hagstr.	Pond (Pd)
Mount Sheldon Butterweed	*Senecio sheldonensis* A.E. Porsild	Nothing appropriate
William's Catchfly	*Silene williamsii* Britton	Gravel bar (Gb); possibly ecosite 20-Capu
Porsild's False Candytuft	*Smelowskia porsildii* (W.H. Drury & Rollins) Jurtzev	Likely nothing appropriate; possibly ecosite 13 (boulder channels)
Alaska Starwort	*Stellaria alaskana* Hultén	Talus (Rt); possibly ecosite 12 and 13
Matted Starwort	*Stellaria dicranoides* (Cham. & Schltdl.) Fenzl	Nothing appropriate
Yukon Aster	*Symphyotrichum yukonense* (Cronquist) G.L. Nesom	Gravel bar (Gb); ecosite 43
Pink Dandelion	*Taraxacum carneocoloratum* A. Nelson	Nothing appropriate
Siberian False Oats	*Trisetum sibiricum* ssp. *sibiricum* Rupr.	Nothing appropriate
Arctic Yellow Violet	*Viola biflora* var. *biflora*	Nothing appropriate

1 Nothing appropriate indicates that no specific correlation between species habitat characteristics and defined Project ecological communities could be identified.

Within the Project footprint, subalpine ecosites 12 and 13 provide potential habitat for approximately six rare plants. These two ecosites cover approximately 90 ha and 190 ha respectively throughout the LAA. The Project footprint will remove approximately 8% of ecosite 12 and 34% of ecosite 13.

The NAR portion of the Project footprint follows valley bottoms or lower slopes for much of its length, where wetland and riparian ecosystems are common. Consequently there are more ecosystems within the NAR section of the Project footprint that have potential for rare plants. Approximately 7% of the ELC and BEM-mapped footprint consist of riparian or wetland ecosystems, including ponds, gravel bars, and floodplains, with potential for at least one Track-listed species. Dry, warm, aspen stands with Purple Reedgrass (ecosite 21) and warm, moderate sloping grasslands (ecosite 20-Capu) also have the potential for rare plants. These two ecosites cover approximately 1,080 ha and 125 ha respectively throughout the NAR area. The Project footprint will remove approximately 4% of ecosite 21 and 2% of ecosite 20-Capu of those available ecological communities in the LAA.

Clearing the land during construction will result in the removal of potential rare plant habitat, resulting in a residual effect. The effect is adverse as potential rare plant habitat will be lost. The effect is site-specific, because the Project clearing will be confined to the footprint. The magnitude of the effect is low because 1) no rare plants were identified during field surveys, 2) there is a proportional loss of less than 10% for mapped ecological communities where rare plants could potentially occur within the total LAA, and 3) it was previously stated that all of the ecological communities capable of supporting rare plant species that occur in the LAA are commonly found throughout the RAA. The duration of the effect will be permanent as certain sites will not be reclaimed, and habitat loss will occur once for clearing. The effect will be partially reversible over the long-term once Vegetation is allowed to re-establish in areas where site conditions have not been drastically changed, but in certain areas where reclamation or natural regeneration will not occur, such as open mine pits, the loss of habitat is permanent. The effect characteristics ratings are summarized in **Table 4.4-12**.

There are no residual effects to rare plants expected for the Project Operation phase, as habitat loss will occur from Vegetation clearing during the Construction phase, and any Vegetation maintenance is not expected to contribute further to this loss of habitat. The context for the residual effects of habitat loss for rare plants is considered low. No rare plants have been identified but in general plants are classed as being rare due to their sensitivity to change or loss of habitat and their inability to recover from changes in habitat or loss of habitat. Individual rare plants if located would have a low resilience to a loss of habitat and typically would not easily adapt to this loss of habitat.

Table 4.4-12 Effect Characteristics Ratings for Rare Plants – Habitat Loss

Residual Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	Potential rare plant habitat will be lost from Vegetation clearing within Project footprint
Magnitude	Low	Considered low since probability of locating rare plants is low, no rare plants located in previous searches and percent loss of rare plant habitat is less than 10% of mapped rare plant habitat within the total LAA
Geographic Extent	Project footprint	The potential loss of rare plant habitat should only occur within the cleared area.
Timing	Growing season	Most rare plants are more vulnerable during the growing season
Frequency	Infrequent	The residual effect is expected to occur once
Duration	Permanent	Not all areas will be reclaimed which signifies the potential of a permanent loss of rare plant habitat
Reversibility	Partially reversible	The majority of the Project footprint will be reclaimed or natural regeneration will occur in most areas except in areas of waste rock piles or open pits
Likelihood	Unlikely	The loss of habitat could potential occur, but the presence of a rare plant species within the project footprint is unlikely.

4.4.6.4 Summary of Project-related Residual Effects and Significance of Residual Effects on Rare Plants

Based on the information presented above and summarized in **Table 4.4-13**, there is a not significant residual effect of habitat loss for rare plants. In general, the magnitude of habitat loss is low and there is a low probability of any rare plants or Watch-list species being located within the Project footprint. In consideration of the uncertainty how individual rare plants will be affected by habitat loss, confidence in the predictions for habitat loss is moderate.

Table 4.4-13 Summary of Potential Residual Adverse Effects on Rare Plants

Potential Residual Adverse Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss	• Clearing, grubbing, and grading • Upgrade of existing road and construction of new road section • Development of the WRSFs	• Project Design • Minimize Habitat Loss • Protect rare plants • Project Personnel Awareness Training • Limit Activities to Project footprint • Minimize Dust and Emissions • Reduce Fire Hazards to Adjacent Vegetation	A	L	PF	G	PT	I	P	U	L	NS	M

Note: The following ratings are used for effects characteristics, as defined in **Table 4.4-1**:

Direction: A = Adverse, P = Positive
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: S = Site specific location within Project footprint, PF = Project footprint, L = Local (limited to LAA), R = Regional (limited to RAA)
Timing: n/a = no timing applicable, G = Growing season
Duration: LT = Long-term, ST = Short-term, PT = Permanent-term
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully reversible, P = Partially reversible, I = Irreversible
Context: L=Low, M=Moderate, H=High
Likelihood: L = Likely, U = Unlikely
Significance: NS = Not Significant, S = Significant
Level of Confidence: L = Low, M = Medium, H = High

4.4.7 VEGETATION HEALTH SUBCOMPONENT

This section describes the nature of Project-related residual effects identified with respect to Vegetation health subcomponent, including an assessment of significance

4.4.7.1 Potential Project-related Effects

The potential effect to the Vegetation health subcomponent is the risk of increased trace metal concentrations in plants due to an increase in dust deposition from Project activities. Refer to **Section 4.2** for a complete list of potential Project-related effects.

4.4.7.2 Mitigation Measures

Dust reduction and suppression will be important during Construction and Operation because fugitive dust can cover local Vegetation (Spatt and Miller 1981) and plants can uptake metals in dust either directly through tissue or through roots in the soil (Adriano 2001), potentially affecting plant function. The most likely areas of dust generation will be from road traffic from the pits, ore placement, and spreading on the heap leach pad, crushing facilities, and waste rock, and ore stockpiling activities.

During the all development phases, activities will be Limited to the Project footprint (**Section 4.3.3**) and other mitigations such as Minimizing Dust and Emissions (**Section 4.3.4**), Reducing Fire Hazards to Adjacent Vegetation (**Section 4.3.5**), and Project Personnel Awareness Orientation (**Section 4.3.7**) will be implemented. These mitigations will be effective because they follow known best management practices, concentrate activities to the Project footprint, and minimize effects to adjacent Vegetation.

4.4.7.3 Project-related Residual Effects and Significance of Residual Effects

Various Project activities during Construction, Operations, and Reclamation and Closure phases could potentially increase the amount of dust deposition which could increase the amount of available trace metals uptake in plants, resulting in an effect on Vegetation health. Management and mitigation measures described previously will help to minimize the effects to Vegetation health. However, direct and indirect effects will not be fully mitigated and thus a residual effect is anticipated for to the Vegetation health subcomponent.

This section is a detailed summary of background information to support the residual effects assessment of Vegetation health subcomponent in regards to an increase in trace metal concentration due to an increase in dust deposition and emissions from Project activities.

Dust deposition will occur during the Project as a result of construction, operation, and reclamation and closure activities. Dust fall modeling (**Section 9.0 — Air Quality and Greenhouse Gas Emission Analysis**) indicates that dust will be transported downwind and deposited according to local atmospheric conditions and particle size. Typically, the effects of dust fall on Vegetation are dependent on the size and

type of the airborne particles, deposition load and frequency of exposure (figures available in **Appendix 9-B Air Quality and Greenhouse Gas Emissions IC Report**) depicts the maximum daily deposition rate of total suspended particulates during Year 6 of the Project's Operation phase, as predicted by the dust deposition model. The figure shows the geographical extent of the dust fall from the mine site.

Dust along the NAR is not expected to disperse more than 1 km from the road with the highest deposition occurring within a few hundred meters of the road edge. The dust generated from Project-traffic is also very low because the proposed freight traffic to and from site along the NAR is estimated at 8 trucks per day.

There are no known dust deposition thresholds specific to effects on Vegetation health. There is limited evidence available on levels at which dust deposition affects plants. Based on interpretation from Farmer (1993) who brings together numerous other sources of evidence for effects to plants due to dust deposition, suggests that damage to Vegetation from dust deposition will occur at approximately the same levels as nuisance will occur for people. Based on available information, damage to plants is unlikely to occur at annual mean deposition rate of less than 350 mg/m²/day and severe damage could possibly occur at annual mean deposition rates greater than 1,190 mg/m²/day. Spatt and Miller (1981) reported a decline in Sphagnum abundance with a deposition rate of 1.0 to 2.5 g/m²/day, while (Farmer 1993) recorded some effects to vegetation for deposition rates as low as 0.07 g/m²/day. Since no two studies used/showed similar rates it was difficult to select threshold values that would be appropriate for this assessment. It was decided to use rates that were used in other Yukon mine assessments and to ensure the high threshold value range included rates from studies that showed dust deposition damage to plants. It was decided that dust fall deposition rates will adapt the following ranks:

- Low threshold value = 0.027 to 0.126 mg/dm²·day (1–4.6 g/m²/year)
- Moderate threshold value = 0.126 to 1.37 mg/dm²·day (4.6–50 g/m²/year)
- High threshold value = > 1.37 mg/dm²·day (>50 g/m²/year).

Based on air quality model outputs, dust particles could potentially cover approximately 47,543 ha of Vegetation habitat around and including the mine site (**Appendix 9-B Air Quality and Greenhouse Gas Emissions IC Report**). The predicted greatest daily concentration of dust will fall within the mine site footprint (1,138 ha) and spread over into adjacent areas to spread across a total area of approximately 1,375 ha. This signifies that approximately 237 ha of adjacent Vegetation and soil will receive a daily dust fall that exceeds the high threshold value.

Management and mitigation measures will help to minimize adverse effects to daily dust fall levels and dust fall extent around the mine site footprint resulting from the Project Construction, Operation and Reclamation and Closure phases. During all phases, dust deposition may still occur beyond threshold levels outside of the Project footprint, and there will be some effects on Vegetation. Metals contained in dust could potentially accumulate in soils beyond the Project footprint, although the affected area is expected to be small in

comparison to the LAA and RAA. Similar to dust deposition effects, plant responses to metals in soil are varied depending on the species. It is expected that bioavailability of metals in soils will not increase to reach mortality thresholds.

The effects of trace metal uptake may be detectable only through analytical methods or may exhibit clear visual symptoms (e.g., Vegetation decline) within the affected areas. Any effects to Vegetation health may be minimized by the proposed mitigation measures and monitoring programs during the Project Construction, Operation, Reclamation and Closure phases. Project activities will increase the amount of dust deposition which could potentially lead to an increase in trace metal uptake by plants, resulting in a residual effect. The effect is adverse as Vegetation health could change within the LAA.

The effect is adverse as potential for a negative effect to Vegetation health exists in the form of possible loss in species diversity and abundance in areas adjacent to the Project footprint. The adverse effect will be limited to the LAA. The magnitude of the effect is moderate since there is the potential that Vegetation health will be affected and this effect could be manifested as a decline in species abundance and diversity in areas where high dust deposition thresholds will be reached. The duration of the effect is long-term since it is likely that existing species abundance and diversity will return, but will take time once activities have stopped. The effect is partially reversible over the long-term once Vegetation is allowed to re-establish, but depending on soil conditions some species may not be able to return. The effect characteristics ratings for changes in Vegetation health are summarized in **Table 4.4-14**. The context of the effect is considered moderate since the overall vegetation community has resilience to the imposed stress and should be able to adapt. Certain individual species may have a low resilience to an increase in metal uptake due to dust deposition and will not easily adapt to the effect. The deposition of dust should stop once reclamation has been successful, and will allow individual species to recolonize areas (i.e., adapt to the effect).

Table 4.4-14 Effect Characteristics Ratings for Vegetation Health – Change in Vegetation Health

Residual Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	There is the potential that Vegetation health will be affected due to increases in dust deposition.
Magnitude	Moderate	Considered moderate since there is the potential of reduced species abundance near the mine site and in close proximity to the NAR especially in moss species' abundance.
Geographic Extent	Local (LAA)	The potential loss of species should likely only occur within the LAA. Dust will travel into the RAA but should not have measurable effects on the Vegetation.
Timing	Growing season	The majority of metal uptake by plants will occur during the growing season and this is the period where plants are at their most vulnerable.
Frequency	Continuous	The effect is expected to be continuous until mine closure.
Duration	Long- term	Vegetation health should no longer be affected once Project activities have stopped. It is assumed that once dust deposits stop, pre-disturbance Vegetation will return but this will take time.
Reversibility	Partially reversible	Once mitigation measures are implemented the dust deposition rates should be reduced. It is assumed that once dust producing activities stop the majority of the LAA will return to pre-disturbance composition. Areas immediately adjacent the Project footprint may have greater difficulty returning to pre-disturbance health.
Likelihood	Likely	There will be an effect to Vegetation health due to Project dust producing activities.

4.4.7.4 Summary of Project-related Residual Effects and Significance

Potential residual adverse effects and proposed mitigation measures on change to Vegetation health are summarized in **Table 4.4-15**. The residual effect on Vegetation health is not significant because the limited spatial extent where the effect may occur does not pose a risk to the long-term persistence and viability of healthy Vegetation within the LAA or RAA. The implementation of mitigation and monitoring measures reduces the risk of this effect and the residual effects should be localized to areas immediately adjacent to roads. In consideration of the uncertainty regarding individual species difference in metal uptake, confidence in the predictions for vegetation health is rated as moderate.

Table 4.4-15 Summary of Potential Residual Adverse Effects on Vegetation Health

Potential Residual Adverse Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Dust deposition	• Vehicle and equipment movement within Project footprint • Mining activities (open pit, soil stockpiles) • Reclamation activities (soil movement)	• Minimize Dust and Emissions • Project Personnel Awareness Training	A	L	L	G	LT	C	P	L	M	NS	M

Note: The following ratings are used for effects characteristics, as defined in **Table 4.4-1**:

Direction	A = Adverse, P = Positive
Magnitude:	L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent:	S = Site specific location within Project footprint, PF = Project footprint, L = Local (limited to LAA), R = Regional (limited to RAA)
Timing:	n/a = no timing applicable, G = Growing season
Duration:	LT = Long-term, ST = Short-term, PT = Permanent-term
Frequency:	I = Infrequent, F = Frequent, C = Continuous
Reversibility:	F = Fully reversible, P = Partially reversible, I = Irreversible
Context:	L=Low, M=Moderate, H=High
Likelihood:	L = Likely, U = Unlikely
Significance:	NS = Not Significant, S = Significant
Level of Confidence:	L = Low, M = Medium, H = High

4.5 SUBJECT OF NOTE

4.5.1 INTRODUCTION AND SPREAD OF INVASIVE PLANT SPECIES

Construction activities have the potential through disturbances to create suitable conditions for both the introduction and spread of invasive species. Vehicles of any size (e.g., heavy machinery to all-terrain vehicles) travelling along the NAR and mine site access road could inadvertently transport plant propagules in tires, the undercarriage, or in mud on the vehicle to previously unaffected areas.

Invasive plant species are often favoured over native plant species in cases where they tolerate disturbance or exposed soils offer favorable germination conditions (Pyke and Havens 1999). Construction and development activities increase the potential of introducing invasive plants into local environments by creating favorable habitat through ground disturbance (Polster 2005). Features fundamental to the construction process, namely development of transportation corridors as well as vehicles and machinery travelling along such corridors, provide access and dispersal mechanisms. Invasive plants are often found along road verges and within areas that have sustained some level of disturbance.

Invasive plant species can influence ecosystem diversity, structure, and function through invasion and hybridization. Invasive plants can alter the structure of a natural ecosystem and ultimately change the way in which the site is used by wildlife, insects, and micro-organisms. The effects of invasive species on native diversity is well documented, and is recognized by some as the second greatest threat to listed species after habitat loss (Wilcove et al. 1998, Enserink 1999). Changes in nutrient cycling, hydrology, erosion, and fire regimes may also occur (Canadian Food Inspection Agency 2008).

Baseline invasive plant surveys recorded the presence of five rank 1 invasive species scattered along the NAR (Smooth Brome, Narrow-leaved Hawksbeard, Perennial Sow-thistle, White Sweetclover, and Yellow Sweetclover). Distribution of invasive plants varied by species, but in general invasive plant species were much more prevalent along the existing northern sections of the NAR (i.e., north of the Stewart River), than the southern sections. South of the Yukon River, invasive plant populations were limited to individual plants or small patches, with the exception of Smooth Brome, which was observed to be more prevalent, likely as a result of previous agricultural activities in the Coffee Creek area (onsite Environmental Monitors have been working to eliminate invasive plant populations within the Coffee Property since their discovery in 2015). An individual Narrow-leaved Hawksbeard plant was found at km 21 of the project exploration road (Java road) within the proposed mine site in 2016 surveys (unpublished survey results). The plant was in flower, pulled, bagged and incinerated.

Mechanisms for the introduction and/or spread of invasive plant species include:

- Clearing of native vegetation that may create favourable growth conditions for invasive non-native plant species from seed sources already on or near site.
- Movement of trucks and equipment coming to site from various locations that may contain fugitive non-native seeds in tire treads or other areas of the vehicles
- Revegetation efforts which can inadvertently introduce non-native plant species if seed is used that is not supplied from a native seed source.

Various Project activities during the construction, operation, and reclamation and closure phases could potentially introduce and/or spread invasive species to areas adjacent or within the Project footprint. Establishment of invasive species within the mine site is unlikely if identified mitigation and monitoring measures are implemented. The spread of invasive species within the NAR is possible since rank 1 invasive species are present along existing sections of the route. Road segments with existing rank 1 invasive species have the potential to act as a source for the continued spread of invasive species; road segments with higher density distribution classes have the greatest probability for spreading the extent of existing Rank 1 invasive species.

As described in the Mitigation section (**Section 4.3**), the Proponent will do the following to prevent the introduction and/or spread of invasive species within the Project area. Given the extent of the Pre-Project invasive plant species distribution, the Proponent's management of invasive plant species will differ between the mine site and the NAR, although some mitigation measures for invasive plants will be universal across the Project area including:

- Minimize disturbance of native Vegetation and exposed soil along roadsides, trails and waterways.
- To the extent possible, avoid disturbing areas that are high-risk sites for the potential spread of invasive species (i.e., within or adjacent to existing infestations).
- Equipment bound for the mine site will be inspected prior to accessing the NAR to ensure it is free of soil, invasive plant parts and seed;
- A dedicated NAR off-road truck fleet will be used to transport most materials and equipment from a logistics centre near Dawson;
- Initiate progressive reclamation as soon as possible to limit soil exposure; where practical, this will include salvaging non-infested topsoil and placing it on disturbed areas (healthy topsoil contains nutrients, microorganisms and native plant propagules that promote native plant revegetation).
- If sourcing gravel to be used on-site, the gravel will be inspected to ensure that is weed-free prior to being brought to site.
- Straw matting or similar tools to be used for erosion control purposes will only be used if they can be certified to be weed free.
- Revegetation protocols will target locally collected native seed sources. If additional seed is necessary, it will be limited to certified weed free seed mixes.

- Employee education and awareness training (described further below) that includes plant identification and reporting procedures to assist in early detection of invasive species.

In addition to the above mitigation measures for invasive plants, within the mine site area, the Proponent will actively manage for invasive plants. The following mitigation actions will be taken to prevent invasive species spread south of the Yukon River during all Project phases:

- Conduct annual monitoring of high-risk areas, such as disturbed or bare ground, roadsides, parking, and staging areas to spot invasive species early. This is known as early detection and rapid response (EDRR).
- Where rank 1 invasive species are found within the mine site area in small or moderate patches, targeted removal will be carried out using mechanical (i.e., hand pulling or mowing) or chemical means to remove or destroy the plants. The decision to hand-pull, mow, or apply chemicals will depend on the species, size of the patch, and location of the patch. Chemical treatment will only be considered where invasive plant patches exceed 25 individuals and are more than 30 m from a waterbody. All chemical treatment will abide by the Pesticide Regulations under the Yukon Environment Act, RSY 2002, c.76.
- All plant parts collected during picking will be bagged and incinerated.

Along the NAR, the Proponent will focus on limiting the continued spread of invasive species along the road as a result of Project activities through the following mitigation actions:

- Inspect quarry and borrow sites for invasive species; to the extent practicable, avoid using materials from quarry and borrow sources with an existing infestation in areas currently free of invasive species.
- To the extent possible, avoid disturbing areas within or adjacent to existing infestations; if work must occur in these areas, wherever possible, conduct activities in advance of seed development to avoid spreading seeds.

Detailed information, including mitigation to prevent invasive species spread and control methods for removal will be provided within the proposed Vegetation Management Plan that will be developed before the start of Construction.

5.0 ASSESSMENT OF CUMULATIVE EFFECTS

This section presents an assessment of potential cumulative effects to Vegetation. Cumulative effects result from interactions of Project-related residual effects with the incremental effects on Vegetation from other past, present, and reasonably foreseeable future projects and activities. The full Project and Activity Inclusion List for this cumulative effects assessment (CEA) is provided in the Project Proposal (**Section 5.0 Effects Assessment Methodology, Appendix 5-B**).

This section describes the anticipated residual cumulative effects on Vegetation that may remain after implementation of technically and feasible mitigation measures. These effects are described using the effects characteristics identified in **Table 4.4-1**. The determination of significance for the potential residual cumulative effects on Vegetation was based on a consideration of the residual effects characteristics and environmental context of Vegetation presented in **Section 4.4**.

This assessment does not separate the residual cumulative effects on Vegetation among the individual subcomponents ecological communities, wetland habitats, rare plants, and traditional and medicinal plants because residual cumulative effects are expected to be similar. As such, the anticipated residual cumulative effects are described in the following sections for Vegetation as a VC collectively.

5.1 PROJECT-RELATED RESIDUAL EFFECTS

A list of Project-related residual effects on Vegetation, and the rationale for their inclusion in (or exclusion from) the CEA, is provided in **Table 5.1-1**. Project-related residual effects that were assessed as negligible are not considered likely to interact cumulatively, and consequently were not carried forward into the CEA.

Project-related residual effects that will be included in the CEA are habitat loss due to the Project footprint. Dust deposition was not included in the CEA because the timing and spatial overlap from other projects and activities will likely not have an adverse cumulative effect on Vegetation. Direct habitat loss can be minimized through Project design and mitigation during Project implementation, but cannot be completely eliminated. All Project-related residual effects on Vegetation subcomponents were assessed as not significant. Despite this finding, all residual effects were carried through to the CEA to evaluate the potential for residual effects and significance due to their interaction with the residual effects on Vegetation of other current or reasonable foreseeable future projects in the region.

Table 5.1-1 Project-Related Residual Effects Considered in the Cumulative Effects Assessment for Vegetation

Project-related Residual Effect	Included in Cumulative Effects Assessment	Rationale
Habitat loss	Yes	Combined habitat loss from multiple projects and activities could have an adverse cumulative effect on Vegetation
Dust deposition	No	Combined vehicle traffic along roads from multiple projects and activities could increase the level and rate of dust deposition on Vegetation growing adjacent to roads and possibly increase the concentration of trace metals in soils and plants. It is likely that the successful implementation of mitigation measures and implementation of a trace metal monitoring program will minimize any potential residual effect from the Proponent Project activities and not contribute to effects from other users. There is a high probability that other road users such as placer miners do not mitigate against the possible effect of an increase in dust deposition along existing roads. Also during Operation phase four trucks from the Project are anticipated to travel to and from site per day, whereas higher vehicle traffic is expected on the access road from other projects and land users.

5.2 Spatial and Temporal Scope of the Cumulative Effects Assessment

The spatial boundary of the CEA for Vegetation is the RAA (described in **Section 1.3.1**). The temporal boundaries are the same as those described in **Section 1.3.2**. The temporal characteristics of the Project's Construction, Operation, Reclamation and Closure, and Post-closure phases are described in the Project Proposal (**Project Description — Section 2.0**).

5.3 Other Projects and Activities

Projects and land use activities that have resulted or may result in residual effects to Vegetation were selected from the Project and Activity Inclusion List in the Project Proposal (**Effects Assessment Methodology — Section 5.0**). Relevant projects and activities within the spatial and temporal scope of the CEA that may result in residual adverse effects on Vegetation that could interact with the Project-related residual effects are identified in **Table 5.3-1.** An overview description of each of these projects and activities is provided, along with relevant residual effects on Vegetation.

The following definitions were used to classify the status of projects and activities that could interact with the Project:

- Past — projects and land use activities that occurred in the past and are no longer active
- Present — existing and active projects and land use activities; all projects or land use activities that applied for approval or permitting prior to 2015 are assumed to be present projects or land use activities
- Future — reasonably foreseeable future projects or land use activities for which proposals have been submitted to YESAA (subsection 50(1)), or have entered into a formal approval or permitting process; applications submitted in 2015 and 2016 are assumed to be future projects or land use activities.

Mineral exploration and placer mining projects have occurred in, and are likely to continue to occur in, the RAA. There are no known areas that are excluded from mineral exploration, and there are a number of placer claims that will likely exist and be active either continuously or intermittently into the foreseeable future. Although the claim blocks can be very extensive and numerous, actual works are likely to be limited to a few focal areas for either a short period of time, or seasonally for many years, as is the case for several quartz claims in the area. Projects and activities in each category (e.g., quartz mining and exploration, placer mining, industrial, transportation) are assumed to cause similar types of residual effects and are therefore assessed as a category.

Table 5.3-1 Potential Residual Adverse Effects of Other Projects and Activities on Vegetation

Project or Activity	Status	Description	Potential Residual Effects
Quartz Mining	Future	There are two future quartz mining projects within the RAA with the potential to occur during the life of the Coffee Project (i.e., **Casino** and **Lonestar**).These projects are likely to have similar residual effects as the Project, which are described in Section 4.	Localized habitat loss
Quartz Exploration (multiple permits)	Present	There are 18 present quartz exploration permits within the RAA. Exploration for these permits is likely to continue either continuously or intermittently throughout the life of the Project. None of these exploration permits are expected to be developed within the life of the Project.	Localized habitat loss
Placer Mining (multiple permits)	Past, Present, and Future	There are 241 present placer permits within the RAA. Exploration and mining for these permits is likely to continue either continuously or intermittently throughout the life of the Project. Although the claim blocks can be very extensive and numerous, actual works are likely to be limited in extent to a few focal areas for either a short period of time, or seasonally for many years.	Localized habitat loss
Industrial	Present	**Development of Quarry Resources at Km 674.5 on the Klondike Highway** – development of a rip-rap quarry 40 km east of Dawson City on the Klondike Highway. This quarry lease is for five years and the estimated volume of quarry material is 100,000 m^3.	Localized habitat loss
Utilities	Present	**Dawson Airport CDMA IX Cell Site Build** –construction of an 80 m access road and power line.	Localized habitat loss
Energy	Present	**Proposed Power Line to Cellular Tower** –Clearing of a 1 ha area of Vegetation to install a power line to a cellular tower. There is likely seasonal maintenance, including removal of Vegetation within the right-of-way.	Localized habitat loss
Transportation	Present	**Laskey Access** – Establish road access to a placer claim and construct a pipe or water line to provide sufficient water for placer mining activities throughout the year.	Localized habitat loss
Forestry	Past	Two forestry projects have occurred in the past within the Bonanza Creek watershed. Project activities included road construction and upgrades, fuel wood harvesting, salvage logging, road de-commissioning, and restoration.	Localized habitat loss

Project or Activity	Status	Description	Potential Residual Effects
Settlements	Present	Three small-scale settlement activities are presently occurring within the RAA. Two activities involve the construction of rural residences and access roads, and one activity involves the construction and maintenance of a power line to a rural residence.	Localized habitat loss
Existing road network	Present	There are 836 km of paved and unpaved roads within the RAA (GeoYukon 2015).	Localized habitat loss
Trapping and hunting	Present	Multiple Trapline Concession Areas and one Guide Outfitter Concession Area overlap with the RAA. Trapping and hunting occurs seasonally.	No effect

5.4 POTENTIAL CUMULATIVE EFFECTS

This section identifies and discusses the potential interactions between Project-related residual effects and the residual effects of other projects and activities that may result in adverse cumulative effects on Vegetation. For the purpose of this assessment, the subcomponent ecological community was selected to represent the wetland habitats, traditional and medicinal plants, and rare plants subcomponents. For each identified interaction, the potential for residual cumulative effects was assessed using the same process described for the assessment of Project-related residual effects (see **Section 4.4.1**), including consideration of potential mitigation measures, characterization of residual effects, and determination of significance. All potential cumulative effects on Vegetation were carried forward for assessment. If an interaction is unlikely to result in a cumulative effect or is the cumulative effect is expected to be negligible, it was not carried forward for assessment beyond summary notes provided in **Table 5.4-1**.

Table 5.4-1 Potential Cumulative Effects on Vegetation Due to Interactions between the Project and Other Projects and Activities

Other Project / Activity	Potential Residual Adverse Effect	Potential for Interaction Resulting in Cumulative Effect (see Note) and Rationale
Quartz mining	Localized habitat loss	Yes — There are two reasonably foreseeable future quartz mines within the RAA that may interact cumulatively with the Project. Other quartz mine activities are likely to have similar residual effects on Vegetation including, habitat loss within portions of the permitted areas.
Quartz Exploration (multiple permits)	Localized habitat loss	Yes — There are multiple quartz exploration permits that could interact cumulatively with Vegetation. Exploration activities create localized habitat loss within portions of the permitted area.
Placer Mining (multiple permits)	Localized habitat loss	Yes — There are numerous past, present, and reasonably foreseeable future placer permits within the RAA that may interact cumulatively. Placer mining creates localized habitat loss within portions of the permitted area.
Industrial	Localized habitat loss	No — the development of quarry resources approximately 34 km east of Dawson City at Km 674.5 on the Klondike Highway is not likely to interact cumulatively.

Other Project / Activity	Potential Residual Adverse Effect	Potential for Interaction Resulting in Cumulative Effect (see Note) and Rationale
Utilities	Localized habitat loss	No — the construction of an 80 m access road and power line at the Dawson City Airport are not likely to interact cumulatively.
Energy	Localized habitat loss	No —the clearing of 1 ha of Vegetation near the Dawson City Airport to install a power line to a cellular tower (and associated seasonal maintenance) is not likely to interact cumulatively.
Transportation	Localized habitat loss	No — the establishment of road/water access to a placer mine in the Dominion Creek watershed is not likely to interact cumulatively.
Forestry	Localized habitat loss	No — forestry activities are not likely to interact cumulatively because they occurred in the past and the resulting regenerating forest shows that Vegetation has returned to the area (no loss of habitat). The roads built for accessing cut blocks will be captured by effects related to the existing road network.
Settlements	Localized habitat loss and reduced habitat effectiveness	No — small-scale settlement activities in and around Dawson City are not likely to interact cumulatively.
Existing road network	Localized habitat loss	Yes — There are 836 km of existing paved and unpaved roads within the RAA that may interact cumulatively. Roads result in direct habitat loss.

Note: No: no interaction or not likely to interact cumulatively; Yes: potential for cumulative effect

5.5 MITIGATION MEASURES FOR CUMULATIVE EFFECTS

There are no additional Project-specific mitigation measures that the Proponent can implement to manage cumulative effects on Vegetation (refer to **Section 4.3** of this assessment) for proposed mitigation). However, should there be regional concerns about habitat loss the Proponent is willing to participate in mutli-stakeholder working/planning groups as an engaged industrial partner in to discuss regional-level management concerns.

Other land users have the potential to cause adverse effects to Vegetation within the region surrounding the Project area. The Proponent does not have the ability to manage the actions of other businesses (e.g., outfitting, trapping, mining) operating within the RAA. Furthermore, proponents of other projects in the area may have conditions in their operating permits that are inconsistent with the Proponent's Project mitigation measures. To mitigate potential adverse effects that are outside of the Proponent's control and ensure the long-term health of regional Vegetation, a landscape level planning process that includes updated Habitat Management Plan(s) could be developed by management authorities. This management plan could be developed through a multi-stakeholder working group that includes those parties that have the responsibility for land management. Working group members could include the YG, Environment Canada, First Nations, and the Proponent. While the Proponent cannot develop or implement the plan independently, it can participate as a stakeholder member of the working group.

5.6 RESIDUAL CUMULATIVE EFFECTS AND SIGNIFICANCE OF RESIDUAL CUMULATIVE EFFECTS

This section describes the nature of the residual cumulative effects identified with respect to the overall Vegetation VC, including an assessment of significance, at the RAA level arising from potential interactions identified in **Table 5.4-1**. For the purpose of the CEA, ecological communities, the traditional and medicinal plants, rare plants and wetland habitats subcomponents were combined and evaluated together as Vegetation. The primary reason for this was the absence of detailed ecological mapping within the RAA. Potential interaction includes the loss of Vegetation habitats. In addition, at the regional level, overall Vegetation is assumed to be abundant. Therefore, the Project interaction is expected to be loss of habitat.

5.6.1 BACKGROUND INFORMATION

As described in **Section 2.0**, the Project's ecological mapping area was limited to a relatively small area surrounding the Project footprint to address detailed mapping to inform mitigation for site-specific locations of sensitive ecosystems such as wetlands, rare plant habitat, and potentially unique ecological communities. Detailed mapping at a regional level is not available here or anywhere else in Yukon. There are some project-specific examples of ELC near the Project area (e.g., Casino Project), but the information is limited in spatial extent, and none of these products overlap with the Project. Additionally, all project-specific ELC mapping in the region use different ecological community descriptions due to the lack of a territorial ecosystem classification system.

5.6.2 CUMULATIVE RESIDUAL EFFECTS ASSESSMENT

Vegetation habitat loss occurs when Vegetation habitat is physically altered by Project activities to such an extent that the habitat is no longer viable for successful plant growth. **Section 4.2** provides a broader description of the potential effects to Vegetation resulting from loss of habitat.

Habitat Loss

The CEA examines the cumulative effects of direct habitat loss within the RAA. Direct habitat loss was estimated based on the available information on present and future habitat disturbance within the RAA. All Projects or activities that are expected to have an interaction were included in the CEA. The primary data source was unpublished data from the Yukon Government that mapped existing surface disturbances based on high resolution satellite imagery (YG 2016). Multiple spatial data sources were combined to estimate the total amount of disturbed habitat within the RAA:

- Surface Disturbances, Yukon Government (YG 2016, Unpublished data)
- National Roads Network (GeoYukon 2015)

The CEA for Vegetation habitat used the following assumptions about the spatial and temporal boundaries of other projects and activities:

Quartz mining (future): Reasonably foreseeable future mines considered in this assessment were **Casino** and **Lonestar**. The proposed mine footprint for the **Casino Mine**, obtained from YESAB submissions, was used to define expected disturbance areas for this project. A proposed footprint was not available for **Lonestar**, therefore, a probable disturbance area was inferred by digitizing areas of concentrated exploration activity within this mining claim from satellite imagery.

Quartz Exploration: All past, present, and future quartz exploration projects were assumed to be active throughout the life of this Project. Each project was assumed to have a 10 ha footprint around the project center, based on the project coordinates from the YESAB On-line Registry.

Placer mining: All past, present, and future placer projects were assumed to be active throughout the life of this Project. Disturbance areas were based on the placer land used permit areas for each project. Timing of placer mining is seasonal in the summer.

Roads: The spatial extent of disturbance due to roads was based on roads data from the YG. All features classified as roads or limited-use-roads were included. Roads were categorized as paved all-season, unpaved all-season, or unpaved seasonal according to shapefile attributes. Each road category was assigned a width following EDI 2013 (i.e., paved roads – 20 m and unpaved – 8 m), and lines were converted to polygons using these widths.

General disturbance: Data from the YG that maps existing surface disturbances based on high resolution satellite imagery was included to capture spatial footprints of settlements and forestry projects (Unpublished data, YG 2016). Including this spatial layer also ensures that estimates in the CEA incorporate any present and past habitat effects associated with other projects and activities that were not captured in the Project and Activity Inclusion List in the Project Proposal (**Section 5.0 Effects Assessment Methodology**).

Given the assumptions identified above, past, present, and reasonably foreseeable future projects (including Coffee Creek Project) and activities could directly affect 493 km² of habitat within the RAA, which represents approximately 9.5% of Vegetation habitat within the RAA (**Table 5.7-1**) that would be lost. New disturbance from the Project contributes approximately 0.4% to the cumulative disturbance footprint.

The majority of cumulative habitat loss in the RAA is associated with placer claims (i.e., placer claims cover 443 km² of the RAA). Not all of the placer claims within the RAA will be developed during the life of this Project. Placer claims that are developed are unlikely to convert the entire claim area to placer mining. The estimates for habitat loss and reduced habitat effectiveness in this CEA are considered extremely conservative. Even if all of the placer claims within the RAA were developed during the next 20 years, the actual habitat loss from these developments would likely be much smaller than the areas used for this CEA. Finally, the RAA for Vegetation is focused on the area immediately around the mine footprint and the NAR.

The NAR takes advantage of existing access roads used in placer mining; therefore, the RAA is biased towards more heavily developed areas within the larger region.

Table 5.6-1 Cumulative Vegetation Habitat Loss in the RAA

Baseline Habitat in RAA	Habitat Loss in RAA				Remaining Habitat in RAA	
	Other Anthropogenic Disturbances		Coffee Project			
km²	km²	% of RAA	km²	% of RAA	km²	% of Baseline
5,166	493	9.5	22	0.4	4,651	90

Ratings for the predicted residual cumulative effect on habitat loss were assigned following the effects characteristics outlined in **Table 4.4-1**. Detailed rationale for each residual effects characterization is provided (**Table 5.6-2**). Thresholds for assessing the magnitude of cumulative effects on habitat loss followed those outlined in **Table 4.4-1** with the assumption that all Vegetation (ecological communities, rare plants, traditional and medicinal plants and wetland habitats) may occur within the areas that interact cumulatively with the Project:

- Low: <10% of habitat loss
- Moderate: 10 – 50% of habitat loss
- High: >50% of habitat loss.

There will be a cumulative loss of Vegetation habitat within the RAA via direct habitat loss during construction; however, this loss could be partially reversed following successful reclamation of disturbed areas. Some of the disturbed habitat could be reclaimed to baseline conditions, which would fully reverse the effects of habitat loss, while other projects and activities (e.g. primary roads and highways) are expected to persist indefinitely. However, the cumulative loss of habitat in areas that cannot be fully reclaimed could be mitigated by the collective actions of individual project proponents, which could include minimizing/mitigating disturbances to Vegetation habitats and reclaiming key habitat areas if they are disturbed by anthropogenic activities. In addition, based on current known past, present and future projects within the RAA, it is unlikely that there will be enough large-scale anthropogenic disturbances to reduce Vegetation viability as a result of direct habitat loss. Anthropogenic disturbances can act cumulatively with natural disturbances such as fire, but the scale at which fires occur would mask any effect of industrial-related habitat losses. Considering mitigation and the low likelihood of large-scale anthropogenic disturbances in this landscape, the cumulative effect of habitat loss on Vegetation is not significant in the RAA (**Table 5.6-2**). In consideration of uncertainty regarding the lack of precise spatial data regarding the size of past, present, and reasonably foreseeable future projects and activities, the confidence in this prediction is moderate.

Table 5.6-2 Summary of Cumulative Effect Characteristics Ratings for Vegetation – Habitat Loss

Residual Cumulative Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	The effect would result in a direct loss of habitat
Magnitude	Low	Up to 9.5% of the vegetated area within the RAA could be affected by past, present, and reasonably foreseeable future projects within the RAA. The Coffee Project contributes an additional 0.4% loss of habitat within the RAA.
Geographic Extent	RAA	The effect would occur at the regional level
Timing	n/a	Habitat loss would occur only once for each project but the process could continuously occur over an extended period
Frequency	Infrequent	Of the 212 quartz and placer projects within the RAA, 192 are already active. Only 20 additional projects are proposed (i.e., 1 quartz project and 19 placer projects). Habitat loss would occur relatively infrequently. Most of these projects will likely be limited in spatial extent, located in areas that are already previously disturbed, and/or occur on a seasonal basis
Duration	Long-term	The direct loss of habitat would be a long-term loss
Reversibility	Partially reversible	Some of the disturbed habitat could be reclaimed when projects or activities are completed, while other projects and activities (e.g. primary roads and highways) are expected to persist indefinitely
Probability of Occurrence	Likely	Direct habitat loss has already occurred or is currently occurring due to a number of other projects and activities operating within the RAA. Future projects are currently planned and will likely result in direct loss of habitat
Context	Moderate	The ability of each ecological community or plant species to adapt to the direct loss of habitat will vary — some species are more resilient than others and some species could take longer to propagate and grow

5.6.3 Summary of Residual Cumulative Effects and Significance of Cumulative Effects on Vegetation

The CEA was conducted at the scale of the RAA for Vegetation. Project-related residual effects considered in the CEA included direct habitat loss. The projects and activities considered in the CEA included quartz projects, placer projects, and existing road networks. These projects and activities were selected based on their potential to interact cumulatively with other projects and activities within the RAA, including the Coffee Creek Project. Given the assumptions identified in **Section 5.6.2**, past, present and reasonably foreseeable future projects and activities could directly affect 493 km^2 (9.5%) of habitat within the RAA.

Although there will be a cumulative loss of vegetated habitat within the RAA via direct habitat loss, this loss could be partially reversed following successful reclamation of disturbed areas. Based on current known past, present and future projects within the RAA, it is unlikely that there will be enough simultaneously-occurring large-scale anthropogenic disturbances to reduce the amount of Vegetation as a result of direct habitat loss. Considering mitigation and the low likelihood of simultaneously occurring large-scale anthropogenic disturbances in this landscape, the cumulative effect of habitat loss on Vegetation is not significant (**Table 5.6-3**). In consideration of uncertainty regarding the lack of Vegetation mapping, and the lack of precise spatial data regarding the size of past, present and future projects and activities, the confidence in this prediction is moderate.

Table 5.6-3 Summary of Potential Residual Cumulative Effects on Vegetation

Potential Residual Adverse Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat loss	Quartz Projects Placer Projects Existing Road Network	Minimize project/activity footprints; use existing roads	A	L	RAA	n/a	I	L	P	L	M	N	M

Note: The following ratings are used for effects characteristics, as defined in **Table 4.4-1**:

Direction: A = Adverse, P = Positive
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: S = Site specific location within Project footprint, PF = Project footprint, L = Local (limited to LAA), R = Regional (limited to RAA)
Timing: n/a = no timing applicable, G = Growing season
Duration: LT = Long-term, ST = Short-term, PT = Permanent-term
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully reversible, P = Partially reversible, I = Irreversible
Context: L=Low, M=Moderate, H=High
Likelihood: L = Likely, U = Unlikely
Significance: NS = Not Significant, S = Significant
Level of Confidence: L = Low, M = Medium, H = High

6.0 SUMMARY OF EFFECTS ASSESSMENT ON VEGETATION

Vegetation was selected as a VC because Project activities will disturb, change, or remove vegetated areas, including habitat for traditional and medicinal plants, rare plants, and ecological and wetland communities. Project activities will generate emissions and fugitive dust which could lead to an increase in trace metals concentration in soils and plants which could have an adverse effect on Vegetation health, and activities may introduce or spread invasive plant species.

First Nations place value on all ecosystems and as such, all vegetated ecosystems that may interact with the Project were included in the assessment. Terrestrial ecosystems provide habitat for culturally important and harvestable plants, lichens, and at-risk components of regional, territorial, federal, national, or global biodiversity. Wetlands are important ecosystems because of their ecological, hydrological, biochemical, and habitat function role. Wetlands are known to play an important role in maintaining water quality and regulating water flow. Wetlands also provide habitat for a variety of flora and fauna, including rare or at risk species.

General Vegetation considerations included habitat loss and an increase in dust deposition. Concerns associated with effects of habitat loss were addressed with the subcomponents ecological communities, wetland habitats, traditional and medicinal plants, and rare plants. The risk of invasive plant species was addressed as a subject of note and will continue to be addressed through invasive species monitoring at the mine site. The potential increase in trace metal concentrations which could lead to a change in Vegetation health is considered as the effect of an increase in dust and emissions deposition on Vegetation adjacent to the Project footprint.

The assessment of Project-related effects on Vegetation was based on detailed ecological land classification and broad ecosystem mapping within the LAA, with reference to the likely occurrence of those mapped communities with the broader regional assessment area where detailed mapping was not available. Other information considered in the effects assessment included baseline information on rare plant occurrence. Potential Project-related effects considered included habitat loss (e.g., loss of some proportion of ecological communities, wetland habitats, traditional and medicinal use plants habitat, and rare plants habitat) and an increase in dust deposition.

The Project-related effects on Vegetation are limited to the Project's footprint due to clearing and to adjacent Vegetation due to dust deposition. The Vegetation found in the footprint and the LAA are common in the area, and there are no known rare, threatened, or unique ecological communities. Traditional and medicinal use plants found in the Project footprint are also common throughout the LAA. There are no COSEWIC or SARA-listed plant species known to occur in the area; however, four Watch-list species were found in the LAA, and the baseline studies conducted for this assessment have helped to provide more information on their range of occurrence in Yukon.

To mitigate habitat loss, Vegetation clearing will be minimized by restricting clearing and grubbing activities to the Project footprint. Where possible, Vegetation clearing activities will avoid periods of high hazard potential for wildfire. To mitigate habitat loss during the Operation phase, all movement of personnel and equipment will be restricted to the Project footprint and progressive reclamation of areas that are no longer used will occur. To mitigate the potential loss of rare plants, pre-clearing surveys for rare plants will be completed in probable rare plant habitat prior to construction activities should those activities occur during the growing season.

To mitigate changes to Vegetation health, dust control measures such as maintaining surface moisture, will be implemented. Also, wherever possible, speed limits will be enforced on roads such as the mine site access road. Water on-site will be controlled to prevent the release of metal-contaminated run-off from entering adjacent vegetated areas. No materials, hazardous or non-hazardous, will be dumped into vegetated areas. Parts of the mine site that are no longer required or used to stockpile soils will be revegetated or covered as soon as possible to prevent the spread of dust.

To mitigate the introduction and spread of invasive species, practical and proactive management recommendations will be followed such as restricting the movement of equipment and machinery from infested to non-infested areas. Disturbances of native Vegetation and exposed soil along roadsides will be minimized. Whenever possible all vehicles and equipment bound for the mine site should be free of soil, invasive plant parts and seeds. At the mine site, annual monitoring of high-risk areas will be conducted and any observed invasive species may be removed.

Following the successful application of all recommended mitigation measures, detectable residual Project-related effects are anticipated to occur from habitat loss, and change in Vegetation health due to roadside dust; however, no significant effects were identified for any of the Vegetation subcomponents. Although a residual effect might occur, the effect is unlikely to pose a risk to the long-term persistence and viability of Vegetation, including ecological communities, wetlands, and traditional/medicinal and rare plants at the local and regional level.

Residual cumulative effects due to interactions with other projects and activities were assessed for the Project at the scale of the RAA. The Project-related residual effect considered direct habitat loss within the region. The projects and activities considered in the CEA included quartz projects, placer projects, and existing road networks. These projects and activities were selected based on their potential to interact cumulatively with other projects and activities within the RAA, including the Coffee Creek Project. Past, present, and reasonably foreseeable future projects and activities could directly affect 9.5% of vegetated habitat within the RAA. These predictions are based on several assumptions and represent a conservative approach. It is unlikely that all quartz projects would operate at the same spatial extent as the Coffee Creek Project during the life of the Project, nor would they occur simultaneously. The estimated project footprint

for each placer mine is also conservative and may over-represent the area actually disturbed within each placer claim.

The amount of habitat lost is a rough estimate and not defined by ecological community or wetland community, because detailed ecological mapping is not available for the entire RAA. Although there will be a cumulative loss of Vegetation within the RAA via direct habitat loss, this loss could be partially reversed following successful reclamation of disturbed areas. The cumulative loss of habitat in areas that cannot be fully reclaimed could be mitigated by the collective actions of individual project proponents, which could include minimizing/mitigating disturbances (Vegetation clearing) and reclaiming areas if they are disturbed by project activities. Considering mitigation and the low likelihood of large-scale anthropogenic disturbances in this landscape, the cumulative effect of habitat loss on Vegetation is not significant within the RAA.

Potential residual effects due to accidents and malfunctions were also assessed in **Section 28 of the Project Proposal** for the Project. Accidents and malfunctions may occur during any phase of the Project. The objective of the Proponent is to minimize the likelihood of incidents and the associated consequences that might affect Vegetation. Potential accident and malfunction scenarios that may interact with, and result in potential adverse effects to Vegetation include: a hazardous material spill (i.e., cyanide or diesel fuel); water management structure failure (i.e., release of off-specification effluent); earthworks failure (i.e., failure of the heap leach facility and corresponding release of cyanide-contaminated water or failure of a waste rock storage facility); and an on-site or off-site fire or uncontrolled explosion leading to a stand-replacing wildfire. Although all of these potential scenarios could have consequences (i.e., significant residual effects) for Vegetation, particularly if they occur during the growing season, there is low probability of occurrence following the successful implementation of Project design measures, BMPs, and mitigation measures intended to minimize the risk of potential accidents and malfunctions.

7.0 EFFECTS MONITORING AND ADAPTIVE MANAGEMENT

The purpose of effects monitoring is to ensure compliance with all Proponent commitments made during Project planning and ensure that the Project is constructed and operates as described within the range of predicted effects. Effects monitoring and adaptive management programs for the Project are designed to:

- Verify the accuracy of the residual effects assessment where confidence in predictions was low to moderate, and
- Determine the effectiveness of proposed measures taken to mitigate the adverse effects of the Project.

Detailed effects monitoring plans for Vegetation during the all Project phases will be available in a VMP. And detailed effects monitoring plans for Vegetation during the Reclamation and Closure phase are available in the Project's Conceptual Reclamation and Closure Plan (**Appendix 31-C**). The monitoring plans provide for:

- Periodic measurement of the Project footprint
- Trace metal concentration in plant tissue — an indicator of potential effects on Vegetation (and animal health)
- Invasive plant species — presence within and immediately adjacent to the mine site.

Mitigation and monitoring strategies will be updated to maintain consistency with management plans and new best management practices that may become available during the life of the Project. Updates will also include consideration of management reviews, incident investigations, shared traditional or local knowledge, new or improved scientific methods, regulatory changes, or other Project-related changes.

Two of the key Vegetation monitoring plans are described below: monitoring for trace metals, and monitoring for invasive plant species.

7.1 TRACE METALS MONITORING

The objectives of the Vegetation and soil trace metals monitoring program are to:

- Monitor metals concentrations in both soils and Vegetation, particularly important forage plants (i.e., lichen, willow, and Lowbush Cranberry) near Project infrastructure
- Determine change in trace metal concentrations in soils and Vegetation from baseline conditions
- Assist in identifying whether any trends identified in metal uptake could be attributed to Project activities.

Exposure of Vegetation and soils surrounding the Project footprint to trace metals will be minimized by implementing the mitigation measures listed in **Section 4.3,** the Water Management Plan (**Appendix 31-V)** and a dust management plan. In addition, ongoing monitoring efforts will detect changes in trace metals concentrations in Vegetation and soils surrounding the footprint throughout the life of the Project. Trace metals monitoring will inform adaptive management actions to mitigate effects to Vegetation health. **Table 7.1-1** summarizes the trace metals monitoring plan components that will be expanded in a VMP.

Table 7.1-1 Vegetation and Soil Trace Metals Monitoring Plan Summary

Monitoring Plan Component	Description
Indicator species	Soil, Lichen, Willow, and Lowbush Cranberry
Measurable parameter	Metal and contaminants concentrations in soil and Vegetation
Key project interactions	Dust, effluent and air emissions released into the environment have the potential to affect Vegetation health. Dust and other contaminants may affect the survival of plant species (leading to changes in plant community composition and biomass) and if contaminants are absorbed by plants then they may be ingested by wildlife or humans, which may have an effect on the health of individuals.
Goal	The Project will not result in an increase in metal concentrations in Vegetation above identified thresholds.
Objectives	Quantify metals and cyanide levels in lichen, willow, and Lowbush Cranberry through continued monitoring throughout all Project phases.
Threshold	Threshold levels for each of the elements were determined based on a literature review of current guidelines, metal toxicity thresholds for Vegetation, and dietary tolerances of livestock. Refer to Table 7.4-4 in the VPP for project thresholds identified for trace metal concentrations in soils and Vegetation.
Frequency and scope of monitoring work	Local monitoring: Assess metal concentrations in soil and Vegetation across selected distances from the footprint: Adjacent (0-25 m), Near (75-250 m) and Far (1,500–2,500 m). Monitoring may occur every 2 years or as determined by: Changes to trace metals concentrations based on data collected during sampling; and Consideration of adaptive management required to mitigate effects to Vegetation health.
Monitoring site locations	Permanent plots will be located in suitable ecological community types based on presence on the landscape and tendency to support all of the species of interest. A power analysis will be completed to ensure enough plots are included to facilitate analyses.
Methodology and Analysis	Refer to VMP (**Appendix 31-S**) or soil and Vegetation collection methods. Vegetation and soil samples will be analyzed by an accredited laboratory for metals using Atomic Spectroscopy.

7.2 INVASIVE SPECIES MONITORING

The objectives of the invasive species monitoring program are to:

- Quantify the presence of invasive plant species within and adjacent to the mine site footprint through long-term monitoring
- Manage the introduction and prevent the spread of invasive plants at the mine site from Project activities associated with all Project phases; and
- Assess disturbed areas within and adjacent to the mine site to determine recolonization by plants, both invasive and/or native species.

Invasive plant introduction and spread in the mine site area will be minimized by implementing the mitigation and prevention measures listed in **Section 4.3**. In addition to mitigation measures, ongoing monitoring efforts will facilitate early detection and rapid response of invasive plants to track populations and direct management efforts throughout the life of the Project. Baseline invasive plant surveys of the mine site area are scheduled for the summer of 2016. **Table 7.2-1** summarizes the invasive plant monitoring plan components that will be expanded in a VMP.

Table 7.2-1 Invasive Plant Species Monitoring Plan Summary

Monitoring Plan Component	Description
Indicator	Invasive plant species
Measurable parameter	Occurrence of invasive plant species
Key project interactions	Introduction of invasive plant species can lead to the displacement of native species
Goal	The Project minimizes the potential introduction of invasive plant species to the mine site footprint or surrounding habitat
Objective	To quantify the occurrence of invasive plant species within and adjacent to the mine site footprint
Threshold	No introduction of invasive plant species to the mine site area as a result of Project activities
Frequency and Scope of monitoring work	Local monitoring: Surveillance of mine site footprint and adjacent habitat. Surveys to be conducted once per year through construction and initial operations or as triggered by observations of invasive plant species. Survey frequency may decrease through operations depending on monitoring results
Monitoring site locations	Site selection will include potential entry points and locations with high volume of humans, vehicles and equipment and locations with exposed soil, including mine infrastructure, roadsides, airstrip, and camp facilities.
Methodology	Targeted sample sites will by surveyed on foot, with some sections, such as roadside ditches, surveyed in a vehicle or utility transport vehicle (UTV) at slow speeds
Management	Remove invasive plants by hand pulling, mowing, or herbicide as required Dispose of invasive plants by incineration

7.3 ADAPTIVE MANAGEMENT

The results of the effects monitoring programs will be used to adaptively manage for any previously unanticipated adverse environmental effects of the Project, and/or to modify necessary mitigation measures as needed. Adaptive management is a planned, systematic process for continuously improving environmental management practices by learning about their outcomes. Situations that may require adaptive management to address unanticipated effects on Vegetation include:

- Exceedance of identified thresholds;
- Unexpected events (e.g., identification of listed rare plant within the footprint);

The predetermined thresholds for potential effects of the Project on Vegetation may include adverse effects to Vegetation as indicated by trace metals or invasive plant monitoring. Any unanticipated effects that are detected through monitoring or through other means, such as an accident, will be addressed with adaptive management measures including:

- If there is an increase in trace metal levels in Vegetation from baseline conditions that are approaching Project-specific thresholds, an investigation will be undertaken to identify exposure pathways and recommend improved mitigation measures.
- If invasive plant introduction and spread continue under the Project-specific invasive species management measures than an investigation will be conducted to identify if the pathway of entry can be determined; and if possible, changes will be made to reduce the possibility of further introduction (e.g., wash stations may be considered).
- If a listed rare plant is found during the construction or operations phase a Rare Plant Monitoring Plan will be developed in coordination with qualified personnel.
- If progressive reclamation activities are not meeting Project-specific revegetation predictions, a review of revegetation practices will be completed and revised protocols will be developed using all available monitoring data (such as soil fertility analysis and species-specific revegetation success).
- If an accident or malfunction occurs during any Project phase that results in direct or indirect damage to Vegetation within the LAA, specific Vegetation monitoring plans, and associated mitigations, will be developed as necessary.

Monitoring plans and mitigation measures will be updated and revised if needed, following results of the Project effects monitoring and will incorporate best management practices that may become available during the life of the Project.

8.0 REFERENCES

Adam, G., and H.J. Duncan. 1999. Effect of diesel fuel on growth of selected plant species. Environmental Geochemistry and Health 21: 353–357.

Adriano, D.C. 2001. Trace elements in terrestrial environments: biogeochemistry, bioavailability, and risks of metals. Second edition. Springer, New York, New York, USA.

Auerbach, N.A., M.D. Walker, and D.A. Walker. 1997. Effects of roadside disturbance on substrate and Vegetation properties in arctic tundra. Ecological Applications 7: 218–235.

Barbour, M.G., J.H. Burk, W.D. Pitts, F.S. Gilliam, and M.W. Schwartz. 1998. Terrestrial Plant Ecology. Third edition. Benjamin/Cummings, an imprint of Addison Wesley Longman, Menlo Park, CA, USA.

Bates, P. and S. DeRoy. 2014. The Firelight Group, with White River First Nation. White River First Nation Knowledge and Use Study. Prepared for Kaminak Gold Corporation, Vancouver, BC, Canada.

BC Wild and Environmental Mining Council of BC [BCW and EMCBC]. 2001. Acid Mine Drainage. Mining and Water Pollution Issues in BC. Environmental Mining Council of BC. http://www.protectfishlake.ca/media/amd.pdf. Accessed April 2016.

Canadian Council of Ministers of the Environment [CCME]. 1997. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines: Arsenic. Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada.

CCME. 1999a. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines: Cadmium. Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada.

CCME. 1999b. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines: Chromium. Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada.

CCME. 1999c. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines: Copper. Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada.

CCME. 1999d. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines: Cyanide (free). Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada.

CCME. 1999e. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines: Mercury. Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada.

CCME. 1999f. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines: Lead. Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada.

CCME. 1999g. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines: Zinc. Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada.

CCME. 2006. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada.

CCME. 2007. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines: Uranium. Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada.

CCME. 2009. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines: Selenium. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba, Canada.

Canadian Food Inspection Agency. 2008. Invasive Alien Plants in Canada: Summary Report. Canadian Food Inspection Agency, Ottawa, ON.

Canadian Wildlife Federation [CWF]. 2016. What impact do wildfires have on wildlife? http://cwf-fcf.org/en/discover-wildlife/resources/faq/faqs/what-impact-do-wildfires-have.html?referrer=https://www.google.ca/. Accessed April 2016.

Center for Invasive Plant Management [CIPM]. 2003. Invasive Plant Prevention Guidelines. Available at http://www.weedcenter.org/store/docs/CIPM_prevention.pdf. Accessed March 12016.

Cody, W.J. 2000. Flora of the Yukon Territory. Second edition. National Research Council of Canada, Ottawa, Ontario.

Dale, J.M. and B. Freedman. 1982. Lead and zinc contamination of roadside soil and Vegetation in Halifax, Nova Scotia. Proceedings of the Nova Scotia Institute of Science 32: 327–336.

Debano, L.F.1990. The Effect of Fire on Soil Properities. Soil Quality Monitoring and Long term ecosystem sustainability. http://forest.moscowfsl.wsu.edu/smp/solo/documents/GTRs/INT_280/DeBano_INT-280.php. Accessed April 2016.

Dobrowolsky, D. 2014. Hammerstones: A History of the Tr'ondëk Hwëch'in. A Tr'ondëk Hwëch'in Publication: Dawson City, Yukon, Canada.

Eisler, R. and S.N. Wiemeyer. 2004. Cyanide Hazards to Plants and Animals from Gold Mining and Related Water Issues. Reviews of Environmental Contamination and Toxicology 183: 21–54.

Eller, B.M. 1977. Road dust induces increase of leaf temperature. Environmental Pollution 13: 99–107.

Enserink, M. 1999. Biological Invaders Sweeps. Science 285:1834–1836.

Environment Canada. 2009. The Environmental Code of Practice for Metal Mines. Environment and Climate Change Canada. https://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=CBE3CD59-1. Accessed March 2016.

Farmer, A.M. 1993. The effects of dust on Vegetation: A review. Environmental Pollution 79: 63-75.

Forman, R.T.T., D. Sperling, J.A. Bissonette, A.P. Clevenger, C.D. Cutshall, V.H. Dale, L. Fahrig, R. France, C.R. Goldman, K. Heanue, J.A. Jones, F.J. Swanson, T. Turrentine, and T.C. Winter. 2003. Chapter 10. Wind and Atmospheric Effects. In Road Ecology: Science and Solutions. Island Press, Washington, D.C. 481 pages.

Foy, C.D. 1992. Soil chemical factors limiting plant root growth. Pages 97-149 in B.A. Stewart, Editor. Advances in Soil Science, Volume 19. Springer – Verleg, New York, USA.

Fraser Institute. 2012. What is acid rock drainage? http://www.miningfacts.org/ Environment/What-is-acid-rock-drainage/. Accessed April 2016.

Friend, M. and J.C. Franson, editors. 1999. Field Manual of Wildlife Disease – General Field Procedures and Diseases of Birds. U.S. Department of the Interior and U.S. Geological Survey. http://www.nwhc.usgs.gov/publications/field_manual/field_manual_of_wildlife_diseases.pdf. Accessed April 2016.

Gamberg, M. 2000. Contaminants in Yukon Country Foods. Unpublished report for the Department of Indian and Northern Affairs, Northern Contaminants Program. Whitehorse, YT.

Golder Associates. 2010. Literature Review of Current Fugitive Dust Control Practices within the Mining Industry. Submitted to The Centre for Excellence in Mining. Report Number: 09-1192-0105. Sudbury, Ontario. 46 pp.

Grantz, D.A., J.H.B. Garner, and D.W. Johnson. 2003. Ecological effects of particulate matter. Environment International 29: 213-239.

Jafarov, E.E., Romanosky, V.E., Genet, H., McGuire, A.D., and S.S Marchenko. 2013. The effects of fire on the thermal stability of permafrost in lowland and upland black spruce forests of interior Alaska in a changing climate. Environmental Research Letters. http://iopscience.iop.org/article/10.1088/1748-9326/8/3/035030/pdf. Accessed April 2016.

InterGroup Consultants Ltd. 2009. Socio-Economic Setting for the Proposed Mayo Hydro Enhancement Project (Mayo B). Submitted to Yukon Energy (February 2009).

International Cyanide Management Code [ICMCa]. 2015. About the Cyanide Code. http://www.cyanidecode.org/about-cyanide-code. Accessed April 2016.

Invasive Plant Council of British Columbia [IPCBC]. 2010. Best Practices for Managing Invasive Plants on Roadsides. https://www.th.gov.bc.ca/publications/eng_publications/environment/ManagingInvasivePlants.pdf. Accessed March 2016.

Kabata-Pendias, A. 2011. Trace Elements in Soils and Plants. CRC Press, Taylor and Francis Group, New York, New York, USA.

Lancaster, J. 2000. Alberta Native Plant Council Guidelines for Rare Plant Surveys. http://www.anpc.ab.ca/downloads.htm. Accessed March 2016.

MacKenzie, W.H. and J.R. Shaw. 2000. Wetland classification and habitats at risk in British Columbia. Proceedings of a conference on the biology and management of species and habitat at risk.

Matheus, P. and T. Omtzigt. 2013. Yukon Revegetation Manual Practical Approaches and Methods. https://www.yukoncollege.yk.ca/downloads/front_Chapter_1-17.pdf. Accessed March 2016.

McCune, D.C. 1991. Effects of airborne saline particles on Vegetation in relation to other variables of exposure and other factors. Environmental Pollution 74: 176–203.

Mishler, C. and W.E. Simeone. 2004. Han: People of the River. University of Alaska Press, Fairbanks, Alaska, USA.

Na-Cho Nyak Dun. 2008. Tan Sothan — A Good Path: Integrated Community Sustainability Plan (May 2008).

National Wildlife Federation [NWF]. 2016. Acid Mine Drainage: A Threat to Michigan's Water Quality. Factsheet available from: https://www.nwf.org/~/media/PDFs/Regional/Great-Lakes/Acid_mine_drainage_ factsheet.ashx [accessed 27 April 2016].

Njoku, K.L., M.O. Akinola, and B.G. Taiwo. 2009. Effect of gasoline diesel fuel mixture on the germination and the growth of *Vigna unguiculata* (Cowpea). African Journal of Environmental Science and Technology 3: 466-471.

Padgett, P.E., D. Meadows, E. Eubanks, and W.E. Ryan. 2008. Monitoring fugitive dust emissions from off-highway vehicles traveling on unpaved roads and trails using passive samplers. Environ Monit Assess, 144:93–103.

Parks Canada. 2009. Fire Management. http://www.pc.gc.ca/eng/progs/np-pn/eco/eco5.aspx. Accessed April 2016.

Patorcrzyk-Pytlik, B. 2009. The content of selenium in some species of meadow plants. Journal Elementology 14: 745–753.

Polster, D.F. 2005. The Role of Invasive Plant Species Management in Mined Land Reclamation. Canadian Reclamation, Summer/Fall 2005: 24–32.

Popadynec, R. 2009. (First Nation of Na-Cho Nyak Dun). A time of Bear Roots.

Pyke, C.R. and K.J. Havens. 1999. Distribution of invasive reed *Phragmites australis* relative to sediment depth in a created wetland. Wetlands 19: 283–287.

Sayers, P., J. Hall, and I. Meadowcroft. 2002. Towards risk-based flood hazard management in the UK. Proceedings of the Institution of Civil Engineerings. Civil Engineering, 150:36–42.

Solomonson, L.P. 1981. Cyanide as a possible metabolic inhibitor. Pages 11-28 in Vennesland, B., E.E. Conn, C.J. Knowles, J. Westley, and F. Wissing, Editors. Cyanide in Biology. Academic Press, New York, USA.

Spatt, P.D. and M. Miller. 1981. Growth conditions and vitality of Sphagnum in a tundra community along the Alaska Pipeline Haul Road. Arctic 34: 48–54.

Suitor, M. 2015. Kaminak Gold Corporation at Coffee Creek – Dawson Goldfields Access Considerations; Wildlife Baseline Data Recommendations Prepared for Environmental Dynamics Inc. Yukon Fish and Wildlife Branch.

Towill, L.E., J.S. Drury, B.L. Whitfield, E.B. Lewis, E.L. Galyan, and A.S. Hammons. 1987. Reviews of the Environmental Effects of Pollutants: V. Cyanide. 600/1-78-027. USEPA, Washington, D.C., USA.

Tr'ondëk Hwëch'in Heritage Department. 2011. Tr'ondëk Hwëch'in Best Practices for Heritage Resources. http://www.trondek.ca/downloads/THBestPractices.pdf. Accessed March 2016.

Tr'ondëk Hwëch'in. 2012a. Coffee Creek Traditional Knowledge Survey, Final Report (December 2012)

U.S. Department of Commerce [USDC]. 2016. Oil Types. http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/oil-types.html. Accessed April 2016.

U.S. Environmental Protection Agency [USEPA]. 1980. Ambient water quality criteria for cyanides. 440/5-80-037. USEPA, Washington, DC, USA.

U.S. Fish & Wildlife Service [USFWS]. 2004. Effects of oil spills on wildlife and habitat – Alaska region. http://okaloosa.ifas.ufl.edu/MS/OilSpillFactSheetAlaska.pdf. Accessed April 2016.

University of Alaska Fairbanks [UAF]. 2014. Best Management Practices: Controlling the Spread of Invasive Plants during Road Maintenance. Available at http://aknhp.uaa.alaska.edu/big-files/AKEPIC/Publications/2014/Graziano%20et%20al.%202014%20BMPs.pdf. Accessed March 2016.

Walker, D.A. and K.P. Everett.1987. Road Dust and Its Environmental Impact on Alaskan Taiga and Tundra. Restoration and Vegetation Succession in Circumpolar Lands: Seventh Conference of the Comite Arctique International. Artic and Alpine Research, 19(4):479–489.

Walker, D.A. and K.P. Everett. 1991. Loess ecosystems of northern Alaska: regional gradient and toposequence at Prudhoe Bay. Ecological Monographs 61: 437–464.

Wilcove, D.S., D. Rothstein, D. Jason, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. BioScience 48: 607–615.

Yukon Chamber of Mines. 2010. Yukon Mineral and Coal Exploration Best Management Practices and Regulatory Guide. http://www.yukonminers.ca/index.php/resources/best-management-practices. Accessed March 2016.

Yukon Conservation Data Centre, Environment Yukon [Yukon CDC]. 2015. http://www.env.gov.yk.ca/animals-habitat/documents/plant_watch_list_2015.pdf. Accessed March 2016.

Yukon Conservation Data Centre, Environment Yukon [Yukon CDC]. 2014. Rare Plant Information Sheets. http://www.env.gov.yk.ca/animals-habitat/documents/Species_RarePlants_2014.pdf. Accessed April 2016.

Yukon Ecoregions Working Group [YEWG]. 2004. Klondike Plateau. Pages 159-168 in C.A.S. Smith, J.C. Meikle and C.F. Roots, Editors. Ecoregions of the Yukon Territory: Biophysical properties of Yukon landscapes, Agriculture and Agri-Food Canada, PARC Technical Bulletin No. 04-01, Summerland, British Columbia, Canada.

Yukon Environmental and Socio-economic Assessment Board (YESAB). 2005. Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions. v 2005.11. http://www.yesab.ca/wp/wp-content/uploads/2013/04/Proponents-Guide-to-Info-Requirements-for-EC-Project-Submission.pdf. Accessed December 2015.

Yukon Government, Environment Yukon [YG]. 2012. Invasive plants by invasiveness. Available from: http://www.env.gov.yk.ca/animals-habitat/invasiveplants.php. Accessed August 6, 2015.

Yukon Government, Environment Yukon [YG]. 2011. Best Management Practices for Works Affecting Water in Yukon. Water Resources Branch, Government of Yukon. http://www.env.gov.yk.ca/publications-maps/documents/bestpractes_water.pdf. Accessed March 2016.

Yukon Government, Environment Yukon [YG] 1999. Focus on Ecosystems. Pages 105-124. In Environment Yukon. State of the Environment Report. Yukon Department of Renewable Resources, Planning and Policy Branch, Whitehorse, Yukon. Accessed March 2016 at: http://www.env.gov.yk.ca/publications-maps/report-archive.php

Yukon Invasive Species Council [YISC]. 2015a. Managing Weeds and Invasive Plants. http://www.yukoninvasives.com/pdf_docs/Acerages_new2sm.pdf. Accessed March 2016.

YISC. 2015b. Resources. http://www.yukoninvasives.com/plants.html. Accessed March 2016.

8.1 PERSONAL COMMUNICATIONS

Becker, N. 2016. Natural Resources and Heritage Analyst – Coffee Gold Project. Memo to EDI titled TH Initial Input on Wildlife and Wildlife Habitat Management Plan. Dated April 1, 2016.

Bennett, B. 2016. Coordinator, Yukon Conservation Data Centre (Yukon CDC), phone communication, Whitehorse, Yukon. Dated April 2016.

Suitor, M. 2015. Dawson District Regional Biologist (Yukon Government). Personal communication with EDI, April 20, 2015.

Tr'ondëk Hwëch'in (TH) Technical Working Group (TWG) meeting, April 12 and 13, 2016. Dawson, Yukon.

8.2 SPATIAL DATA REFERENCES

GeoYukon. 2015. Transportation: Roads – National Road Network [ArcGIS geodatabase – feature class]. Yukon Government – Highway and Public Works, Geomatics Yukon, 2015. Available: http://mapservices.gov.yk.ca/GeoYukon/. Accessed September 2015.

Yukon Government [YG]. 2016. SurfaceDisturbanceMaster.gdb [ArcGIS geodatabase – feature class]. Information Management and Technology Branch, Environment Yukon. Unpublished spatial data received: April 5, 2016.