Canadian Zinc Corporation

RECLAMATION ASSESSMENT, INVASIVE AND RARE PLANT SURVEY 2010
PRAIRIE CREEK MINE ACCESS ROAD, NT

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EXECUTIVE SUMMARY

Canadian Zinc Corporation (CZN) contracted EBA Engineering Consultants Ltd. (EBA) in August 2010 to complete an invasive plant survey and a reclamation assessment along the Prairie Creek Mine access road (access road) and a rare plant survey along proposed road re-alignments. Surveys were conducted from August 9 to 13, 2010. The study area for these surveys included that section of the access road occurring within the boundaries of the expanded Nahanni National Park Reserve.

No invasive alien plant species were documented along the access road surveyed; consequently, they are not believed to be an issue at this point in time. Vegetation reclamation is occurring through natural processes. Species composition of the plant species re-colonizing the access road is similar to that of adjacent habitats, which are providing the seed source for the reclamation process.

CZN was proposing two new road alignments, called Wolverine Pass and Polje By-Pass. Interest in developing the proposed Wolverine Pass re-alignment was terminated based on ground stability issues; consequently, it was not surveyed for sensitive plant communities or rare plants. The second re-alignment, the proposed Polje By-Pass, was surveyed for unique or important vegetation communities and rare plants. The habitat in which the proposed Polje By-Pass re-alignment traverses was burned by a forest fire in 1996. The vegetation community now comprises a jack pine regeneration stand approximately 14 years old. No rare plants or sensitive habitats were documented within the jack pine regeneration along the proposed Polje By-Pass alignment. This proposed alternative alignment will not threaten rare plants or sensitive vegetation communities.

In summary, invasive plant species were not observed along the access road and do not present a problem at this time. Natural vegetation reclamation is progressing well and is representative of adjacent habitats. No rare plants or sensitive plant communities were recorded along the proposed Polje By-Pass alignment.

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1.0 INTRODUCTION

Canadian Zinc Corporation (CZN) contracted EBA Engineering Consultants Ltd. (EBA) in July 2010 to conduct a vegetation reclamation and invasive species assessment of the Prairie Creek Mine access road (access road), and a rare plant survey along proposed road re-alignments. Surveys were undertaken inside the Nahanni National Park Reserve (NNPR) and were designed in consultation with Parks Canada (PC) staff.

The 170 kilometre (km) long access road was constructed in 1980 to link the Prairie Creek Mine with the Liard Highway (Figure 1). Since 1982, transport along most of the access road has not occurred and the road has naturally re-vegetated. With present intentions to re-open the access road as a transport link for mineral concentrates and supplies to and from the Prairie Creek Mine, these surveys were intended to document plant species and determine whether additional mitigation measures to reduce impacts on rare plants are required, and to assist with reclamation plan development.

1.1 OBJECTIVES

The objectives of this project were to conduct an invasive species and vegetation reclamation assessment of the access road, and assess the potential for rare plants to occur along two proposed road re-alignments.

The first objective, invasive species and vegetation reclamation assessment of the access road, required the following:

- Design a study to collect information on the status of invasive species and vegetation reclamation on the access road within NNPR to natural species;
- Collect information to assess the potential for invasive plant species; and
- Describe natural reclamation relative to adjacent vegetation communities and discuss which types may require additional reclamation efforts.

The second objective, a rare plant survey along the proposed road re-alignments, required the following:

- Describe and compare the potential impacts on rare plants or rare vegetation communities along the proposed re-alignments.

2.0 METHODS

2.1 INVASIVE SPECIES ASSESSMENT

Methodology used for the invasive alien plant survey involved a quantitative approach. Survey design was fine-tuned to accommodate local conditions[1]. The finer points of sampling methodology were adapted for the nature of the survey, *i.e.* the patchy distribution of the species of interest (invasive species), the nature of the mature forest adjacent to the access road, and the age of road bed (1981).

Community types surveyed were selected from an existing habitat classification. The composition of plant communities was determined from visual inspection of sites and subjectively assessed as being representative of a particular targeted community type.

The sample unit was a single 100 metre (m) transect, consisting of consecutive quadrats placed along a tape measure. The tape measure was laid out along the ground perpendicular to the road corridor and secured with pegs held under tension by means of stretch cords. Transects were systematically placed along the road corridor at 250 m intervals.

A 100 m buffer was used from the edge of a community type to avoid edge effects. Starting at the origin (centreline of the access road), a circular quadrat of 5 m radius was placed tangentially on one side of the tape. The centre of the first quadrat represented 0 m along the transect. Consecutive quadrats were placed at 15 m intervals, thus 5 m between quadrat boundaries. Up to 11 quadrats were to be employed along a transect, where warranted. However, if after two consecutive quadrats there were zero detections of invasive alien plants, then sampling for that transect was terminated. The method employed was an adaptation from Daubenire's methodology for vegetation analysis with the use of a two-dimensional reference frame of fixed size.

Each quadrat was marked off using 76 centimetre (cm) (30 inch) pins with flagging. Four pins were placed around the perimeter of a given quadrat, with a fifth pin in the centre. Surveyors envisioned the circular boundary of the quadrat between the pins. All invasive alien plant species were to be recorded on standardized data forms. The objective was to document invasive species occurring within the quadrats. However, invasive species found incidentally along the road corridor were also to be recorded.

The survey objective was to determine the presence of invasive alien plants, the frequency in which they occur, and how their frequency diminishes from the point of origin (centreline of the access road). Therefore, alien plant species were to be recorded in each quadrat. Frequency was to be calculated as the percentage of quadrats containing the species of interest.

[1] Survey methodology was adjusted to the local site conditions, *e.g.* number of sample units, systematic placement of transects, distance between successive quadrats, number of quadrats per sampling unit, and the size of the quadrat (5 m radius).

For each sampling unit, the following information was entered onto a standardized data form: site number and location, Universal Transverse Mercator (UTM) coordinates (from a Global Positioning System (GPS); Map Datum North American Datum 83), date, topographic position, slope, aspect, dominant vegetation type, percent closed canopy, ground cover, moisture regime, elevation, plant community type, plant species present. For each quadrat, only invasive alien plant species were to be recorded. All vascular plants were identified on site. Representative samples of invasive alien plants were to be collected, as well as other species that might be difficult to identify in the field. These were to be identified later under magnification with the aid of taxonomic guides.

Prior to going into the field, a plant list of targeted invasive alien plant species was assembled with the help of PC and Dr. Suzanne Carrière, Ecosystem Management Biologist with the Wildlife Division of the Department of Environment and Natural Resources (ENR), Government of the Northwest Territories (GNWT). Information on these species, photographs and their respective habitat requirements were assembled into a binder and studied prior to going into the field. The binder was used in the field to aid in proper identification. In addition, the list of invasive alien species was reviewed prior to the start of each transect.

The species list was based on range maps found in taxonomic guides and environmental reports. The list was created using the rare plants of the NWT from the National Herbarium in Ottawa, *Vascular Plants of Continental Northwest Territories* (Porsild and Cody 1980), *Rare Vascular Plants in the Northwest Territories* (McJannet *et al.* 1995) and other reports including Beak Consultants Ltd. (1981) and Ker, Priestman and Associates (1980). In addition, any plant species potentially occurring within 150 km of the corridor was included. The resulting list contained approximately 300 plants known to occur, or hypothetically occur, in the area. A species hypothetically occurring in the area includes plants whose distribution covers, or is adjacent to, the study area but has not yet been documented on site.

Common names of species have been used where possible, for those that do not have common names Latin nomenclature was used. Plant species nomenclature follows current standards (Working Group on General Status of NWT Species (ENR 2010)). In a few cases where plant names were not listed by ENR, nomenclature followed Cody (2000) or Porsild and Cody (1980). By convention, common names of plants typically begin with lower case letters. In some cases, the genus name is used as a common name with the first letter capitalized. These conventions were followed in this report.

2.2 VEGETATION RECLAMATION

Methodology used to document the status of vegetation reclamation along the access road consisted of recording the species occurring on the road surface and those species occurring in adjacent habitat, and then comparing the two species lists. Aerial photographs were taken for each point surveyed on the ground along with the adjacent community types. In

addition, the entire road corridor within the NNPR boundary was photographed showing the present state of the reclamation status with that of adjacent habitat.

2.3 RARE PLANT SURVEY ALONG THE PROPOSED ROAD RE-ALIGNMENTS

The approach to this study component involved searching for rare plants or sensitive habitats along the proposed road alignment. A digital facsimile of the proposed road alignments were uploaded onto a GPS, providing the survey team with a line to follow across the landscape while searching for rare plants or sensitive habitats. Plant species designated with special conservation status[2] by ENR, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and the federal *Species At Risk Act* (SARA) were the main focus of this survey.

3.0 RESULTS

Steve Moore of EBA and one field assistant from CZN conducted vegetation surveys along the access road occurring within the boundaries of NNPR from August 9 to 13, 2010. Vascular plants were identified on site. Representative samples were collected for select species that were difficult to identify in the field such as willows, sedges and grasses, which were later identified under magnification with the aid of taxonomic guides. No one taxonomic plant key is comprehensive enough to adequately address all genera. Certain dichotomous plant keys provide better treatment of select genera than other texts, and are typically based on the author's research experience. Consequently, an array of dichotomous plant keys were utilized in identifying plant species, including Aiken *et al.* (2008), Argus *et al.* (1999), Argus (2004a and 2004b), Argus (1973), Brayshaw (1976), Cody (2000), Douglas (1982, 1995), Hurd *et al.* (1998), Moss (1977), Porsild and Cody (1980), and Trelawny (2003).

Datasheets were filled out for each site. A series of photographs were taken depicting the most representative aspects of a given community type. UTM coordinates were collected and stored using a Garmin 12 CX GPS and recorded on the datasheets.

3.1 INVASIVE SPECIES ASSESSMENT

A previous habitat classification was completed by Beak Consultants Ltd. (Beak 1981). Despite being 30 years old, little has changed within the study area and the habitat classification is still relevant, accurate, highly functional and readily recognizable in the field; consequently, it was employed for these surveys.

Based on the existing habitat classification eight community types occur along the access road within the boundaries of the NNPR, and include: Alpine Tundra, Subalpine Shrub, Spruce-Lichen, Black Spruce Parkland, Riparian Alluvial, Pine Parkland, Mixed Conifer-

[2] Species with special conservation status include those designated as May Be At Risk, At Risk, Special Concern, Threatened, and Endangered.

Deciduous, and Black Spruce Muskeg. Seven of the eight community types were surveyed. The eighth community type, Black Spruce Muskeg, was not surveyed due to accessibility issues. The helicopter was not able to land within reasonable hiking distance from this community type.

Twenty-four sampling stations were established along the access road corridor (Figure 2). No invasive alien plant species were documented along the access road alignment surveyed. A number of indigenous colonizers were present along the access road, as expected. One particular species, Pumpelly Brome (*Bromus pumpellianus*), was documented as commonly growing along the access road and needs further elaboration. This species of grass is similar to awnless brome (*B. inermis*), an exotic/alien species, but was distinguished from it based on stem and inflorescence characteristics[3] (Appendix A). Pumpelly brome was observed growing along the roadway, while the invasive, awnless *B. inermis* was not detected.

3.2 VEGETATION RECLAMATION

Vegetation reclamation work consisted of documenting the vegetation growing along the access road within the NNPR. Documentation occurred at each of the invasive plant survey sites, plus additional sites as deemed appropriate. Documentation occurred on the ground and aerial photographs were also taken. Plant species growing on the access road were recorded, followed by documentation of plant species present in adjacent community types. As in the invasive plant survey, a 100 m buffer was used from the edge of a community type to avoid edge effects. The same eight community types were surveyed with the exception of Black Spruce Muskeg and Riparian Alluvial. Black Spruce Muskeg was not surveyed due to accessibility issues. The Riparian Alluvial community type was not surveyed in context to vegetation reclamation work as it occurs on gravel bars and along stream edges in braided streams, a community type that is altered on an annual basis through erosion and ice-gouging during spring melt.

The road was built in 1981 and used over two winter seasons. In recent history, a small section of the road has been periodically maintained by CZN from the proposed mine site over the mountain pass and including an eight km section within the new NNPR boundary. Plant reclamation by native species has been occurring through natural processes along the access road. The revegetation process is proceeding naturally, establishing and filling in with native species from adjacent vegetation communities (Photographs 1 and 2). The entire access road has been re-colonized by vegetation from adjacent plant communities. The success of the revegetation is due, to a large extent, to the fact that the organic layer was never compromised (*i.e.* not scraped off) during initial road construction, except in a few locations.

[3] The invasive alien *B. inermis* is similar to *B. pumpellianus*, differing chiefly by its non-hairy nodes, glabrous or somewhat scabrous, and typically awnless lemmas.

3.2.1 Alpine Tundra

The access road passes through the new NNPR boundary, starting in the Alpine Tundra community type and proceeding down contour into the other community types, as mentioned above. A short section of road (outside the NNPR boundary) traversing the Alpine Tundra was re-routed to the opposite side of a creek, providing an excellent opportunity for studying the reclamation process since road abandonment. The status of the reclamation process in the Alpine Tundra community type can be seen in Photographs 3 and 4. After 28 years, the original road surface is advancing towards a climax Alpine Tundra community, with a few exceptions where talus slides have periodically reversed this process.

The plant species present on the access road surface are similar to that in adjacent habitat (Table 1). Reclamation along the road surface within the Alpine Tundra community type is developing towards an advanced seral stage with pockets of exposed mineral soil. Species representation is similar to that in adjacent habitats. Based on field observations of the abandoned section of road within the Alpine Tundra, reclamation will occur naturally once the existing road is left undisturbed.

3.2.2 Subalpine Shrub

The access road passes through a small segment of Subalpine Shrub community type, approximately 5 km in length. This section of road has undergone periodic maintenance since 1982 and has not had an opportunity to re-colonize (Photograph 5). Despite periodic disturbance, willows and horsetails are encroaching across the surface from adjacent habitat (Photograph 6).

Natural reclamation along this section of road within the Subalpine Shrub community type is at a younger seral stage due to periodic disturbances. Reclamation is slowly occurring by colonizing species such as willow, horsetail, and fireweed (Table 1). Source seed for the reclamation is from adjacent habitat units. Based on field observations, this section of road will re-colonize from adjacent sources once the existing road is left undisturbed.

3.2.3 Spruce-Lichen

The Spruce-Lichen community represents a climax community occurring on relatively stable colluvial slopes from the valley bottom to the upper slopes. This community is susceptible to natural disturbances through snow slides. The climax stage is represented by tall spruce trees and a well developed mat of lichen (*Cladina stellaris*) (Beak 1981).

Very little of the access road occurs within the Spruce-Lichen community type, but passing tangentially by a few small polygons of habitat. Because the Spruce-Lichen community occurs on steep slopes (Photograph 7), portions of the road bed had been placed at the foot of the steep-sloped Spruce-Lichen community, along the edge of the Riparian Alluvial communities (Photograph 8). Small sections of the existing access road that pass through this community type, or along its edges, are naturally re-colonizing with native species but

are presently at a young seral stage. This section of road in photograph 8 has been exposed to disturbance through periodic maintenance since 1982, yet reclamation is occurring and species similar to the original community type, such as spruce, are becoming re-establishing on the access road. The herbaceous layer is re-colonizing along with some shrubs (willows – *Salix glauca*). The occasional small spruce is present on the road bed, indicting that spruce regeneration is naturally occurring (Table 1). Source seed for the reclamation is from adjacent habitat. Based on field observations the community will naturally reclaim the access road over time and, if left undisturbed, will develop in to a Spruce-Lichen community.

3.2.4 Black Spruce Parkland

The Black Spruce Parkland community type is the predominant cover type occurring along the roadway within the new NNPR boundary. Although this community type is named Black Spruce Parkland, white spruce commonly occur on the better drained sites. Beak (1981) found that species diversity was limited to 20 species.

The section of the access road occurring within the Black Spruce Parkland community type has not been disturbed over the last 28 years and natural reclamation is well established with a dense stand of trees. The advanced state of reclamation along this section of the road is evident in Photographs 9 and 10. After 28 years, the habitat along the access road is developing towards a mature Black Spruce Parkland community. The plant species present on the access road are similar to those in adjacent habitat (Table 1) (Photographs 11 and 12). Based on field observations of the section of road within the Black Spruce Parkland community type, reclamation will occur naturally once the existing road is left undisturbed.

3.2.5 Pine Parkland

The access road traverses approximately 10 km of Pine Parkland community type within the new NNPR boundary. This community type occurs on well-drained upland areas and characteristically has a more open tree canopy with significant coverage of *Cladonia* lichen (Photograph 13). Jack pine is the predominant tree species with smaller amounts of white and black spruce.

This section of the access road has not been disturbed over the last 28 years and reclamation is well underway as can be seen Photograph 14. The plant species present on the access road bed are similar to those in adjacent habitat (Table 1). Based on field observations of the abandoned section of road within the Pine Parkland, reclamation will occur naturally once the existing road is left undisturbed.

3.2.6 Mixed Conifer-Deciduous

The access road traverses approximately 19 km of Mixed Conifer-Deciduous community type within the NNPR. This community type represents a post-fire successional forest comprising of aspen, birch, spruce, jack pine, alder and willow. Forest regeneration has

produced a dense stand of mixed trees limiting access to this section of the access road (Photographs 15 and 16).

Natural reclamation along this section of road within the Mixed Conifer–Deciduous community type is well underway (Table 1). Source seed for the reclamation is from adjacent habitat units. Based on field observations this section of road is naturally regenerating as a mixed conifer-deciduous community type from adjacent habitats.

3.2.7 Riparian Alluvial

The Riparian Alluvial community type occurs in the bottom of valleys and consists of vegetated gravel bars within the braided streams. This community type undergoes annual disturbance in the form of erosion and ice-gouging during spring runoff; consequently, it was not assessed in the context of reclamation. Regular disturbance is a natural, recurring event and the species present reflect this situation (Photographs 17 and 18).

3.2.8 Black Spruce Muskeg

The access road traverses a small segment of Black Spruce Muskeg community type. The Black Spruce Muskeg community type was not surveyed due to accessibility issues.

3.3 RARE PLANT SURVEY ALONG THE PROPOSED ROAD RE-ALIGNMENTS

The objective was to survey the two proposed alternative road alignments called Polje By-Pass and Wolverine Pass (Figure 2). However, once in the field, CZN re-examined the proposed Wolverine Pass alternate road alignment and decided to not pursue that option, thus leaving only the proposed Polje By-Pass alignment to be surveyed for rare plants and sensitive habitats.

The entire proposed Polje By-Pass road alignment was flown three times, examined from the air, and then surveyed, in its entirety, from the ground. The ground crew hiked the proposed road alignment with the aid of a GPS while searching for rare plants and sensitive habitats. Plant species designated with special conservation status (see Section 2.1.3) were the main focus of this survey. Sensitive habitats (*e.g.* unique or important vegetation communities) that might be impacted by the proposed road alignment were also considered and were to be documented and assessed.

The habitat for which the proposed Polje By-Pass road alignment traverses was subjected to a forest fire in 1996 (Kochtubajda *et al.* 2006) that completely burned the majority of standing timber. The only trees to survive the fire were those located adjacent to creeks, in the riparian zones. A jack pine forest has established itself following the fire (Photographs 19 and 20). The entire proposed Polje By-Pass road alignment passes through this community type, with the exception of two creeks where white spruce trees survived the fire. The width of these sites is highly variable, with one swath being only a few metres wide and the second one less than 10 m wide.

The community type consists of a jack pine regeneration stand approximately 14 years old. This fire regeneration stand is dominated by jack pine, averaging 1 to 1.5 m in height (Photograph 21 and 22) and represents an early seral stage. The shrub stratum canopy closure varied between 10 and 25 % and consisted of two layers, medium and low shrubs, consisting of dwarf birch/ willow and cranberry, respectively. Dwarf birch and willow height varied but was typically less than 2.0 m, except in some of the depressions that contain ephemeral streams where they can reach over 2.0 m in height. Other shrub species occurred but had low relative dominance and included Labrador tea and cinquefoil. The herbaceous stratum was represented by bunchberry, twinflower, fireweed, grass (*Agrostis scabra*), *Arnica* spp., *Draba* spp., yellow lousewort (*Pedicularis labradorica*), and running clubmoss (*Lycopodium clavatum*). Ground cover includes various lichens/mosses and rock.

Many dead trees (snags) were left standing, and considerable debris, in the form of tree trunks and branches, remain on the ground, with patches of exposed mineral soil throughout. The vegetation present in this seral stage is typical of jack pine regeneration stands occurring in the Northwest Territories.

None of the plant species documented along the proposed Polje By-Pass are listed under SARA or COSEWIC, nor are they listed as being rare in McJannet *et al.* (1995). The proposed alternative route is approximately 500 m from a polje[4], which has the potential to contain sensitive habitats. These poljes, however, are permanently filled with water and no plants were observed.

4.0 DISCUSSION

4.1 INVASIVE SPECIES AND VEGETATION RECLAMATION ALONG THE ACCESS ROAD

Twenty-four sampling stations were established along the access road corridor (Figure 2). No invasive alien plant species were documented along the access road alignment; consequently, they are not believed to be an issue at this point in time.

Vegetation reclamation is occurring. Indigenous plant species are re-establishing themselves along the access road. Species composition along the access road is similar to that of adjacent habitat. Adjacent habitats are providing the seed source for the reclamation process. Therefore, vegetation reclamation is occurring naturally with indigenous species.

The reclamation process that has occurred over the last 28 years provides insight into how reclamation would likely occur once the currently proposed road development ceases operation. Over time the proposed road, once left undisturbed, will undergo natural reclamation with each section of road surface reflecting the plant species in adjacent habitat.

[4] Poljes are depressions in the ground that have formed in karst regions as a result of rock (*e.g.* limestone) dissolving in water. These landscape features sometimes form lakes and contain disappearing streams or underground rivers. Some poljes are known to contain unique communities of plants and animals.

This process would be further augmented by leaving the organic layer and herbaceous layer in place.

4.2 UNIQUE OR IMPORTANT VEGETATION COMMUNITIES ALONG THE PROPOSED POLJE BY-PASS AND WOLVERINE PASS RE-ALIGNMENTS.

Interest in developing the proposed Wolverine Pass re-alignment was terminated based on ground stability issues. CZN will not be pursuing re-aligning the road up to Wolverine Pass.

The proposed Polje By-Pass re-alignment was surveyed for unique or important vegetation communities and rare plants. The habitat in which the proposed Polje By-Pass re-alignment traverses has been burned by a forest fire in 1996. The vegetation community now comprises a jack pine regeneration stand approximately 14 years old. This fire regeneration stand is dominated by 1 to 1.5 m tall jack pine and a shrub stratum consisting of dwarf birch/ willow and cranberry. The ground cover consists of a mosaic of herbaceous plants, dead/ burnt timber and exposed mineral soil. This vegetation community is typical of jack pine regeneration stands following forest fires and commonly occurs across the Northwest Territories.

No rare plants or sensitive habitats were documented within this habitat along the proposed Polje By-Pass alignment.

4.3 SUMMARY

Natural vegetation reclamation is progressing well and is representative of adjacent habitats. Invasive plant species were not observed along the access road and do not present a problem at this time. No rare plants or sensitive plant communities were recorded along the proposed Polje By-Pass alignment.

5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of CZN and their agents. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than CZN, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in EBA's Services Agreement and in the General Conditions provided in Appendix B of this report.

6.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

Sincerely,

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TABLES

TABLE 1. COMPARISON OF PLANT SPECIES GROWING ON THE ACCESS ROAD AND ADJACENT HABITATS

Alpine Tundra		
Species Common in Adjacent Habitat to the Road		Species Recorded Growing on the Road
Common Name	Scientific Name	Common Name / Scientific Name
Entire-leaved Mountain Avens	*Dryas integrifolia*	Entire-leaved Mountain Avens
Arctic White Heather	*Cassiope tetragona*	Arctic White Heather
Dwarf snow willow	*Salix nivalis*	---
Net-veined Willow	*Salix reticulata*	Net-veined Willow
Black-and-White-Scale Sedge	*Carex albonigra*	Black-and-White-Scale Sedge
Alpine Bilberry	*Vaccinium uliginosum*	---
Rock Cranberry	*Vaccinium vitis-idaea*	Rock Cranberry
Alpine Knotweed	*Bistorta vivipara*	Alpine Knotweed
Moss Campion	*Silene acaulis*	Moss Campion
Lapland Rosebay	*Rhododendron lapponicum*	---
Field Locoweed	*Oxytropis campestris*	Field Locoweed
Narrow-leaved Labrador Tea	*Ledum palustre* ssp. *decumbens*	Narrow-leaved Labrador Tea
Arctic Pyrola	*Pyrola grandiflora*	Arctic Pyrola
Shrubby Cinquefoil	*Dasiphora fruticosa*	Shrubby Cinquefoil
Skeleton-leaved Willow	*Salix phlebophylla*	Skeleton-leaved Willow
Small-flower Anemone	*Anemone parviflora*	Small-flower Anemone
Gray willow	*Salix glauca*	Gray willow
Few Flower Meadow Rue	*Thalictrum sparsiflorum*	Few Flower Meadow Rue
Northern Wood Rush	*Luzula confusa*	Northern Wood Rush
Yellow Mountain Saxifrage	*Saxifraga aizoides*	Yellow Mountain Saxifrage
Scotch False Asphodel	*Tofieldia pusilla*	Scotch False Asphodel

TABLE 1. COMPARISON OF PLANT SPECIES GROWING ON THE ACCESS ROAD AND ADJACENT HABITATS (CONT'D)

Subalpine Shrub			
Species Common in Adjacent Habitat		Species Recorded Growing on the Road	
Common Name	Scientific Name	Common Name / Scientific Name	
Dwarf Birch	*Betula glandulosa*	---	
Common Labrador Tea	*Ledum groenlandicum*	---	
Gray willow	*Salix glauca*	---	
Shrubby Cinquefoil	*Dasiphora fruticosa*	---	
Alpine Bilberry	*Vaccinium uliginosum*	---	
Lapland Rosebay	*Rhododendron lapponicum*	---	
Common Bearberry	*Arctostaphylos uva-ursi*	---	
Alpine Bearberry	*Arctostaphylos alpina*	---	
Arctic Sagebrush	*Artemisia arctica*	**Arctic Sagebrush**	
Entire-leaved Mountain Avens	*Dryas integrifolia*	---	
Rough Fescue	*Festuca altaica*	**Rough Fescue**	
Blue-jointed Reed Grass	*Calamagrostis canadensis*	---	
Red Bearberry	*Arctostaphylos rubra*	---	
Small Cranberry	*Vaccinium oxycoccos*	---	
Variegated Horsetail	*Equisetum variegatum*	**Variegated Horsetail**	
Net-veined Willow	*Salix reticulata*	---	
Gray willow	*Salix glauca*	---	
Everlasting spp	*Antennaria sp.*	---	
Arctic White Heather	*Cassiope tetragona*	---	
Moss Campion	*Silene acaulis*	---	
Northern Wood Rush	*Luzula confusa*	---	
Small-flower Anemone	*Anemone parviflora*	---	
Alaska Willow	*Salix alaxensis*	**Alaska Willow**	
Chickweed spp	*Stellaria sp.*	**Chickweed**	
Rough Fescue	*Festuca altaica*	**Rough Fescue**	
---	---	**Few Flower Meadow Rue**	*Thalictrum sparsiflorum*
---	---	**Fireweed**	*Chamerion angustifolium*

TABLE 1. COMPARISON OF PLANT SPECIES GROWING ON THE ACCESS ROAD AND ADJACENT HABITATS (CONT'D)

Spruce-Lichen			
Species Common in Adjacent Habitat		**Species Recorded Growing on the Road**	
Common Name	**Scientific Name**	**Common Name / Scientific Name**	
White Spruce	*Picea glauca*	**White Spruce**	
Black Spruce	*Picea mariana*	**---**	
Dwarf Birch	*Betula glandulosa*	**Dwarf Birch**	
Shrubby Cinquefoil	*Dasiphora fruticosa*	**Shrubby Cinquefoil**	
Alpine Bilberry	*Vaccinium uliginosum*	**---**	
Gray willow	*Salix glauca*	**Gray willow**	
Lapland Rosebay	*Rhododendron lapponicum*	**---**	
Common Juniper	*Juniperus communis*	**---**	
Buffalo-berry	*Shepherdia canadensis*	**---**	
Common Labrador Tea	*Ledum groenlandicum*	**---**	
Common Bearberry	*Arctostaphylos uva-ursi*	**---**	
Red Bearberry	*Arctostaphylos rubra*	**---**	
Bulrush Sedge	*Carex scirpoidea*	**Bulrush Sedge**	
Rough Fescue	*Festuca altaica*	**Rough Fescue**	
Entire-leaved Mountain Avens	*Dryas integrifolia*	**Entire-leaved Mountain Avens**	
Alpine Bilberry	*Vaccinium uliginosum*	**---**	
Labrador Lousewort	*Pedicularis labradorica*	**Labrador Lousewort**	
Alpine Knotweed	*Bistorta vivipara*	**Alpine Knotweed**	
Alaska Wild Rye	*Elymus alaskanus*	**Alaska Wild Rye**	
---	**---**	**Green Alder**	*Alnus crispa* ssp. *crispa*

TABLE 1. COMPARISON OF PLANT SPECIES GROWING ON THE ACCESS ROAD AND ADJACENT HABITATS (CONT'D)

Black Spruce Parkland			
Species Common in Adjacent Habitat		**Species Recorded Growing on the Road**	
Common Name	**Scientific Name**	**Common Name / Scientific Name**	
White Spruce	*Picea glauca*	**White Spruce**	
Black Spruce	*Picea mariana*	**Black Spruce**	
Dwarf Birch	*Betula glandulosa*	**Dwarf Birch**	
Jack Pine	*Pinus banksiana*	**Jack Pine**	
Gray willow	*Salix glauca*	**Gray willow**	
Alpine Bilberry	*Vaccinium uliginosum*	**Alpine Bilberry**	
Prickly Rose	*Rosa acicularis*	**Prickly Rose**	
Common Labrador Tea	*Ledum groenlandicum*	**Common Labrador Tea**	
Common Bearberry	*Arctostaphylos uva-ursi*	---	
Blue-jointed Reed Grass	*Calamagrostis canadensis*	---	
Dwarf Dogwood	*Cornus canadensis*	**Dwarf Dogwood**	
Variegated Horsetail	*Equisetum variegatum*	**Variegated Horsetail**	
Shrubby Cinquefoil	.	---	
Everlasting spp	*Antennaria sp.*	**Everlasting spp**	
Alaska Wild Rye	*Elymus alaskanus*	**Alaska Wild Rye**	
---	---	**Fireweed**	*Chamerion angustifolium*
---	---	**Green Alder**	*Alnus crispa* ssp. *crispa*
---	---	**Field Horsetail**	*Equisetum arvense*
---	---	**Rock Cranberry**	*Vaccinium vitis-idaea*
---	---	**Downy Lyme Grass**	*Leymus innovatus*
---	---	**Running Clubmoss**	*Lycopodium clavatum*
---	---	**Littletree Willow**	*Salix arbusculoides*
---	---	**Balsam Poplar**	*Populus balsamifera*
---	---	**Bristly Clubmoss**	*Lycopodium annotinum*

TABLE 1. COMPARISON OF PLANT SPECIES GROWING ON THE ACCESS ROAD AND ADJACENT HABITATS (CONT'D)

Riparian Alluvial		
Species Common in Adjacent Habitat		**Species Recorded Growing on the Road**
Common Name	**Scientific Name**	**Common Name / Scientific Name**

Riparian Alluvial was not assessed due to lack of access

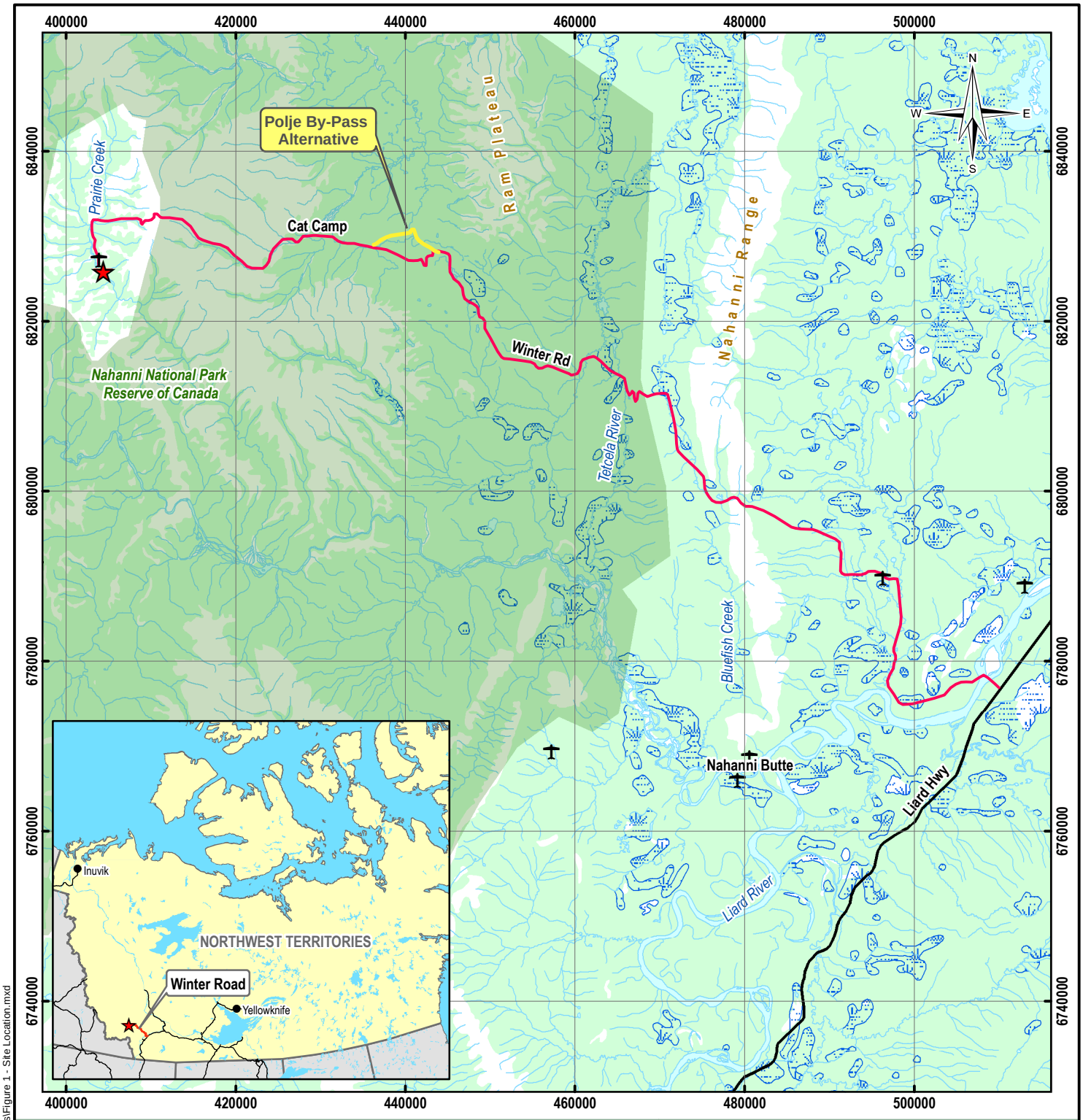
Pine Parkland			
Species Common in Adjacent Habitat		**Species Recorded Growing on the Road**	
Common Name	**Scientific Name**	**Common Name / Scientific Name**	
Jack Pine	*Pinus banksiana*	**Jack Pine**	
White Spruce	*Picea glauca*	**White Spruce**	
Black Spruce	*Picea mariana*	**---**	
Dwarf Birch	*Betula glandulosa*	**Dwarf Birch**	
Gray willow	*Salix glauca*	**Gray willow**	
Littletree Willow	*Salix arbusculoides*	**Littletree Willow**	
Alpine Bilberry	*Vaccinium uliginosum*	**Alpine Bilberry**	
Common Labrador Tea	*Ledum groenlandicum*	**Common Labrador Tea**	
Rock Cranberry	*Vaccinium vitis-idaea*	**Rock Cranberry**	
Field Horsetail	*Equisetum arvense*	**Field Horsetail**	
Labrador Lousewort	*Pedicularis labradorica*	**Labrador Lousewort**	
Fireweed	*Chamerion angustifolium*	**Fireweed**	
Prickly Rose	*Rosa acicularis*	**Prickly Rose**	
---	**---**	**Everlasting spp**	*Antennaria sp.*
---	**---**	**Alpine Clubmoss**	*Diphasiastrum alpinum*
---	**---**	**Downy Lyme Grass**	*Leymus innovatus*
---	**---**	**Bristly Clubmoss**	*Lycopodium annotinum*
---	**---**	**Green Alder**	*Alnus crispa* ssp. *crispa*
---	**---**	**Black Crowberry**	*Empetrum nigrum*
---	**---**	**Trembling Aspen**	*Populus tremuloides*
---	**---**	**Running Clubmoss**	*Lycopodium clavatum*
---	**---**	**Alpine Clubmoss**	*Diphasiastrum alpinum*

TABLE 1. COMPARISON OF PLANT SPECIES GROWING ON THE ACCESS ROAD AND ADJACENT HABITATS (CONT'D)

Mixed Conifer-Deciduous		
Species Common in Adjacent Habitat		**Species Recorded Growing on the Road**
Common Name	**Scientific Name**	**Common Name / Scientific Name**
Green Alder	*Alnus crispa* ssp. *crispa*	**Green Alder**
Black Spruce	*Picea mariana*	**---**
Scouler Willow	*Salix scouleriana*	**Scouler Willow**
Jack Pine	*Pinus banksiana*	**Jack Pine**
Paper Birch	*Betula papyrifera*	**Paper Birch**
Trembling Aspen	*Populus tremuloides*	**Trembling Aspen**
Dwarf Birch	*Betula glandulosa*	**Dwarf Birch**
Shrubby Cinquefoil	*Dasiphora fruticosa*	**Shrubby Cinquefoil**
Alpine Bilberry	*Vaccinium uliginosum*	**Alpine Bilberry**
Common Labrador Tea	*Ledum groenlandicum*	**Common Labrador Tea**
Prickly Rose	*Rosa acicularis*	**Prickly Rose**
Northern Comandra spp	*Geocaulon lividum*	**Northern Comandra spp**
Balsam Poplar	*Populus balsamifera*	**Balsam Poplar**
Field Horsetail	*Equisetum arvense*	**Field Horsetail**
Rock Cranberry	*Vaccinium vitis-idaea*	**Rock Cranberry**
Fireweed	*Chamerion angustifolium*	**---**
Dwarf Dogwood	*Cornus canadensis*	**Dwarf Dogwood**
Red Bearberry	*Arctostaphylos rubra*	**Red Bearberry**

Black Spruce Muskeg		
Species Common in Adjacent Habitat		**Species Recorded Growing on the Road**
Common Name	**Scientific Name**	**Common Name / Scientific Name**
Black Spruce Muskeg was not assessed due to lack of access		

FIGURES



LEGEND

- Prairie Creek Mine (including the proposed waste rock facility)
- Runway
- Polje By-Pass Alternative
- Winter Access Road (Approximate)
- Road
- Watercourse
- Protected Area
- Waterbody
- Wetland
- Vegetation

NOTES
Base data source:
NTS 1:250,000

ISSUED FOR USE

PRAIRIE CREEK MINE ACCESS ROAD INVASIVE PLANT AND RARE PLANT SURVEY

Site Location

PROJECTION: UTM Zone 10		DATUM: NAD83	
Scale: 1:650,000 (10 5 0 10 Kilometres)			
FILE NO.: Figure 1 - Site Location.mxd			
PROJECT NO.: Y22101185	DWN: MZ/SB	CKD: SM	REV: 0
OFFICE: EBA-KELOWNA	DATE: April 11, 2011		

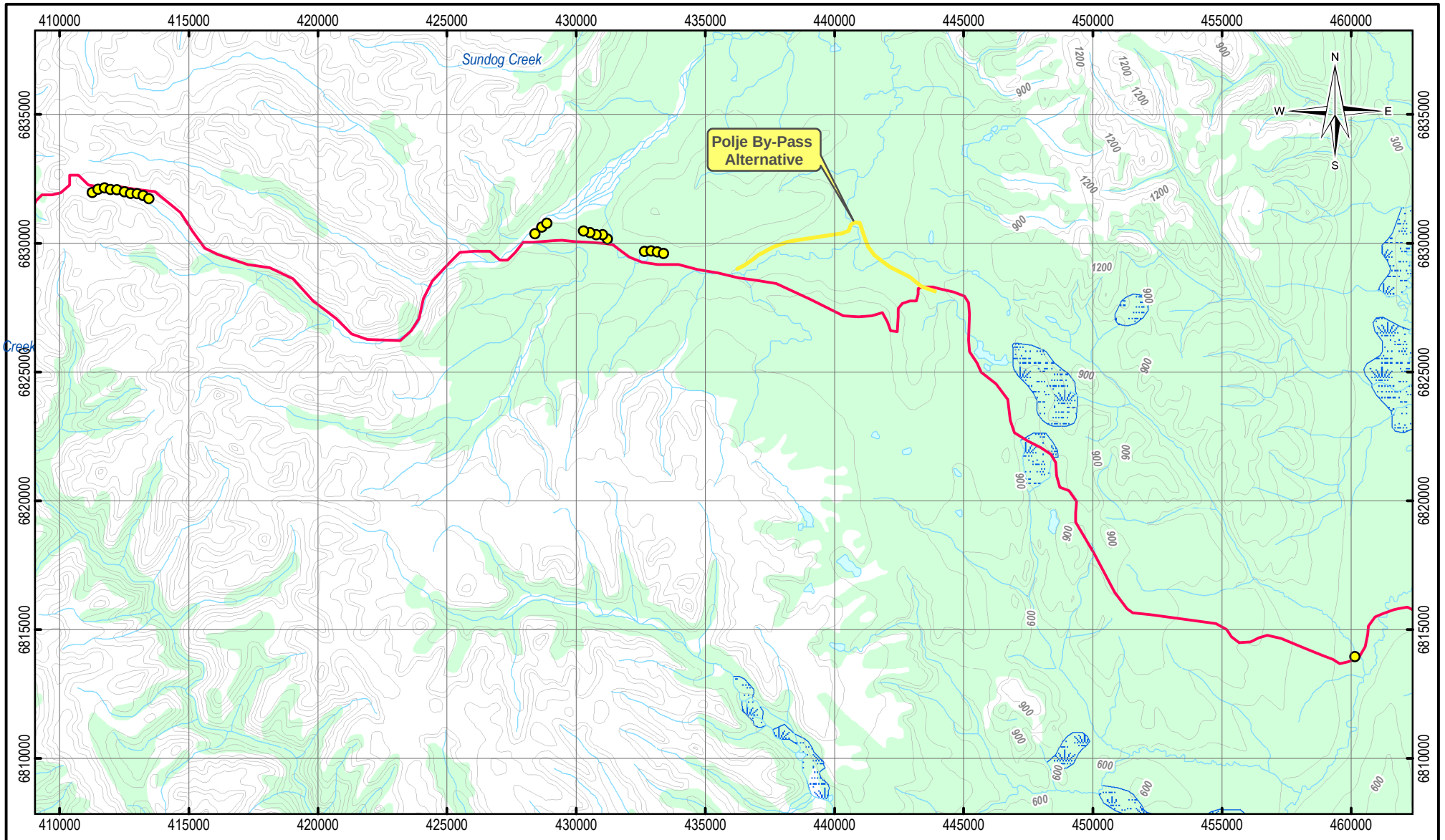
CANADIAN ZINC CORPORATION

EBA Engineering Consultants Ltd.

Figure 1

Q:\Kelowna\GIS\ENVIRONMENTAL\Y221\Y22101185_Canadian_Zinc\Maps\Figure 1 - Site Location.mxd

Q:\Kelowna\GIS\ENVIRONMENTAL\Y221\Y22101185_Canadian_Zinc\Maps\Figure 2 - Location of Invasive Species Assessment.mxd



LEGEND

- Location of Invasive Species Assessment
- Winter Access Road (approximate)
- Contour (100 m)
- Watercourse
- Polje By-Pass Alternative
- Waterbody
- Wetland
- Vegetation

ISSUED FOR USE

NOTES
Base data source: NTS 1:250,000

Scale: 1:210,000

5 2.5 0 5

Kilometres

PROJECTION	DATUM
UTM Zone 10	NAD83

FILE NO.
Figure 2 - Location of Invasive Species Assessment.mxd

CANADIAN ZINC CORPORATION
EBA Engineering Consultants Ltd.

PRAIRIE CREEK MINE ACCESS ROAD INVASIVE PLANT AND RARE PLANT SURVEY

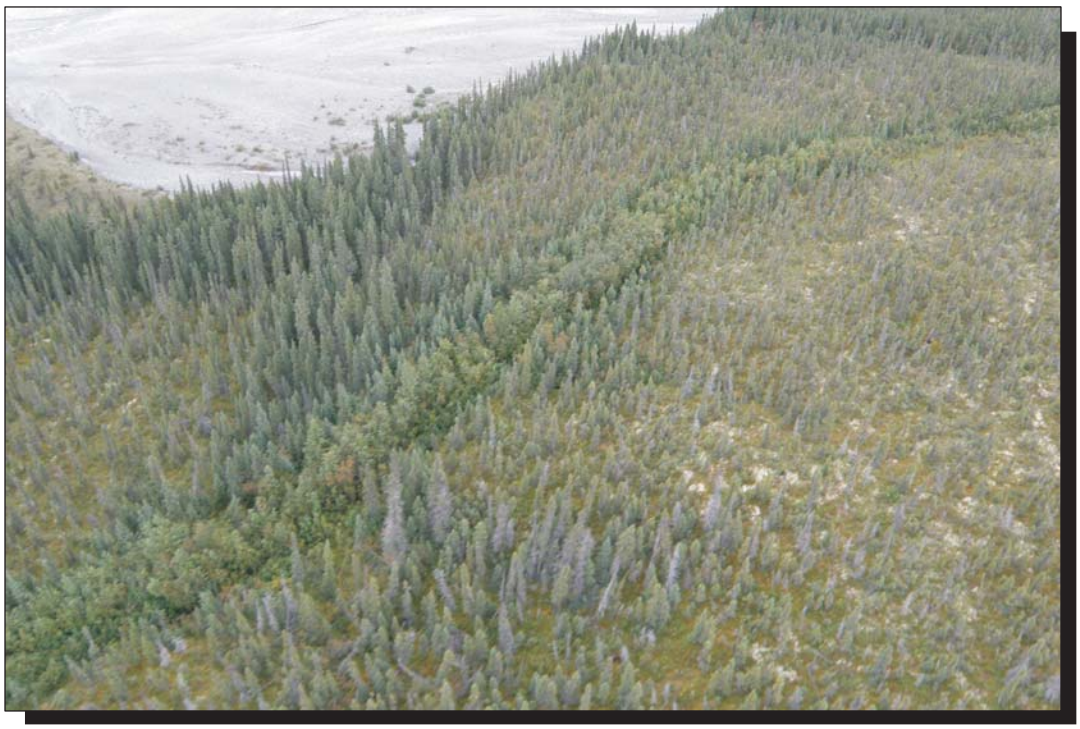
Location of Invasive Species Assessment and Rare Plant Survey

PROJECT NO.	DWN	CKD	REV
Y22101185	MZ/SB	SM	0

OFFICE	DATE
EBA-KELOWNA	April 11, 2011

Figure 2

PHOTOGRAPHS



Photograph 1
The light green-coloured strip (appearing near the lower left corner and upwards to the upper right corner of the photo) shows the access road has been re-vegetated by spruce.

Photograph 2
A ground view of white spruce reclamation along the road with a shrub strata and a thick layer of moss.

Photograph 3
Reclamation is well underway along this original section of the old road traversing Alpine Tundra community type.

Photograph 4
The best sections of reclamation occur in patches that were likely not scrapped off during the time of road construction.

Photograph 5
This section of road has undergone periodic maintenance since 1982 and has not had an opportunity to re-colonize.

Photograph 6
Despite periodic road maintenance some species such as willows, horsetails, and fireweed are re-establishing themselves along the access road through the Subalpine Shrub community type.

Photograph 7
The Spruce-Lichen community represents a climax community occurring on relatively stable colluvial slopes from the valley bottom to the upper slopes.

Photograph 8
Only in a few locations does the access road cross over the edge of Spruce-Lichen community types. Despite being exposed to periodic maintenance since 1982 vegetation reclamation is occurring, reverting that section of road back to its original state.

Photograph 9
Along some sections the access road reclamation has advanced to the point were the road corridor becomes virtually indistinguishable from the adjacent habitat (road runs from the lower left corner and upwards to the center of the top edge of the photo).

Photograph 10
After 28 years, the habitat along the road bed is developing towards a mature Black Spruce Parkland community.

Photograph 11
The Black Spruce community type is developing well with defined stratum layers: small trees, shrubs, herbaceous and ground layers. Along some stretches the moss layer was up to 25 cm thick.

Photograph 12
This photograph shows the dense restocking of spruce trees. Some stretches along the road way were much thicker but could not be effectively photographed for report presentation.

Photograph 13
The Pine Parkland community type occurs on well-drained upland areas. Jack pine is the predominant tree species with smaller amounts of white and black spruce.

Photograph 14
The plant species present on the access road surface are similar to that in adjacent Pine Parkland community type and include jack pine, white spruce, willow, dwarf birch and cranberry.

Photograph 15
The mixed conifer-deciduous community type represents a post-fire successional forest comprising of aspen, birch, spruce, jack pine, alder and willow.

Photograph 16
Natural reclamation along this section of road within the Mixed Conifer–Deciduous community type is well underway, generating a dense stand of mixed trees.

Photograph 17
The Riparian Alluvial community type occurs in the bottom of valleys and consists of vegetated gravel bars within the braided streams.

Photograph 18
This community type undergoes annual disturbance in the form of erosion and ice-gouging during spring runoff and was not assessed in context to reclamation.

Photograph 19
The habitat for which the proposed Polje By-Pass road alignment traverses was subjected to a forest fire in 1996 that completely burned the majority of standing timber.

Photograph 20
A jack pine stand has become established along the entire proposed Polje By-Pass road alignment and represents an early seral stage.

Photograph 21
The shrub stratum canopy closure varied between 10 and 25 % and consisted of two layers, medium and low shrubs, consisting of dwarf birch/ willow and cranberry, respectively.

Photograph 22
Many dead trees (snags) were left standing, and considerable debris, in the form of tree trunks and branches, remain on the ground, with patches of exposed mineral soil throughout.

APPENDIX A

APPENDIX A CONSPECTUS OF *BROMUS* SPECIES

APPENIDX A CONSPECTUS OF *BROMUS* SPECIES		
Common Name	**Scientific Name**	**NWT GSRank[1]**
Fringed Brome	*Bromus ciliatus*	Secure
Meadow Brome	*Bromus commutatus*	Exotic/Alien
Soft Brome	*Bromus hordeaceus*[2]	Exotic/Alien
Awnless Brome	*Bromus inermis*	Exotic/Alien
Pumpelly Brome	*Bromus pumpellianus*[3]	Secure
Corn brome	*Bromus squarrosus*	Exotic/Alien
Downy brome	*Bromus tectorum*	Exotic/Alien

[1] Working Group on General Status of NWT Species (ENR 2011)

[2] *B. hordeaceus* (formerly *B. mollis*)

[3] *B. pumpellianus* syn. *B. pumpellianus* ssp. *inermis* and *B. inermis* var. *pumpellianus*

There are three *Bromus* species of relevance to this project including: fringed brome, *B. ciliatus*, pumpelly brome, *B. pumpellianus*, and awnless brome, *B. inermis.* The first two species are indigenous to this region while the last one is an exotic, invasive alien species. To the causal observer these three species would appear to be similar in appearance. There are, however, minute differences in their appearance and conservation status. Presented below is a table highlighting key identification features between the species.

Conspectus of three *Bromus* Species

	Bromus ciliatus	*Bromus pumpellianus*	*Bromus inermis*
Attribute	**Indigenous**	**Indigenous**	**Exotic/Invasive/Alien**
Nodes	**Nodes pubescent**	**Nodes pubescent**	**Nodes glabrous**
Culms	7 to 12 dm	5 to 10 dm	5 to 10 dm
	Tufted	Mostly solitary – rhizome	Mostly solitary - rhizome
	Sheaths short pilose	---	---
Leaves	Up to 10 mm wide	3 to 8 mm wide	3 to 8 mm wide
	scattered long, soft hairs on both surfaces	Glabrous	Glabrous
Panicle	15 to 25 cm	10 to 20 cm	10 to 20 cm
	Spreading or drooping	Ellipsoid	Ellipsoid
Spikelets	1.5 to 2.5 cm long	green, bronze or purple-tinged	green, bronze or purple-tinged
	4 to 9 flowered	2 to 11 flowered	2 to 11 flowered
Glumes	**Glabrous**	---	---
Lemmas	**Glabrous on back, long-ciliate marginal nerves**	**Glabrous on back, villous along the marginal nerves**	**Glabrous**
	10 to 15 mm long	**fuzzy-hairy**	**Scabrous (somewhat)**
	---	10 to 12 mm long	10 to 12 mm long
Awn	**3 to 5 mm long**	**Straight, short-awned 2 to 3 mm long**	**Awnless (typically)**

Note: *B. inermis* is similar to *B. pumpellianus*, differing chiefly by its totally glabrous or somewhat scabrous, and usually awnless lemmas.