

# Appendix 14-B

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Listed Plant Species, Listed Ecological  
Communities and Sensitive  
Ecosystems - Baseline Surveys

# Listed Plant Species, Listed Ecological Communities and Sensitive Ecosystems Baseline Surveys

*Crown Mountain Coking Coal Project*



**Michael Keefer, MSc, PAg**

**Tom Braumandl, RPF**

**Myra Juckers, PAg**



*Penstemon nitidus*  
Photo by: Ian Gardiner



Keefeer Ecological Services Ltd  
3816 Highland Rd.  
Cranbrook BC V1C 6X7  
(250) 489-4140  
[www.keefereco.com](http://www.keefereco.com)

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## Introduction

Keefer Ecological Services Ltd. (KES) was retained by NWP Coal Canada Ltd. (NWP Coal) to conduct a survey of vascular plants, ecological communities of management concern and sensitive ecosystems occurring within the Crown Mountain Coking Coal Project Area. Plants and ecological communities of management concern include vascular plant species and ecological communities listed under the British Columbia Conservation Data Centre's (BC CDC) Red or Blue lists as well as vascular plant species listed under the Species at Risk Act (SARA) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Public Registry. The status definitions of listed species include:

### BC CDC

*Red List:* Any species or ecosystem that is at risk of being lost (extirpated, endangered or threatened).

*Blue List:* Any species or ecosystem that is of special concern.

### SARA & COSEWIC

*Special Concern:* A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

*Endangered:* A wildlife species facing imminent extirpation or extinction.

*Extirpated:* A wildlife species that no longer exists in the wild in Canada but exists elsewhere.

*Extinct:* A wildlife species that no longer exists.

In addition to surveying for listed plants and ecological communities within the local study area (LSA), KES used terrestrial ecosystem mapping (TEM) to locate ecosystems sensitive to the impacts of industrial development and providing special habitat values. These sensitive ecosystems include wetlands, grasslands/brushlands, floodplains, ponds, rivers, rock outcrops, talus, cliffs, alpine vegetation, krummholz, and avalanche chutes. These baseline surveys are valuable in providing an inventory and distribution of listed plants and sensitive ecosystems throughout the study area prior to disturbance.

Two provincially and federally listed tree species, whitebark pine (*Pinus albicaulis*) and limber pine (*Pinus flexilis*) are not dealt with in this report. These species will be summarized in a separate report due to different methods and concerns around their endangerment.

## Objectives

The key objective of the study was to survey the area for listed vascular plants<sup>1</sup>, listed ecological communities and sensitive ecosystems to provide a record of the location of these features found in the LSA. Data from this study can be used to inform the design and operation of the proposed mine to minimize impacts of the Project to listed plant species and ecological communities, and sensitive ecosystems. Further, this data may be used as part of the mine closure planning to ensure that

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<sup>1</sup> Rare bryophytes and lichens were not searched for as assessments of these organisms are typically beyond the scope of environmental assessments.

potentially impacted species and ecosystems may be included in this planning to minimise effects to these species over time.

Survey work was performed in conjunction with other project work including TEM, soils and terrain assessment work, and pre-construction monitoring work allowing for a greater intensity of effort than would otherwise have been possible.

## Study Area

The local study area (LSA) of the NWP Coal Crown Mountain Coking Coal Project spans 12,886 ha and comprises the bulk of the Alexander, West Alexander and Grave Creek watersheds of southeastern British Columbia, north of Crowsnest Highway 3 (Figure 1 and Figure 2). The study area encompasses four biogeoclimatic units, which include dry warm Montane Spruce subzone (MSdw), Kootenay dry cool Engelmann Spruce-Subalpine Fir variant (ESSFdk1), dry cool woodland Engelmann Spruce-Subalpine Fir subzone (ESSFdkw), and dry cool parkland Engelmann-Spruce Subalpine Fir subzone (ESSFdkp).

Within the Kootenay region, key habitat types for listed plants are typically non-forested ecosystems as they make up a smaller portion of the landscape and as such are more likely to contain rare species or ecosystems due to their uncommon habitat attributes (e.g., BC MOE, n.d.; GCC, 2017). For this study, ecosystems with the highest potential for listed plants were determined to be wetlands and warm aspect slopes that are permanently non-forested because of factors such as recurrent fire, difficult site conditions, and/or herbivory.

## Methods

### BC CDC Search

Early in 2014, prior to conducting field surveys, vascular plant species at risk with the potential to occur in the study area were identified by reviewing the BC Conservation Data Centre database (BC CDC, 2014). The BC Species and Ecosystems Explorer database was searched using the following queries: vascular plants, biogeoclimatic zone (ESSF and MS), conservation status (red and blue lists), forest district (Rocky Mountain Forest District). The list of potential vascular plant species at risk is presented in Appendix A.

There was a major reassessment of rankings for both vascular plants and ecological communities undertaken by the BC CDC in 2018. Several species and ecological communities that were listed at the outset of the project are no longer considered rare (blue or red-listed) or have had their ranking reduced from red to blue. Additionally, long-leaved hawsbeard (*Crepis acuminata ssp. acuminata*) was added as a red-listed species, and sheep cinquefoil (*Potentilla ovina var. ovina*) had its ranking increased from blue to red. There have been a few additions of ecological communities to the blue and red lists for the study area. All results presented in this report reflect the present (October 22, 2018) CDC status.

At-risk ecological communities were also searched in the BC CDC database using the following queries (BC CDC, 2018): biogeoclimatic zone (ESSFdk1, ESSFdkp, ESSFdkw, MSdk1, IDFun), ecosection classification (ELV – Elk Valley), ministry of environment region (Kootenay), forest district (Rocky Mountain Forest District), regional district/municipalities (East Kootenay/Sparwood), and conservation status (red and blue lists). The list generated from the search is presented in Appendix B.

### Listed Vascular Plant Field Sampling and Identification Methods

Based on knowledge of habitat requirements, potential assessment areas were selected by examination of aerial imagery (World Imagery from ESRI Web Server used under license (no date is provided for this imagery but appears to date from about 2009), Google Earth, and existing predictive ecosystem mapping (PEM) information<sup>2</sup>. Non-forested areas and wetlands were sought out as they are the ecosystems with greatest likelihood to support rare plants. Sites were assessed during onset of flowering, which occurred in May through June 2014 for low to mid elevation species and in July through August 2014 for high elevation species. When sites were visited, a meander search was conducted, which involved walking through a site and observing all plant species present (Penny and Klinkenberg, 2013; ANPC, 2012). The Site Visit Form (SIVI; Appendix C) was used to describe locations where listed plants were found, which also provided information for terrestrial ecosystem mapping (TEM) work. Listed plants were also searched for in subsequent field visits for other site projects (e.g., 2018 drill pad and road pre-construction assessments). Plant naming follows that of EFloraBC<sup>3</sup> (accessed October 2018). Plant samples were collected of any species not known to the survey team, as well as listed species found for later verification. All plant samples were collected and placed in locking plastic bags and then placed in a cooler to preserve freshness. Following tentative identification, voucher specimens were pressed and mounted as herbarium samples. Specimens with any taxonomic uncertainty were sent to the Royal BC Museum and/or Dr. Terry MacIntosh to verify species identification. While the entire LSA was assessed through desk-top assessment and high potential, accessible sites were visited on the ground, priority was given to searching high potential habitats within the Project infrastructure footprints. Figure 1 and Figure 2 present transects and point observations where listed plants were searched for.

<sup>2</sup> Cranbrook TSA and Dominion Coal Block Predictive Ecosystem Mapping Ketcheson *et al.* 2013 update. Available at <http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=40871>

<sup>3</sup> <http://ibis.geog.ubc.ca/biodiversity/eflora/>

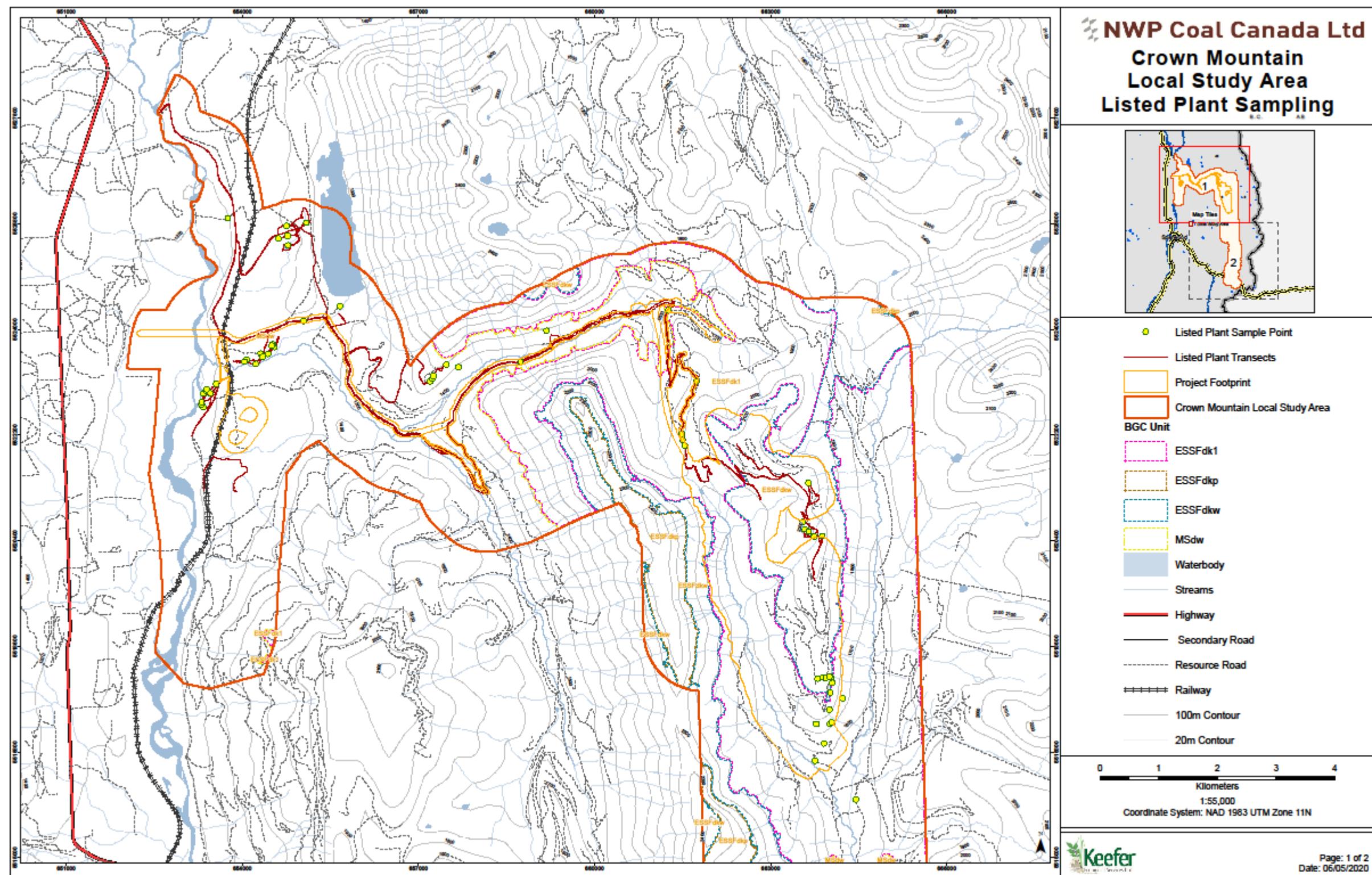


Figure 1. Local study area (north half) with locations of rare plants transects and sample points.

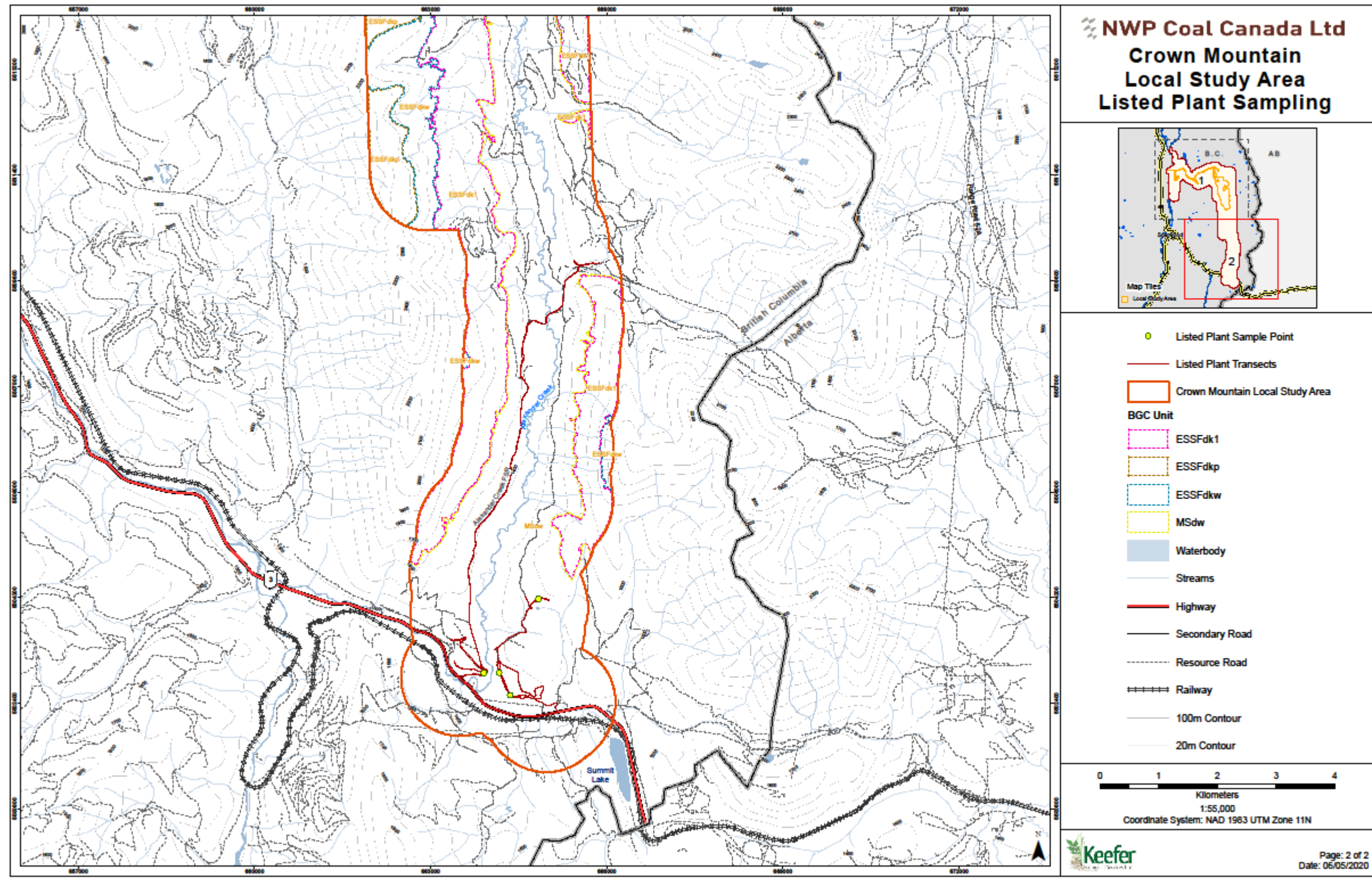


Figure 2. Local study area (south half) with locations of rare plants transects and sample points.



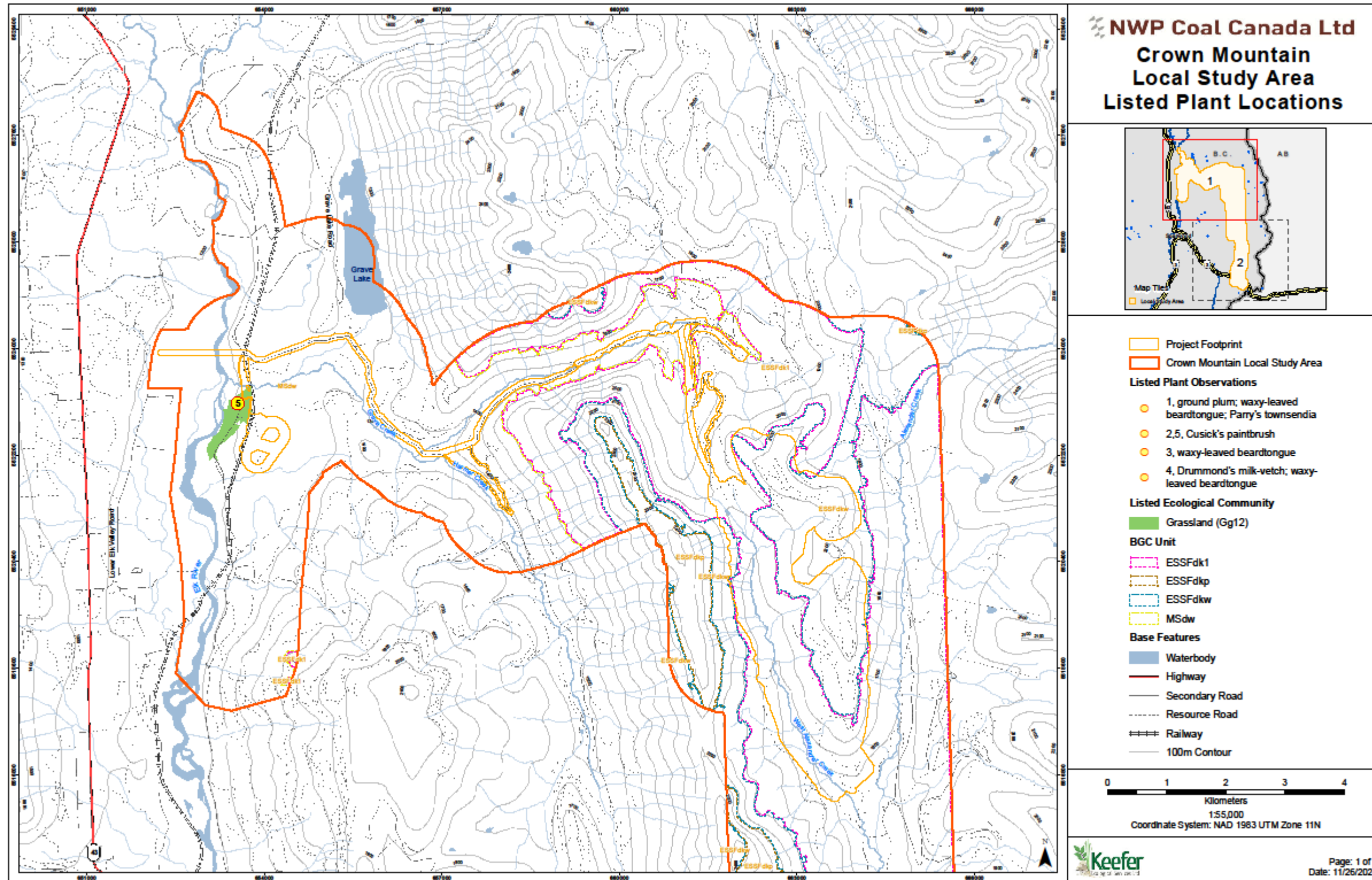


Figure 3. Local study area (north half) with locations of rare plants.

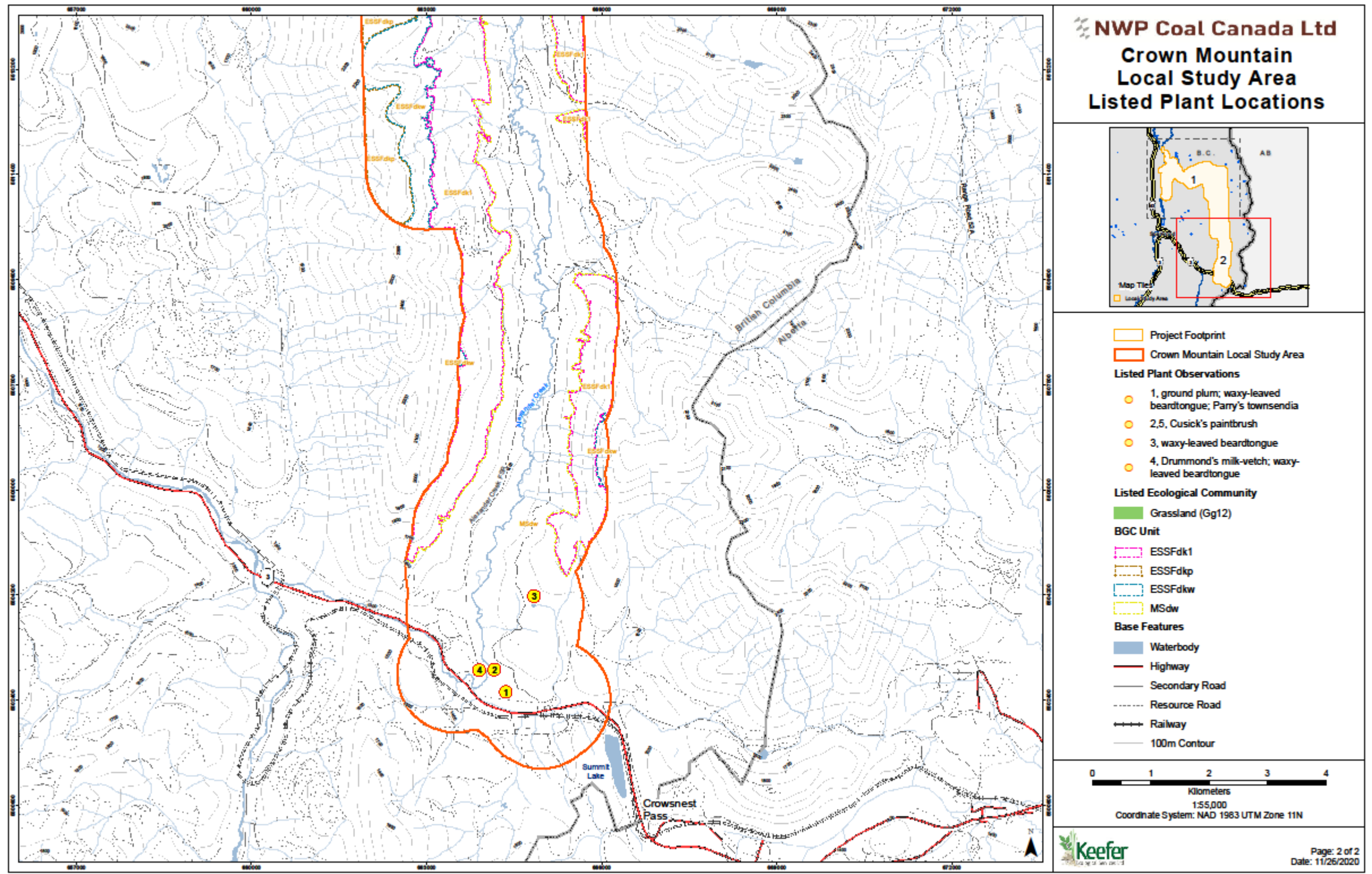


Figure 4. Local study area (south half) with locations of rare plants.

## At-Risk Ecological Communities and Sensitive Ecosystems Determination

The TEM created for the Crown Mountain Coking Coal Project used the new BEC guide for the East Kootenay (MacKillop *et al.*, 2018). These revisions have resulted in alterations to BGC units and corresponding site series from those listed in the CDC reports. As such, the at-risk communities identified under BC CDC as potentially occurring within the study area do not directly correspond to the revised site series. In response, the at-risk ecological communities identified by BC CDC and the biogeoclimatic unit they fall under were cross referenced with the MacKillop *et al.* (2018) guide to identify which site series from the revised guide have the potential of containing these at-risk communities (Appendix B).

The presence of at-risk ecological communities was searched for in the field, during field work for the TEM and listed plant species surveys.

In addition to sites identified as at-risk, additional ecosystems that are sensitive to development and/or have high habitat values were mapped using TEM. A listing of sensitive ecosystems to locate within the study area was obtained by consulting the Standards for Mapping Ecosystems at Risk (RISC 2006). They include (TEM map codes in brackets):

- Vegetated alpine ecosystems (alpine fellfield (Af), alpine meadow (Am), alpine late snow-bed (As), alpine tundra (At), krummholz (Sk);
- Wetlands (Wa, Wf, Wm, Ws, Ww);
- Ponds (PD);
- Rivers (RI);
- Flood ecosystems (Fl, Fm);
- Grasslands/brushlands (Gg, Gb);
- Disclimax meadows and shrubfields (Xv);
- Rock Outcrops (Ro);
- Rock Talus (Rt);
- Cliffs (Rc);
- Avalanche Paths (Vh, Vs, Vt);
- Riparian (110, 111 site series in proximity to watercourses wetlands or ponds).
- 

Riparian mapping used more sources than other sensitive ecosystem types. A combination of the BC Freshwater Atlas (Prov. of BC, n.d.), LSA TEM and Elk Valley Cumulative Effects Management Framework (EV CEMF; Davidson *et al.*, 2018) riparian mapping was used to delineate riparian habitat within the LSA. The EV CEMF employed a cost analysis method (Fernandez *et al.*, 2012, Davidson *et al.*, 2018) using a Digital Elevation Model derived from LiDAR data to identify the location of riparian habitat throughout the RSA and so would have been ideal to use for the LSA to ensure consistent interpretation. However, when assessed at the scale of the LSA, it was noted that the EV CEMF lacked accuracy in several locations. In portions of the LSA, the EV CEMF riparian mapping took in significant upland areas and

included wetlands (which are treated as a separate VC), anthropogenic sites (e.g. compressor station, cultivated fields, mine tailings), and avalanche tracks (which are also treated as a separate VC). We utilized the EV CEMF mapping in places where it was accurate and, in some instances, took in areas that, due to scale issues within TEM polygons, were missed in the TEM. The TEM was utilized to modify the CEMF mapping by identifying ecosystems adjacent to water bodies that displayed influence of elevated levels of soil moisture (site series 110, 111). This riparian layer overlaps with all flood and river ecosystems as well as some wetlands that are adjacent to Alexander Creek.

## Results and Discussion

### Listed Plants

The initial search of the CDC database (January 2014) identified 75 listed plant species that were potentially present within the LSA. The 2018 revision of the CDC database resulted in only 44 species being identified as blue- or red-listed. The lists generated from these searches are presented in Appendix A.

Key potential habitat types in the Elk Valley for listed plants are typically non-forested and are frequently warm aspect slopes that are believed to be maintained in non-forested or open forest conditions through a combination of fire, moisture stress, soil instability and herbivory. Such habitats are found sporadically throughout the LSA and were targeted for survey. Other areas with elevated potential for listed plants include wetlands, riparian areas, limestone outcrops, high elevation forests and ridgetop environments. Lower priority areas such as mature forests were well sampled with TEM plots.

Occurrences of six listed plant species were found within the LSA (including whitebark pine which is reported in a separate report; Figure 3 and Figure 4, Table 1). The five species reported here are red-listed<sup>4</sup> (Table 1). These species were found at five locations within the LSA (Figure 3 and Figure 4). Location information for these occurrences and the occurrence of the listed ecological community are provided in Appendix D. Results and discussion are presented by location where listed plants (apart from whitebark pine) were found.

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<sup>4</sup> Cusick's paintbrush was red-listed prior to 2019 when its status was changed to unknown.

Table 1. Red and blue listed plants found within the Crown Mountain Coking Coal Project LSA.

Provincial Status	Scientific Name	Common Name	Habitat	Observed Occurrences
Red Listed	<i>Astragalus crassicaarpus</i>	ground plum	Dry grassy openings in the montane zone	1
	<i>Astragalus drummondii</i>	Drummond's milk-vetch	Dry, open, grassy slopes in the montane zone	2
	<i>Castilleja cusickii</i>	Cusick's paintbrush	Mesic meadows in the montane zone	2
	<i>Penstemon nitidus var. nitidus</i>	wax-leaved beardtongue	Dry hillsides, grasslands and roadside banks in the montane zone	3
	<i>Townsendia parryi</i>	Parry's townsendia	Dry rocky slopes within the alpine zone.	1

### Location 1: Alexander Creek weigh scale

Location 1 is the only site within the LSA where more than two species of listed plants were found (ground plum, wax-leaved beardtongue, Parry's townsendia). Both species are red-listed. This site is located about 400 m east of Alexander Creek and 300 m north of Highway 3 at an elevation of 1389 m within the dry warm Montane Spruce subzone (MSdw). Throughout this area of the LSA there are small areas of grasslands that have high concentrations of listed plants in small, warm-aspect, xeric (very dry), steeply-sloping areas that are rarely found elsewhere in the East Kootenay. These ecosystems are severely threatened by spotted knapweed (*Centaurea stoebe*). Between the initial visit in 2014 and the most recent visit in 2016, the KES crew observed a large increase of knapweed cover and in turn a substantial decrease in cover of ground plum (a red-listed species). The surveys in 2014 found at least 50 ground plum individuals with only 2 surveyors; in 2015 roughly 15 botanists were present and only 2 individuals of ground plum were found at Location 1. Ground plum was found in two spots at this location, at the south west and south east corners of the terrace edge (separated by about 500 m). The very small population (circa 5 plants) of Parry's townsendia is highly restricted to an area of approximately 100 m<sup>2</sup>. That population is also surrounded by spotted knapweed, its habitat is highly susceptible to invasion due to the site being erosive and coarse textured. The wax-leaved beardtongue appears to have a healthy reproducing population and was found at two locations here. Location 1 is

well away from any planned mine infrastructure. It is found over 14 km from the southernmost pit and about 5 km south of nearest coal tenure license boundary.

### **Location 2: Southwest facing slope above lower Alexander Creek**

This location is found about 450 m to the northwest of Location 1, in a similar topographic habitat above Alexander Creek in the MSdw. The site is only moderately sloping and is mesic in terms of soil moisture. Cusick's paintbrush (a red-listed species) was found at this location distributed in a spotty manner often associated with more mesic conditions. The occurrence of Cusick's paintbrush is a new discovery for the Elk Valley with the previous closest occurrence being recorded in the Flathead Valley near the US border (Eflora BC<sup>5</sup>, accessed 2017). As with Location 1, Location 2 is well away from planned mining infrastructure.

### **Location 3: South facing slope above southern powerline**

This location is a steep south-facing grassland at 1495 m within the MSdw, located about 2 km north of Highway 3. The site has a xeric (very dry) soil moisture regime and exhibits open grassland vegetation. Wax-leaved beardtongue (a red-listed species) is found widely on this site with at least 20 individuals present. This site is again well away from any planned mining activity, being approximately 13 km south of the southernmost planned pit.

### **Location 4: Alexander Creek hillslope above firing range**

This location is a steep, south-east facing, eroding, xeric slope. It is found at about 1370 m elevation within the MSdw. The site is on the edge of the cutslope of the Alexander Forest Service Road and the local firing range and is about 350 m north-east of the Alexander Creek bridge on Highway 3. Both Drummond's milk-vetch and wax-leaved beardtongue are found here (both red-listed species). Only one individual plant of Drummond's milk-vetch was found in the LSA; this population is at high risk of extirpation from BC with only this one population being known in the province. Wax-leaved beardtongue was widely distributed with at least 20 individuals found. As with the nearby Location 2, this site is about 14 km south of the southernmost planned pit. This site is threatened by accelerated erosion due to maintenance or widening of the road below.

### **Location 5: Grave Prairie**

Location 5 is found at Grave Prairie, an approximately 35 ha grassland on the east bank of the Elk River just south of Grave Creek. Grave Prairie was expected to be a hot spot for listed plants but during survey work only one species was found, Cusick's paintbrush (a red-listed species). This population was distributed on the glacio-fluvial terrace downhill of the access road along the east side of the Elk River and up to the edge of the steep slopes above the Elk River. This site is found about 300 m from the proposed rail load-out facility.

Not detected in the inventory work but believed to be present in the LSA is the provincially red-listed and federally-endangered (COSEWIC, 2014) limber pine. Limber pine is expected on limestone-derived soils in the LSA and has been confirmed by KES staff at several areas close to the LSA on similar geology.

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<sup>5</sup> <http://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Castilleja%20cusickii&redblue=Both&lifeform=4>

This species is expected to occur on the limestone massif, Mt. Erickson as well as Sheep Mountain. The terrain along these two features is very rugged thus limiting the potential to conduct surveys for limber pine safely. Employing mountaineering for such surveys was determined not to be necessary as the Project is expected to have no direct impact within potential critical habitat for limber pine. The main haul road down Grave Creek is over 300 m from likely limber pine habitat and so increased dust input would be minimal.

There were one location where vascular listed plants were found near the Project footprint (Location 5: Grave Prairie, Cusick's paintbrush). Grave Prairie (Location 5) containing the red-listed Cusick's paintbrush is located 300 m from the rail load-out location.

### Listed Ecological Communities

BC CDC has identified an at-risk ecological community that is located within the LSA: the red-listed rough fescue - (bluebunch wheatgrass) - yarrow - clad lichens association. Grasslands are considered one of BC's most endangered ecosystems, covering less than 1% of BC's land base and support over 30% of BC's species at risk (GCC, 2017; Iverson, 2004). As well, in the Elk Valley, grasslands are of high importance as ungulate winter range because they are typically found on warm aspects. Only one occurrence of this community was confirmed within the LSA. This occurrence spans 27 ha at a location known as Grave Prairie. This occurrence is unique to our knowledge along the upper Elk River, with the nearest extensive, level, native grassland being found at Wigwam Flats, some 58 km downstream. The red-listed Cusick's paintbrush (Location 5) was also found within this ecological community in the LSA.

### Sensitive Ecosystems

A total of 3,287 ha of sensitive ecosystems were identified<sup>6</sup>, representing 30% of the LSA (**Error! Reference source not found.**). Summarized at the group level, the riparian group had the highest coverage, at 1,318 ha, representing 10% of the LSA. The rock group had the next highest coverage, at 890 ha, or 7% of the LSA. Two other sensitive ecosystem groups had similar areas. The next most widespread sensitive ecosystem group was the avalanche group at 709 ha or 6% of the LSA. The krummholz and grassland groups are the only other sensitive ecosystem groups to account for more than one percent of the LSA, both at 2%. Wetlands are particularly uncommon in the LSA accounting for only 1% of the area. (Table 2, Appendix E). The percentage of sensitive ecosystem area was remarkably similar across the MSdw, ESSFdk1 and ESSFdkw, at either 26 or 27%. However, 100% of the ESSFdkp is considered sensitive. Mapping of sensitive ecosystems is provided in Appendix E.

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<sup>6</sup> Recognizing some amount of overlap in the mapping of riparian, flood, river and wetland ecosystems, particularly in the MSdw.



Table 2: Total coverage (ha) of sensitive ecosystems within the LSA of the proposed Crown Mountain Coking Coal Project.

Ecosystem Groups	Ecosystem Class/Association Occurring in LSA			MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total (ha)	% of Study Area
Grasslands	Grassland Class	Gg	The Grassland Class defines typical grassland ecosystems that are widespread in semi-arid climates and on very dry sites in non-grassland climates. These ecosystems are graminoid-dominated associations that occur primarily on deep soils, but sites are dry because of very rapid soil drainage, insolation, and/or lack of precipitation. If shrubs occur, they are sparse (< 10%) or of lower stature than grasses. On thinner soils, these communities border on members of the Rock/Talus Group. Site conditions that are similar but are dominated by shrubs are part of the Shrub-steppe or Brushland Classes.	6				6	0.05%
	rough fescue - (bluebunch wheatgrass) - yarrow - clad lichens association	Gg12	The Gg12 typically occurs on level and gently sloping sites in the IDfXk, IDfDm2, IDfDk5, and occasionally in the MSdw, particularly in the Flathead valley. It can also occur on moderately sloping, cool- or neutral-aspect sites with thin soils. Soils typically have a thin loamy, eolian veneer overlying very gravelly soils, often with a cemented calcareous (Cca) layer.	27			-	27	0.2%
	Brushland	Gb	Occurs outside of warm semi-arid climates and are dominated (> 10%) by drought-tolerant woody shrubs of moderate stature. Gb was mapped where species composition was unclear and more detailed classification was not possible.	52	6			58	0.5%
	Choke cherry – Snowberry – Bluebunch	Gb04	The Gb04 occurs infrequently on moderate to steep, warm aspects with coarse loamy or sandy soils. Soils are generally rich with thick Ah (dark, organically-enriched) surface layers, and	58				58	0.5%

Ecosystem Groups	Ecosystem Class/Association Occurring in LSA			MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total (ha)	% of Study Area
	wheatgrass Association		most sites have some moisture at depth. Soil moisture regime is slightly drier than mesic (SMR3 (MacKillop <i>et al.</i> 2018)). The vegetation is very shrubby and is dominated by snowberry and choke cherry with low cover of saskatoon and roses. The sparse herb layer is characterized by scattered bluebunch wheatgrass and silky lupine.						
	Saskatoon – Soopolallie – Juniper brushland association	Gb20	The Gb20 occurs at upper elevations on steep, warm slopes with rocky soils. This shrubby brushland site association is dominated by moderate cover of saskatoon, common juniper, and soopolallie with minor covers of birch-leaved spirea and/or prickly rose. Forbs and grasses are sparse and scattered, and usually consist of strawberry, yarrow, penstemons, and nodding onion. Occasionally, kinnikinnick, pinegrass, and sulphur buckwheat are present.		23	25		<b>48</b>	0.4%
Floodplain	Flood Association - Fringe	Ff	Fringe flood ecosystems develop on subirrigated but rarely flooded nonalluvial soils next to lakes and other still waters, or in slope draws and gullies in areas with dry climates. High soil moisture and modified climates produce tall broadleaf shrub or low treed ecosystems that are distinct from the adjacent upland. These ecosystems are differentiated from the Brushland Class in dry environments by tall shrub physiognomy and moist site conditions.	1				<b>1</b>	0.01%
	Low Bench Flood	Fl	Low bench ecosystems occur on sites that are flooded for moderate periods (20–40 days) during the growing season. The longer duration of	17	-	-	-	<b>17</b>	0.1%

Ecosystem Groups	Ecosystem Class/Association Occurring in LSA		MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total (ha)	% of Study Area
	Low Bench Flood (Mountain alder – common horsetail)	FI01	5	-	-	-	5	0.04%
	Low Bench-Flood (Sitka willow – Red-osier dogwood – Horsetail)	FI04	0.4				0.4	0.003%
	Middle Bench Flood (Cottonwood – Spruce – Red-osier dogwood)	Fm02	167	1	-	-	168	1%
	River	RI	90	23-	-	-	113	1%
Wetland	Alpine Wetland	Wa			2		2	0.02%

Ecosystem Groups	Ecosystem Class/Association Occurring in LSA		MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total (ha)	% of Study Area
	Fen Wetland	Wf	17	2		-	19	0.1%
	Marsh Wetland	Wm	1				1	0.01%
	Marsh Wetland (Beaked sedge – water sedge)	Wm01	13	1	-	-	14	0.1%

Ecosystem Groups	Ecosystem Class/Association Occurring in LSA		MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total (ha)	% of Study Area	
		lake margins, floodplains, and palustrine basins. It is dominated by an abundance of beaked sedge and/or water sedge.							
	Cattail Marsh	Wm05	The Wm05 occurs in depressions and along lakeshores and pond edges and is easily recognized by an abundance of common cattail. Other species typically have low cover. Soils are often mucky due to veneers of well-decomposed organic materials.	0.3				<b>0.3</b>	0.002%
	Great bulrush Marsh	Wm06	The Wm06 occurs along lake margins and in depressions in areas with warm and dry summers. Floodwaters can be up to 1.5 m deep in spring, but sites dry up significantly into the growing season. The vegetation community is characterized by hard-stemmed bulrush and/or soft-stemmed bulrush. Overall, plant species diversity is low.	1				<b>1</b>	0.01%
	Swamp Wetland	Ws	Swamps are nutrient-rich wetlands where significant groundwater flow, periodic surface aeration, and/or elevated microsites allow for growth of trees or tall shrubs on otherwise saturated soils. Ws was mapped where species composition data were lacking, and more detailed classification was not possible.	31	1			<b>32</b>	0.2%
	Bebb's willow – Blue-joint Swamp	Ws03	It is most common along lake or pond margins, seasonal creeks, and fluvial terraces, and in depressions. Bebb's willow dominates the shrub layer, often with black twinberry. Mountain alder and red-osier dogwood may be present. Scattered Sxw trees can occur. Bluejoint reed-grass and/or beaked sedge have high cover in the herb layer; horsetails and a diversity of forbs frequently occur.	7				<b>7</b>	0.1%

Ecosystem Groups	Ecosystem Class/Association Occurring in LSA			MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total (ha)	% of Study Area
	Drummond's willow – Beaked sedge Swamp	Ws04	They occur where water is stagnant, usually in depressions or adjacent to low-gradient streams. Drummond's willow dominates the shrub layer, although other willows may be present. The herb layer is typically dominated by beaked sedge and/or water sedge. Bluejoint reedgrass may occur.	9				9	0.1%
	Spruce – Horsetail – Leafy moss Swamp	Ws07	Sxw is dominant in the overstorey, with Sxw and some Bl in the understorey. Mountain alder, red-osier dogwood, and black twinberry are often present with low to moderate cover. Horsetails are always present and abundant with a diversity of other wetland and upland species, including bluejoint reedgrass, bunchberry, mitreworts ( <i>Mitella</i> spp. and <i>Pectiantia</i> spp.), and twinflower ( <i>Linna borealis</i> ).	19				19	0.1%
	Shallow Water	Ww	Shallow water wetlands are permanently flooded by still or slow-moving water and are dominated by submerged and floating-leaved aquatic plants.	4				4	0.03%
Rock	Rock Cliff	Rc	Cliff ecosystems are vertical rock sites, commonly with high bryophyte cover (rock crusts), but small pockets of soils may support vascular vegetation.		45	42	145	232	2%
	Rock Outcrop	Ro	Occurs in areas with bluffs and knobs of bedrock. Limited soil development and high cover of exposed rock.	11	141	103	78	333	3%
	Talus	Rt	Occurs in areas with active and inactive talus and scree.	46	172	140	17	375	3%
Avalanche	Avalanche Dry Herb Meadow	Vhd	Often occurs in the upper and central track of avalanche paths where mobile substrates and thin soils limit the establishment of shrubs or		12	26	7	45	0.3%

Ecosystem Groups	Ecosystem Class/Association Occurring in LSA		MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total (ha)	% of Study Area	
		trees. Avalanche dry herb meadows are ecosystems in avalanche tracks that are dominated by forbs, graminoids, and/or dwarf woody shrubs							
	Avalanche Moist Herb Meadow	Vhm	Often occurs in the central track or run-out zone of avalanche paths where snow accumulates or where mobile substrates limit the establishment of shrubs or trees. Soils are generally moist and soils maybe deep. Avalanche moist herb meadows are ecosystems in avalanche tracks that are dominated by lush forbs such as cow-parsnip, false-hellebore, Sitka valerian and/or graminoids, such as blue wildrye and bluejoint reedgrass.	1	33	12	46	0.3%	
	Cow-parsnip – Fireweed – Nettle Avalanche Herb Meadow	Vh01	The Vh01 is common in run-out zones and lower-track sections in the ICH, MS, and lower ESSF. It occurs on nutrient-rich soils with mesic to moist moisture regimes. Cow-parsnip is usually found with abundant fireweed and varying amounts of stinging nettle and meadowrues. Bluejoint reedgrass can have high cover but may be absent.		5		5	0.04%	
	Avalanche Shrub Thicket	Vs	Most frequently associated with the track and lateral run-out portions of the avalanche path where deep snow lay occurs infrequently, but site conditions are fresh or wetter. Vs was mapped where species composition data are lacking, and more detailed classification was not possible.	8	239	79	16	342	3%
	Willow – Cow-parsnip – Fireweed - Avalanche Shrub Thicket	Vs10	Sites are often associated with run-out zones adjacent to wetlands and riparian areas, but can also occur on moist, lower avalanche slopes. Vs10 sites are dominated by willows—usually Sitka or Barclay’s—and commonly contain black		8		8	0.1%	

Ecosystem Groups	Ecosystem Class/Association Occurring in LSA			MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total (ha)	% of Study Area
			twinberry, fireweed, cow-parsnip, western meadowrue, valerian, and stinging nettle						
	Avalanche Treed	Vt	Occur where areas are repeatedly exposed to avalanches. This does not include young forests recovering from a single extreme avalanche event. Site conditions are typically dry.	5	102	43	9	<b>159</b>	1%
Krummholz (Subalpine Shrub)	Krummholz	Sk	Krummholz ecosystems occur at the upper elevation extremes for conifer tolerance. Trees grow slowly due to harsh climatic conditions, including cold growing-season temperatures, winter frost, and wind exposure and damage. Trees occur in clumpy patches and can be upright with stunted growth or deformed, shrubby, and gnarled with dwarf stature (shrub-size). Sk was mapped where species composition data are lacking, and more detailed classification was not possible.				37	<b>37</b>	0.3%
	Krummholz Subalpine Fir – Grouseberry – White Mountain Heather	Sk02	Commonly occurs on submesic and slightly raised microsites on treeline slopes in southern dry subzones. Dominant tree is Bl. Common understory species are grouseberry and white mountain heather.			6	94	<b>100</b>	1%
	Krummholz Whitebark Pine – Subalpine Fir – White Mountain Avens	Sk10	Occurs on limestone geology in dry southern subzones. Dominant trees are Pa and Bl. Dominant forb is white mountain avens.				38	<b>38</b>	0.3%
	Alpine Larch – Subalpine	Sk20	Occurs on cool aspects or areas that accumulate more snow than other Alpine larch types. Mountain-heather, primarily western bell				11	<b>11</b>	0.1%



Ecosystem Groups	Ecosystem Class/Association Occurring in LSA			MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total (ha)	% of Study Area
	fir – Mountain Heathers Krummholz		heather is dominant though yellow mountain-heather is dominant on some sites, common to other large stands present.						
Alpine	Alpine Fellfield	Af	Fellfields are ecosystems of exposed locations where the dynamics of frost (freeze and thaw cycles) and of wind give rise to characteristic low plant cover in a rocky or mineral soil matrix. Thin snowpack leads to active freeze–thaw cycles that act to push plants out of the soil. High porosity or lack of soil makes a fellfield a difficult place for plants to grow. Fellfields are commonly populated by cushion plants (tufted perennials that grow close to the ground) and cryptogams.			11	64	<b>75</b>	1%
	Alpine meadow	Am	These ecosystems occur on fresh to moist usually well-developed soils that have continuous winter snowpack. Sites with seepage or unstable soils favor the Alpine Meadow Class over alpine heath ecosystems. Alpine meadow ecosystems are forb-dominated (or large sedge–dominated) ecosystems of subalpine and alpine elevations.			1		<b>1</b>	0.01%
	Alpine late snowbed	As	Areas with very deep or persistent snowpacks that last well into the growing season commonly support plant communities of low cover and low species diversity. These sites generally occur on cool aspects and in sheltered locations where snowmelt is slow.			0.2		<b>0.2</b>	0.002%
	Alpine tundra	At	Alpine tundra ecosystems occur on relatively exposed, cold, submesic to mesic sites with moderate snow cover. They often occur on windswept, gentle terrain such as high-elevation plateaus and rounded ridges and summits.			34	47	<b>81</b>	1%

Ecosystem Groups	Ecosystem Class/Association Occurring in LSA			MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total (ha)	% of Study Area
			Alpine tundra ecosystems are relatively well-vegetated ecosystems of mixed life-form composition, commonly with an abundance of dwarf shrubs and sedges ( <i>Carex</i> spp.) mixed with forbs and grasses.						
Water	Pond	PD	A small body of water greater than 2 m deep, but not large enough to be classified as a lake (e.g., less than 50 ha).	1	1			2	0.02%
	Lake	Lake	A large body of water > 2 m deep and greater than 50 ha.	74				74	0.3%
	Reservoir	Reservoir	An artificial basin created by the impoundment of water behind a human-made structure such as a dam, berm, dyke, or wall.	6				6	0.05%
Riparian		EV CEMF Riparian 110, 111, Flood, RI	Ecosystems associated with and influenced by water. In the study area, they are restricted to narrow (often 20m or less) bands along gullied stream channels. They are also found along Alexander and Grave Creeks and the the Elk River in areas influenced by water. This class overlaps with flood, river, and in some cases wetland ecosystems.	933	353	32		1,318	10%
Disclimax	Vegetation Disclimax	Xv	The vegetation disclimax class describes ecosystems where vegetation competition rather than environmental constraints maintains the non-forested state. Vegetation is generally lush enough to preclude tree establishment through shading, litter fall, or some other resource factor. Two types of vegetation disclimax occur within the study area: a graminoid dominated, circum-mesic meadow and a Sitka alder tall shrub field. The latter type is far more widespread in the study area than the meadow type. While the Sitka alder Xv ecosystem resembles a tall shrub avalanche track, these ecosystems are	5	64	1		70	1%

Ecosystem Groups	Ecosystem Class/Association Occurring in LSA			MSdw	ESSFdk1	ESSFdkw	ESSFdkp	Total (ha)	% of Study Area
			not subject to avalanching. Soil moisture regimes are frequently wetter than mesic leading to lush shrub cover that excludes tree regeneration.						
<b>Total Area Sensitive by BGC unit<sup>7</sup></b>				<b>1,608</b>	<b>1,232</b>	<b>423</b>	<b>564</b>	<b>3,827</b>	
<b>Total Area of BGC unit</b>				<b>6,064</b>	<b>4,704</b>	<b>1,554</b>	<b>564</b>	<b>12,886</b>	
<b>% of BGC unit sensitive</b>				<b>27</b>	<b>26</b>	<b>27</b>	<b>100</b>	<b>30</b>	

<sup>7</sup> This total area includes some area of overlap between riparian and flood, river and wetland ecosystems.

## Conclusion

Five red-listed vascular plant species were found within the LSA. Additionally, whitebark pine, a federally-listed species, is found in many areas within the LSA. However, due to its unique management status, whitebark pine is detailed in a separate report. The five listed species were found at six locations within the LSA. Two of the six locations were found within reasonable proximity (about 300 m distant) to proposed Project infrastructure.

A red-listed ecological community, the rough fescue - (bluebunch wheatgrass) - yarrow - clad lichens association was found within the LSA adjacent to proposed Project infrastructure at Grave Prairie. This low elevation grassland ecosystem covers 27 ha. This ecosystem has no known analogue within an approximately 58 km radius of the LSA.

A wide range of sensitive ecosystems (e.g. grasslands, wetlands, avalanche, rock, floodplain, alpine, riparian) were mapped within the LSA. Thirty percent of the LSA is covered by ecosystems that can be considered sensitive and may require special management consideration if impacted by the Project.

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