AIRPORT FLATS ECOSYSYEM REST0RATION PROJECT

Prepared for

B.C. Parks – Thompson-Cariboo

Cariboo Chilcotin Ecosystem Restoration Committee

Prepared by

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Executive Summary

The Airport Flats project area is located within Churn Creek Protected Area and falls within Airport Flats pasture. The open grassland is valuable spring range for mule deer and several species at risk. Grasslands and open forests at mid and higher elevations within the protected area are disappearing due to tree encroachment onto grasslands and ingrowth of open forests. In order to maintain suitable wildlife habitat within this important wildlife area, open grasslands and dry open forests need to be restored and maintained. Restoration efforts also benefit domestic livestock as grazing has become concentrated on remaining grasslands.

Recent prescribed burns by BC Parks targeting encroachment have had limited success in part because low intensity burning alone does not necessarily remove tree encroachment more than 2.0 m tall. To increase the likelihood that encroachment is successfully removed, prescribed burns can be preceded by slashing treatments.

The principal objective of this project was to reduce encroachment on Airport Flats. This objective was met through treating 157 hectares of encroachment by removing small diameter (<12.5 cm dbh) Douglas-fir stems. The project area was stratified into five habitat types based primarily on the dominant height and overall density of encroachment. Based on results from monitoring plots, total stem densities were reduce from 368 stems per hectare to 111 in the Encroachment Tall Open (ETO) habitat type, from 248 stems per hectare to 35 in the Encroachment Low Open (ELO) habitat type, from 959 stems per hectare to 325 in the Encroachment Tall Moderate density (ETM) habitat type, from 950 stems per hectare to 250 in the Encroachment Moderate height Moderate density (EMM) habitat type and from 1325 stems per hectare to 465 in the Encroachment Tall Dense (ETD) habitat type.

This project focused on felling encroachment. Few stems were bucked or limbed. It is anticipated that portions of Airport Flats, including the area of felled encroachment stems, will be treated further with prescribed burning by BC Wildfire Service in collaboration with BC Parks, separate from this project.

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Introduction

Churn Creek Protected Area is one of the most important grassland/dry forest conservation areas within British Columbia. It was established to conserve a range of grassland and dry forest ecosystems including important California bighorn sheep and mule deer populations and several species at risk. The area is unique in that it includes uninterrupted representation of lower (BGxh), middle (BGxw), and upper (IDF) elevation grassland.

Grasslands and open forests at mid and higher elevations within the protected area are disappearing due to tree encroachment onto grasslands and ingrowth of open forests. In order to maintain quality wildlife habitat within this important wildlife area, open grasslands and dry open forests need to be restored and maintained. Restoration efforts also benefit domestic grazing for livestock which is becoming concentrated on remaining grasslands.

Historically, grasslands in the area were renewed through frequent, low-intensity ground fires. Such fires prevented tree encroachment, rejuvenated understory plants and maintained more open grasslands and forests with large trees. The reintroduction of managed, low-intensity ground fires to these grasslands is intended to restore and maintain the traditional grassland plant communities that are native to the area. Recent efforts by BC Parks to remove grassland encroachment within the Protected Area by burning without manual pre-treatment have had limited success because stems greater than two meters tall cannot be reliably removed by burning alone (Steen 2012). The key objective of this project was to manually cut recent encroachment up to 12.5 centimeters (cm) in diameter at breast height (dbh) to ensure fine and medium sized fuels were placed near the ground and allowed to dry prior to scheduled burning. Prescribed burning of felled stems, not part of this project, will be undertaken separately by BC Wildfire Service in collaboration with BC Parks staff.

Figure 1. View of Airport Flats looking south from the north end of the ridge.

Project Area

The Airport Flats project area is situated within Airport Pasture which is located within the north-central portion of Churn Creek Protected Area immediately north of BC Lake (see Figure 2). Airport Pasture is approximately 650 hectares in size and dominated by a large open grassland plain located on Bishop Mountain. The pasture is bounded on the west by fencing separating it from Maytag Pasture and on the south by fencing and BC Lake separating it from BC Pasture, bluffs separating it from Bishop Field and fencing separating it from Gap Field. The east boundary of Airport Pasture is bounded by fencing along the Empire Valley Road in the vicinity of the Calving Barn camping area while the northeast and north boundaries of the pasture are loosely defined and separated from Onion Bar and Eagle Tree Pastures along the top of the north face of Bishop Mountain.

Figure 2. Airport Flats Project Area. Project area outlined in blue. Boundaries of Airport Pasture outlined by yellow dash - dot lines (fencing) and green dot (bluffs in south and ridge line in north).

The Airport Flats project area falls within the Interior Douglas-fir Very Dry Mild (IDFxm) biogeoclimatic subzone (Steen and Coupe 1997) with elevations ranging from 900 meters above sea level at BC Lake to 1030 meters at upper elevations. Slopes are generally gentle and warm (south to west) consisting of moderately-well to well-drained morainal material (till) with a thin eolian veneer cap (Sinclair et al. 1999). The lower slopes are steeper and dissected by gully erosion.

Although essentially the entire project area was classified as Grassland Benchmark in 2001, as part of the Cariboo Chilcotin Grassland Strategy, there is a complex array of Douglas-fir forest present throughout the area. The western boundary of the project area borders previously logged Douglas-fir forest while the eastern boundary extends to the edge of the existing encroachment with open grassland. There is a scattering of tall large diameter old-growth Douglas-fir in the area often associated with the major gullies. These trees are in the range of 50 – 80 cm dbh with some stems observed to have fire scars. A wave of older Douglas-fir encroachment exists in the 20 -30 cm dbh range and is present in patches mainly on mid to upper slopes. This layer of encroachment appears to be in the range of 40 – 70 years old. More recent encroachment from over the past 30 – 40 years is more extensive with higher densities often associated with older stands of Douglas-fir. Most of the recent encroachment is under 12.5 cm dbh thus that break point was prescribed as the upper limit of slashing.

A previous project, likely undertaken 10 – 15 years earlier, removed smaller encroachment from the perimeter of the large open grassland on the upper ridge of Bishop Mountain. Evidence of this work was detected on the upper slopes of the project area where stumps and slash piles were found. It appears that most slash from this previous project was piled but never burnt. Evidence of live limbs left on the previous-cut stumps was manifest where they had grown to again become trees.

Figure 3. Lower slopes of Airport Flats Project Area above BC Lake.

Methods

Treatment to Remove Encroachment

Slashing crews have successfully removed encroachment up to 17.5 cm dbh for other projects within Churn Creek Protected Area. After reconnaissance of this project area it was recognized that due to the lack of fire in the area for decades, a large component of the encroachment exceeded the upper limit of possible treatment by slashing and would be left standing following completion of the project. As initial reconnaissance suggested that the majority of recent encroachment was under 12.5 cm dbh the break point was used as the upper limit of required cutting. All cutting was conducted by a Stswecemc Xgat'tem Development Limited Partnership (SXDLP) crews under contract to the Friends of Churn Creek Protected Area Society (FCCPAS). The contracted crews were given cutting specifications and distinct portions of the project area were prioritized for cutting. The project extended over three years as funding became available and was secured. FCCPAS volunteers monitored progress and undertook quality assurance to ensure the crew was meeting specifications. Adjustments were made when necessary.

Douglas-fir encroachment stems were hand felled using a combination of brush saws and chain saws. Generally, personnel with brush saws felled stems with a basal (ground level) diameter of less than about 10 cm. Individuals using chain saws, generally felled the larger stems with a diameter at breast height (dbh) of up to 12.5 cm. The largest felled stems had a basal diameter of less than 20 cm. Most stems with a dbh > 12.5 cm were left standing. Felled stems were generally not bucked or limbed.

Figure 4. Falling layer 3 sized encroachment with a chainsaw at Airport Flats Project Area

Treatment Area Stratification

The project area included habitat types that ranged from areas of open grassland to closed stands of encroachment trees greater than 10 meters tall. After reviewing preliminary encroachment mapping based on aerial imagery interpretation completed by Ordell Steen for a previous project, the site was stratified into habitat types based on three categories of tree height and density (see Table 1). As aerial imagery was relatively old (from 2004) habitat types were finalized following reconnaissance walks through the area resulting in five encroachment habitat types along with open grassland (see Table 1).

Table 1. Encroachment habitat types identified for the Airport Flats Project Area

Habitat Type	Map Code	Mapping Attributes
Open Grassland	OG	Open grassland with no to very little encroachment.
Encroachment Low Open	ELO	Encroachment dominated by trees < 5m tall and widely spaced.
Encroachment Tall Open	ETO	Encroachment dominated by open canopy trees > 10m tall along with a low density of smaller trees < 5m tall.
Encroachment moderate height & moderate density	EMM	Encroachment with dominant trees 5 – 10 meters tall with a moderate density of overall stems
Encroachment Tall & moderate density	ETM	Encroachment dominated by trees > 10 meters tall with a moderate density of overall stems
Encroachment Tall Dense	ETD	Encroachment dominated by trees > 10 meters tall with a closed canopy

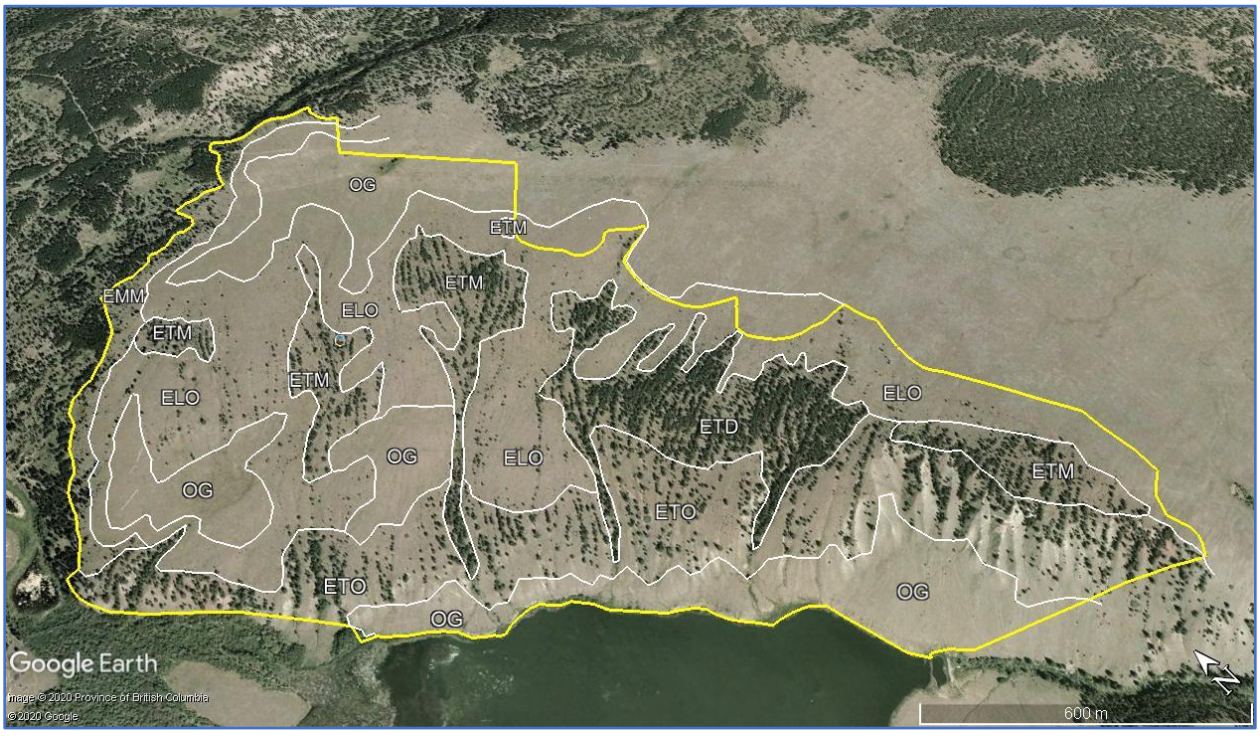

Figure 5. Map of habitat types within Airport Flats Project Area. Project area boundary outlined in yellow.

Establishing Monitoring Point Locations

A minimum of five sample plots were established within the five encroachment habitat types for monitoring effects of the prescribed treatment on grassland encroachment stem characteristics. Additional plots were established within habitat types with greatest extent. No sample plots were located within the Open Grassland habitat type. Plots were located without bias on Google Earth imagery overlain with mapping of habitat types. GPS coordinates were obtained from Google Earth imagery to allow for location of points on the ground. Each sample point center was permanently marked by pushing a ten-inch common nail spike with a two-inch fender washer into the ground. The spike head and washer were painted blue to assist future relocation.

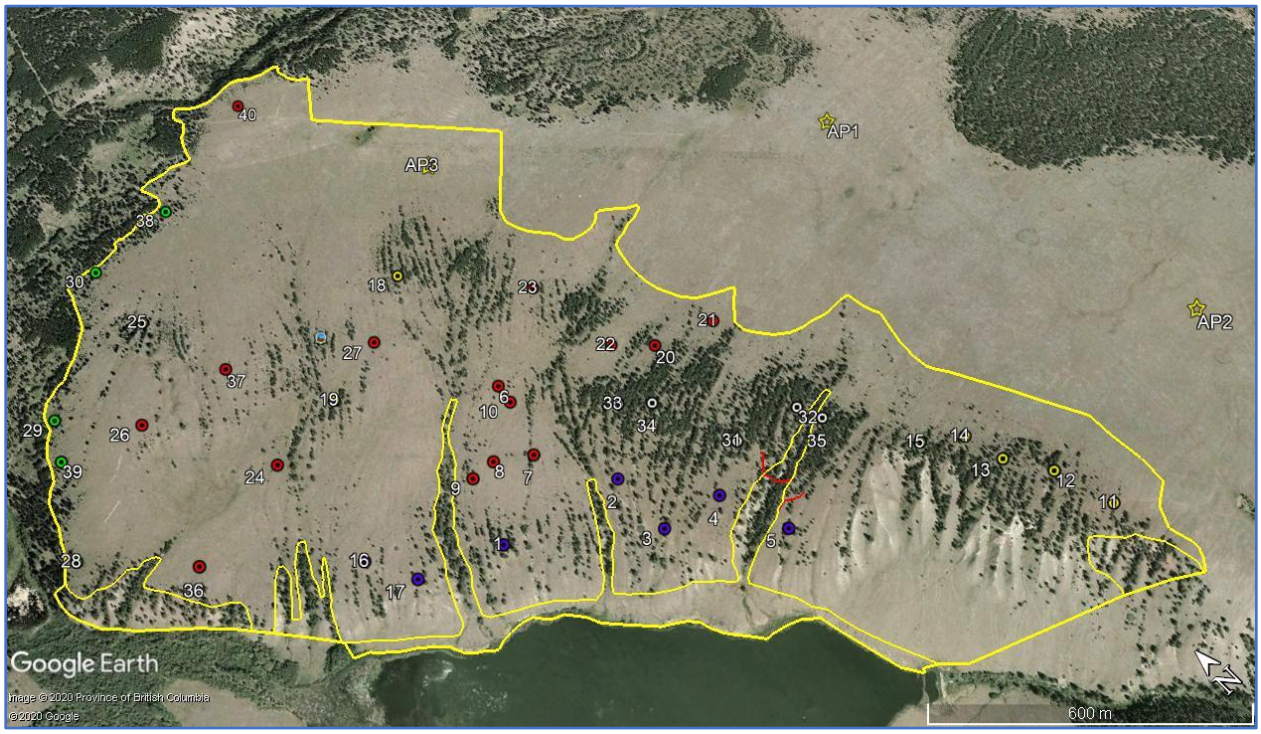

Figure 5. Map showing Airport Flats Project Area with outer boundary outlined in heavy yellow and reserve boundaries delineated in thin yellow. The location of encroachment monitoring plots shown with circular plot icons representing habitat type sampled; blue = ETO, red = ELO, yellow = ETM, green = EMM and white = ETD. Yellow star icons represent permanent pre-existing grassland ecosystem-health monitoring plots.

Table 2. GPS locations and site characteristics of monitoring plots at Airport Flats.

Plot Locations and Site Characteristics						
Type/Plot No.	UTM Coordinates (U10) East	UTM Coordinates (U10) North	Elevation (m)	Slope Aspect	Slope Grade (%)	Slope Position
ETO						
1	547247	5699983	934	SW	22	Mid
2	547494	5699921	946	SW	15	Mid

Table 2 Continued.

3	547491	5699789	931	SW	15	Mid
4	547612	5699758	945	SW	17	Mid
5	547661	5699620	938	W	22	Mid
16	547036	5700145	932	SW	15	Lower
17	547087	5700049	926	SW	20	Lower
ELO						
6	547454	5700224	970	SW	10	Mid
7	547408	5700070	956	SW	11	Mid
8	547342	5700115	955	W	10	Mid
9	547291	5700119	949	SW	11	Mid
10	547448	5700182	968	W	10	Mid
20	547738	5700062	985	W	12	Upper
21	547859	5700015	994	W	8	Upper
22	547677	5700127	979	W	10	Upper
23	547649	5700331	992	SW	8	Upper
24	547035	5700409	952	SW	9	Lower
26	546894	5700656	970	SW	15	Mid
27	547336	5700471	979	SW	10	Upper
36	546806	5700354	941	SW	12	Lower
37	547084	5700634	979	SW	20	Mid
40	547480	5701107	1033	S	4	Crest
ETM						
11	548122	5699215	992	SW	26	Upper
12	548093	5699333	994	SW	18	Upper
13	548043	5699417	991	W	18	Upper
14	548027	5699497	993	W	15	Upper
15	547959	5699551	985	SW	26	Upper
18	547466	5700549	995	SW	15	Upper
19	547199	5700432	968	SW	12	Upper
25	547024	5700828	997	SW	10	Mid
EMM						
28	546644	5700528	935	W	20	Lower
29	546775	5700789	965	W	?	Mid
30	547021	5700992	1001	W	20	Mid
38	547209	5701000	1019	SW	10	Upper
39	546736	5700709	957	W	20	Lower
ETD						
31	547712	5699807	966	W	22	Lower
32	547845	5699770	979	W	15	Mid
33	547599	5700027	969	SW	15	Mid
34	547648	5699980	973	W	20	Mid
35	547693	5700248	978	W	25	Mid

Documented Tree Characteristics

Tree encroachment at each monitoring point was described with a combination of a fixed radius and a variable radius plot. Fixed radius plots (5.64 m radius plots centered on each sample point) were used to sample all tree species stems < 17.5 cm dbh, including young seedlings. Larger trees (≥ 17.5 cm dbh) were sampled in variable radius plots, also centered on the sample points, using a basal area factor (BAF) 4 prism. In the fixed radius plot, the center of the tree bole at 30 cm height was the point for judging whether the tree was in or out of the plot.

In both the fixed and variable radius plots, the following information was recorded for each tree stem within the plot:

- stem number
- species
- diameter (cm) at breast height (dbh)
- diameter (cm) at 30 cm height
- height (m)
- tree condition (good, fair, poor, morbid, dead)
- percent live crown (percent of total stem height with live branches)

Trees were grouped into five size classes or layers defined for the purposes of this project:

- Layer 1 –stems ≥ 17.5 cm dbh
- Layer 2 - stems 12.5 – 17.4 cm dbh
- Layer 3 - stems 7.5 – 12.4 cm dbh
- Layer 4 - stems > 1.3 m tall and < 7.5 cm dbh
- Layer 5 – stems < 1.3 m tall

Any, none, or all of these size classes may be present.

Tree condition was documented in four classes for live trees and one class for dead trees:

- good – all upper stem branches are fully leafed (have full complement of needles) with dark green, long needles;
- fair – several upper stem branches are not fully leafed or many needles are light or yellow green or stunted, tree vigor obviously reduced;
- poor – many to most upper branches with reduced complement of needles or all needles light to yellow green;
- moribund – live needles on only 1 – few branches, tree appears near death.
- dead – no live needles on any tree branch.

Percent live crown of a tree was estimated as the percent of the total stem length, from the ground to the top leader, that had live branches.

As the project extended over three years, plots were established in either 2017, 2018 or 2019, prior to treatment, and monitored again post-treatment in either 2018 or 2019.

Tree age estimates were obtained by counting tree rings from a sample of stumps of freshly cut trees and measuring the stump diameter or utilizing an increment borer estimating tree age at stump height (30 cm).

Tree stand data were summarized by tree size class for each monitoring point and then averaged across the encroachment type. Pre- and post-treatment data for each encroachment type were summarized and compared for tree stem density (stems/ha) to document success in meeting treatment objectives.

Photographic Record

The 40 monitoring point locations also served as photo points with both pre-treatment and post-treatment photographs taken from each plot center. Four photographs were taken at each point, one in each of the four cardinal bearings.

Results

Area Treated and Crew Productivity

The SXDLP contract crew worked fifteen days in November and December 2017, eight days in October and November 2018 and 5 days in July 2019. Crew strength varied from 3 to 5 individuals depending on the day with a total of 113 person days worked to complete the project. Approximately 61 hectares were treated in 2017, 61 hectares in 2018 and 35 hectares in 2019 for a total of 157 hectares of encroachment treated.

Following slashing in 2017, a band of heavy slash loading was present along the ridge line near the south end of the project area. To ensure that slash was not an impediment to mule deer movement, the slashing crew also bucked and piled the slash in an area of 1.5 hectares and the following year, in November 2018, piles were burnt by FCCPAS volunteers. In 2019 slashing crews also bucked and piled a small area of heavy slash to reduce fuel loading. That slash was located in the north corner along the project area boundary. The 0.4 hectares of piles were burnt by FCCPAS volunteers in November 2019.

Figure 6. Burning slash piles at north end of project area.

Pre-treatment Habitat Type Tree Characteristics

The two primary site attributes utilized to separate encroachment habitats types were dominant tree height and crown closure/stem density.

Stem densities in the seven plots within the ETO habitat type varied from 7 to 1000 stems per hectare and averaged 368 stems per hectare. This habitat type was found on the steeper lower slopes and was dominated by an open stand of tall, large-diameter old-growth Douglas-fir with an understory of open layer 4 encroachment. Other tree layers were present but at low densities (see Figure 7).

Figure 7. Example of the ETO Habitat Type

The ELO habitat type was the most common within the project area found on upper, mid and lower slopes. Stem densities in the 15 plots varied from 0 to 1100 stems per hectare and averaged 248 stems per hectare pre-treatment. This type was dominated by recent encroachment in layer 4 along with some stems in layer 3 and layer 5. Most stems were less than five meters tall and widely spaced. Few layer 2 and very few layer 1 stems occurred in any plots. Most stems possessed live limbs to ground level (see Figure 8).

Figure 8. Example of the ELO Habitat Type

Stem densities in the eight plots within the ETM habitat type varied from 219 to 2816 stems per hectare and averaged 959 stems per hectare. This habitat type was mostly found on gentle slopes at mid to upper elevations within the project area and contained a moderately-closed stand of tall layer 1 trees along with recent encroachment of moderate density. Layer 1 had a cluster of trees in the 20 – 30 cm dbh range along with an open layer of tall, large-diameter old-growth Douglas-fir. The more recent encroachment was dominated by trees in layer 5 followed by stems in layer 4 and even less in layer 3. Few trees occurred in layer 2 (see Figure 9).

Figure 9. Example of the ETM Habitat Type

Stem densities in the five monitoring plots within the EMM habitat type varied from 400 to 2064 stems per hectare and averaged 950 stems per hectare. This habitat type was only found along the northwest boundary of the project area immediately adjacent to a Douglas-fir forest type. A portion of the upper slopes of this habitat had been treated by a previous restoration project. All stem classes were represented within this habitat type although layers 4 and 5 were the most abundant. Most stems were less than 10 meters tall with no noted old growth stems. Both live and dead limbs were detected to ground level (see Figure 10).

Figure 10. Example of EMM Habitat Type

Stem densities in the five monitoring plots within the ETD habitat type varied from 480 to 3180 stems per hectare and averaged 1325 stems per hectare. This habitat type was found on gentle slopes at mid to upper elevations within the project area. The ETD habitat type had a closed canopy of tall layer 1 trees along with more recent encroachment. Layer 1 contained both an open stand of tall, large-diameter old-growth Douglas-fir and a cluster of older encroachment in the 20 – 30 cm dbh range. More recent encroachment located in the understory was dominated by stems in layer 4 with fewer stems in layer 3 and then less trees in layers 2 and 5. Although this habitat type had a closed canopy of older stems and many trees with dead limbs near ground level there were few dead trees observed within the stand (see Figure 11).

Figure 11. Example of ETD Habitat Type

Pre-treatment mean densities and size of trees in plots from each encroachment type is summarized in Table 2 and Figure 12. All stems recorded in plots were Douglas-fir with virtually all stems considered alive.

Table 1. Pre-treatment Douglas-fir stand characteristics as an average by Encroachment Type at Airport Flats.

Encroachment Type	Tree Layer	Stems/ha	Diameter (cm)		Height (m)
			1.3 m	0.3 m	
ETO	1	97	27.0	35.0	12.8
	2	29	12.8	19.1	6.4
	3	29	10.4	15.3	5.9
	4	157	3.6	6.7	2.8
	5	57	-	1.9	0.8
ELO	1	1	52.0	47.8	13.4
	2	20	14.8	19.6	7.3
	3	40	9.3	13.8	5.3
	4	133	4.1	7.5	3.2
	5	53	-	1.1	0.8
ETM	1	146	28.3	34.2	13.0
	2	63	15.0	18.9	8.6
	3	100	8.9	13.2	6.0
	4	225	3.7	6.3	3.1
	5	425	-	1.8	0.7
EMM	1	70	29.6	34.2	12.3
	2	80	14.9	19.9	7.7
	3	100	9.6	12.6	6.7
	4	260	3.2	5.7	2.8
	5	440	-	1.4	0.6
ETD	1	345	24.0	28.1	12.8
	2	140	14.5	17.4	9.2
	3	240	9.6	11.7	8.0
	4	480	3.0	4.4	3.2
	5	120	-	1.4	0.8

Post-treatment Habitat Type Tree Characteristics

Based on results from monitoring plots the slashing crew removed all layer 4 stems from the treatment area (Table 3; Figure 13). Some shorter layer 5 stems remained in the ELO, ETM and EMM habitat types following treatment with most remaining stems less than 0.5 meters tall. Monitoring showed a small number of layer 3 stems were left in the ETD habitat type and that a portion of layer 2 stems were removed from all habitat types. There was no change in densities of layer 1 stems in any habitat type. Total stem densities were reduced from 368 stems per hectare to 111 in the ETO habitat type, from 248 stems per hectare to 35 in the ELO habitat type, from 959 stems per hectare to 321 in the ETM habitat type, from 950 stems per hectare to 250 in the EMM habitat type and from 1325 stems per hectare to 465 in the ETD habitat type.

Table 2. Post-treatment Douglas-fir stand characteristics as an average by Encroachment Type at Airport Flats.

Encroachment Type	Tree Layer	Stems/ha	Diameter (cm)		Height (m)
			1.3 m	0.3 m	
ETO	1	97	27.0	35.0	12.8
	2	14	13.0	17.0	7.0
	3	0	-	-	-
	4	0	-	-	-
	5	0	-	-	-
ELO	1	1	52.0	47.8	13.4
	2	7	14.8	19.6	7.3
	3	0	-	-	-
	4	0	-	-	-
	5	27	-	0.4	0.3
ETM	1	146	28.3	34.2	13.0
	2	29	16.4	20.7	8.6
	3	0	-	-	-
	4	0	-	-	-
	5	150	-	0.5	0.3
EMM	1	70	29.6	34.2	12.3
	2	40	15.1	20.4	7.9
	3	0	-	-	-
	4	0	-	-	-
	5	140	-	1.3	0.5
ETD	1	345	24.0	28.1	12.8
	2	100	14.8	18.1	9.8
	3	20	9.3	12.2	8.0
	4	0	-	-	-
	5	0	-	-	-

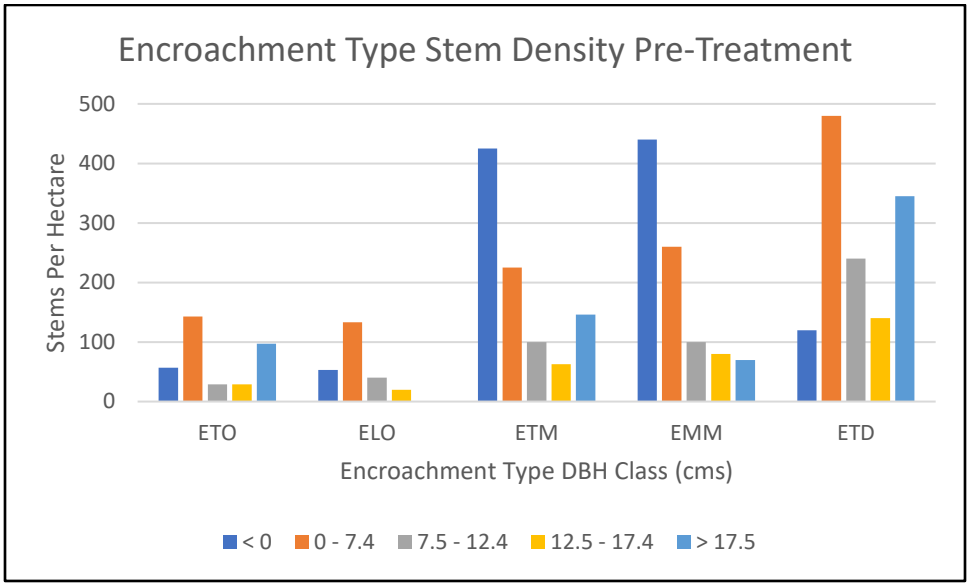

Figure 12. Summary of Pre-treatment stem density by encroachment type and diameter class.

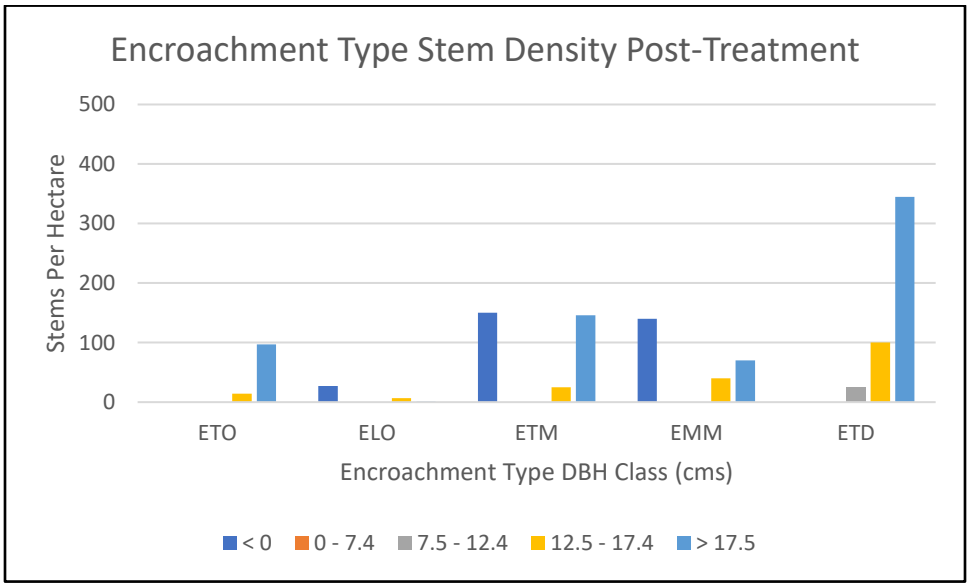

Figure 13. Summary of Post-treatment stem density by encroachment type and diameter class.

Anecdotal Observations

Grassland Condition

In 2014 Steen (2015) established three permanent assessment plots within the upper grasslands (IDFxm) of Airport Pasture to document and monitor the health of grassland ecosystems (see Figure 5 for location of plots). Methodology followed that developed by the Grassland Conservation Council of BC which placed grasslands into one of four possible categories listed in order of declining condition; reference, slightly altered, moderately altered and greatly altered. Plot AF1 was established to represent dominant conditions in the west part of the pasture where grassland health was considered moderately altered. Plot AF2 represented conditions in the east part of the pasture where grassland health was considered greatly altered to borderline moderately altered. Steen (2014) noted that reference and slighted altered grasslands occurred locally within the upper grasslands with plot AF3 representing an area of grassland in the reference condition. No plots were established in the middle grasslands (BGxw).

During field work while completing this restoration project, observations of grassland condition generally followed those documented by Steen. Grassland condition generally improved from south to north as noted by the reference condition observed by Steen at plot AP3. Grassland condition also generally improved with distance from the primary water source, BC Lake. Permanent sources of water are scarce in the pasture with BC and Hairy Fish Lake the two main watering sites available to livestock. The small wetland just east of the south end of the project area collects snowmelt in spring but usually only contains standing water for a few weeks.

Although no plots were established, grassland health along the toe slope position adjacent to BC Lake was considered greatly altered with patches of weedy plant species such as mustard (*Sisymbrium spp*.), summer cypress (*Kochia scoparia*), western stickseed (*Lappula redowskii*) Canada thistle (Cirsium arvensis), alfalfa (*Medicago sativa*), along with a few common burdock (*Arctium minus*) and hound's tongue (*Cynoglossum officinale*) present. At mid-slope patches of bluegrass (*Poa spp*.) were noted and at upper elevations alfalfa and crested wheatgrass (*Agropyron cristatum*) were scattered along the ridge in the vicinity of the old airstrip. Relatively low levels of fine fuels were noted on the lower slopes which may hamper efforts to carry a future prescribed fire in that portion of the project area.

Figure 14. Patches of western stickseed in foreground.

Invasive Plant Species

Controlling invasive plant species continues to be and ongoing and major issue within Churn Creek Protected Area. During field work an effort was made to document and where possible, removed invasive plant species (see Figure 15, Appendix 3).

The concentration of diffuse knapweed (*Centaurea diffusa*) outlined in white on Figure 15 has grown from a number of clumps as documented between 2005 and 2007 to a large patch of scattered plants now over 1.0 hectares in size. Due to the extent of this infestation no attempt was made to remove mature plants.

A concentration of common burdock was detected along the west edge of the project area just south of Hairy Fish Lake (see Figure 15). The burdock patch is located on level terrain in rich moist soil adjacent to the toe slope. The impacted ecosystem is rare within the protected area and valuable wildlife habitat. Due to the extent of the infestation no attempt was made to remove mature plants.

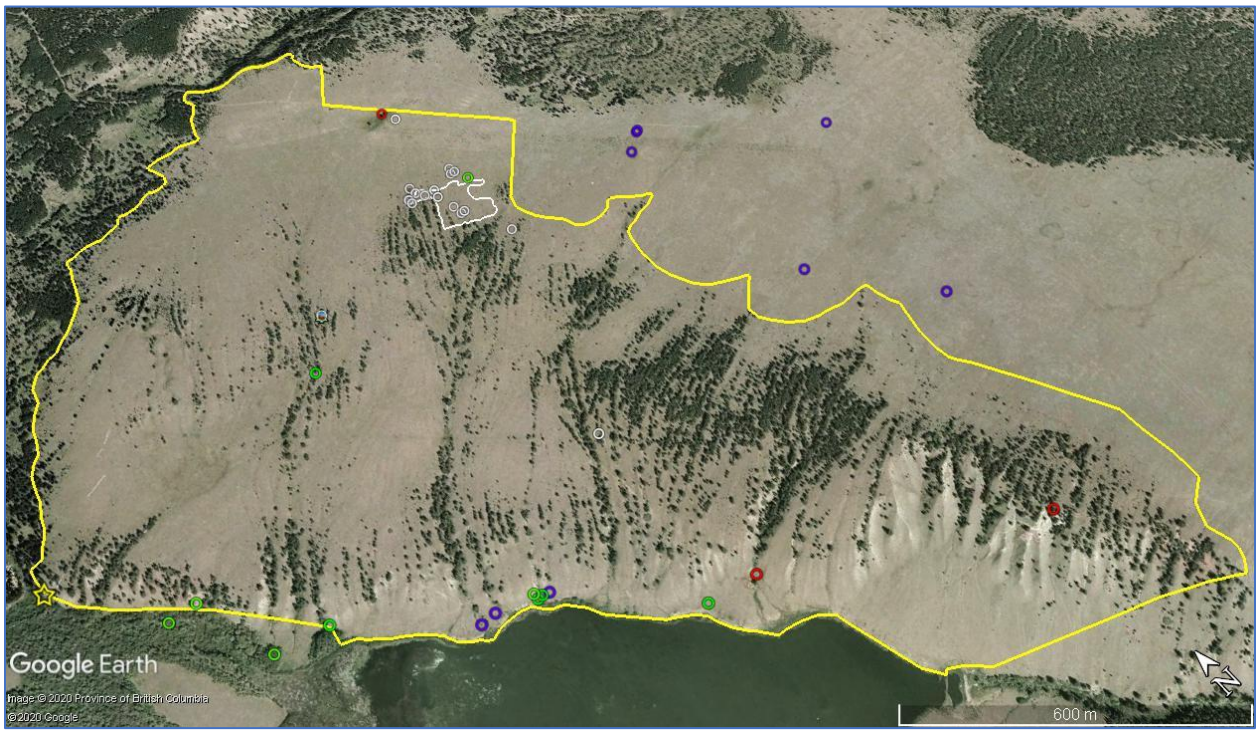

Figure 15. Locations of documented invasive plants within Airport Flats project area. The colour of circles represents different species; white = diffuse knapweed, blue = hound's tongue, green = common burdock, red = hound's tongue & common burdock. Yellow star represents location of concentration of common burdock south of Hairy Fish Lake.

Discussion

Treatment Prescription

The need for treatment of forest encroachment of grassland and forest ingrowth is widespread within Churn Creek Protected Area with numerous relevant guidelines developed to aid in ecosystem restoration projects. When developing the prescriptions for this project the guiding principles outlined in several relevant documents were reviewed and considered including Best Management Practices (Cariboo-Chilcotin Grassland Strategy Working Group 2001, 2007), regional grassland restoration recommendations (Steele et. al. 2007) and the BC Parks Tree Removal Policy. As the project area falls within the Koster-Grinder mule deer winter range guidelines for restoring Mule Deer habitat (Dawson and Armleder 2000) were also reviewed. The stand attributes of encroachment habitat types were also a key variable in determining the upper limit of cutting specifications.

The prescription removed the majority of stems from the ELO habitat type converting it to an open grassland with scattered trees and expanding the area of open grassland within the treatment area from approximately 21% to nearly 59%. With decades old encroachment, even after treatment the ETO, ETM and EMM habitat types had attributes that would have them characterized more as open forest and represented approximately 18, 11 and 4 percent of the treatment area respectively. The ETD habitat type contained basal area approaching that adequate to meet minimum residual basal area immediately post harvest for the low crown closure habitat class of mule deer winter range, although not adequate basal area in the large diameter category (≥ 37.5 cm dbh). The ETD habitat type represented approximately 9% of the treatment area. The prescribed fire planned for the area may further reduce encroachment.

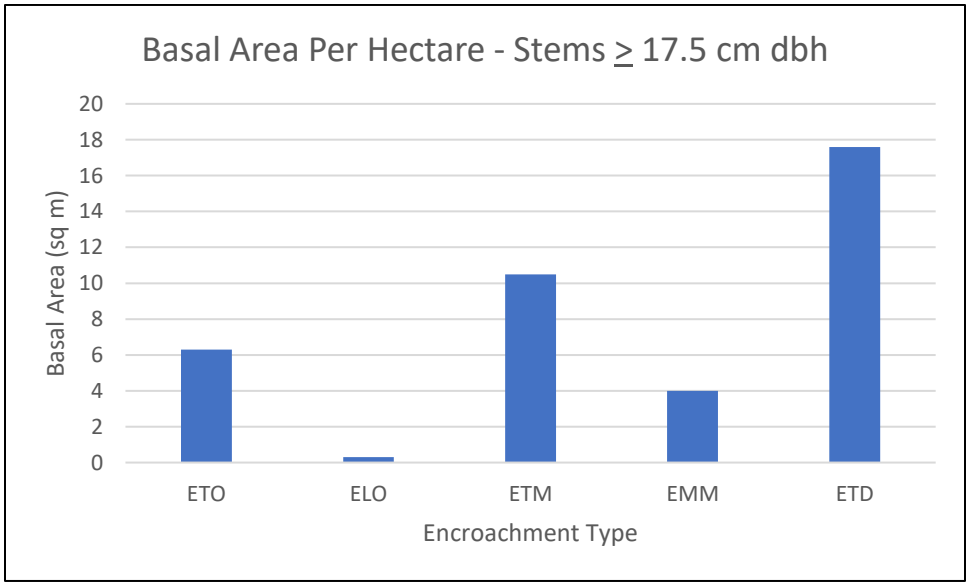

Figure 14. Residual basal area of stems ≥ 17.5 cm dbh within encroachment habitat types at Airport Flats.

The project area was designed with future prescribed burning in mind encompassing the extent of encroachment on the warm aspects above BC Lake. The west boundary followed the edge of a forest habitat type with a cooler aspect and the upper boundary extended to the crest position and cooler aspect. The southeast boundary followed the edge of open grassland with little encroachment. The open grassland to the southeast also has a similar aspect and could be combined with the treatment area when planning prescribed burning.

Other areas within Airport Pasture are also in need of restoration. The east end of Airport Pasture contains a mix of encroachment and Douglas-fir open forest with ingrowth. Much of the cooler slopes on the north side of the pasture were logged prior to Protected Area establishment and are filling in with encroachment and ingrowth. The west end of the pasture was also logged prior to Protected Area establishment. The low pass north of Hairy Fish Lake is dominated by both west and east facing slopes that are a mix of encroachment and ingrowth.

Project Costs

The total direct costs of this project were $42,188.37 of which CCERC contributed $32,188.37 and BC Parks provided $10,000.00. These funds generate a per hectare cost of treatment of approximately $270.00 for the project area. Of the total direct costs $37,013.65 or 88% was directed to the slashing crew. Expenses totaled $3,431.21 or 8% and included materials and supplies and travel costs for FCCPAS volunteers. Administration and overhead costs totalled $1,743.51 or 4%. FCCPAS in-kind support contributions were valued at approximately $25,000.00.

Future Monitoring

In the past, fires were a frequent and widespread natural disturbance agent in the region (Blackwell et. al. 2001, Harvey et. al. 2017). Although the majority of layer 3 and smaller stems were removed from the treatment area a few of the shorter encroachment stems were overlooked by the slashing crew and some of the freshly cut stumps had live limbs remaining on them following treatment. In 2019 a large number of Douglas-fir germinates were observed in some plots. These young stems were not recorded but could represent the beginning of a new major wave of encroachment in the area. Prescribed burning of the site should reduce the risk of the shorter remaining live stems surviving longer term and reduce the frequency of subsequent manual treatment of the site.

The Friends of Churn Creek Protected Area Society anticipates monitoring sampling plots following treatment of the project area with a prescribed burn as Airport Flats will be incorporated into BC Parks ongoing burning program for Churn Creek Protected Area. The principal interest is in documenting any further reductions to the abundance of the remaining encroachment following prescribed burning

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Appendices

Appendix 1: Pre-treatment Stand Characteristics. All stems were Douglas-fir.

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ETO							
1	>17.4	268	26.4	36.4	13.7	G	85
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	100	-	2.0	1.1	G	100
	Total	368					
2	>17.4	7	83.5	90.0	19.0	F	75
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	7					
3	>17.4	59	29.4	48.2	12.0	G	90
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	59					
4	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	100	10.1	14.1	6.0	G	100
	0 - 7.4	800	3.6	6.7	2.9	G	100
	< 1.3 m tall	100	-	2.0	0.8	D	0
	Total	1000					
5	>17.4	28	42.5	48.3	15.6	G	100
	12.5 - 17.4	100	12.6	21.1	5.7	G	90
	7.5 - 12.4	100	10.7	16.5	58	G	85
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	200	-	2.5	0.8	G	100
	Total	428					
16	>17.4	296	22.7	27.0	11.5	G	90
	12.5 - 17.4	100	13.0	17.0	7.0	F	90
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	396					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ETO							
17	>17.4	18	54.0	58.0	15.0	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	200	3.5	6.6	2.5	G	100
	< 1.3 m tall	100	-	0.5	0.2	G	100
	Total	318					
ETO	>17.4	97	27.0	35.0	12.8		
Average	12.5 - 17.4	29	12.8	19.1	6.4		
	7.5 - 12.4	29	10.4	15.3	5.9		
	0 - 7.4	157	3.6	6.7	2.8		
	< 1.3 m tall	71	-	1.9	0.7		
	Total	368					
ELO							
6	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
7	>17.4	19	52.0	47.8	13.4	G	100
	12.5 - 17.4	100	14.2	18.4	6.3	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	400	2.8	5.5	2.3	G	100
	< 1.3 m tall	200	-	2.0	0.8	G	100
	Total	719					
8	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
9	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ELO							
10	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
20	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	200	8.5	11.6	5.2	G	100
	0 - 7.4	900	4.4	7.6	3.5	G	100
	< 1.3 m tall	0	-	-	-	-	-
	Total	1100					
21	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	200	9.9	15.3	5.0	G	100
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	300	-	0.3	0.2	G	100
	Total	500					
22	>17.4	0	-	-	-	-	-
	12.5 - 17.4	100	14.3	18.8	8.0	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	100	3.5	7.4	3.0	G	100
	< 1.3 m tall	100	-	0.5	0.5	G	100
	Total	300					
23	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	100	10.0	15.4	6.0	G	100
	0 - 7.4	400	5.4	9.3	3.9	G	100
	< 1.3 m tall	200	-	1.5	0.8	G	100
	Total	700					
24	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ELO							
26	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	100	8.7	13.5	5.2	G	100
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	100					
27	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	100	6.3	12.0	4.2	G	100
	< 1.3 m tall	0	-	-	-	-	-
	Total	100					
36	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
37	>17.4	0	-	-	-	-	-
	12.5 - 17.4	100	15.9	21.5	7.5	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	100	0.5	3.0	1.4	G	100
	< 1.3 m tall	0	-	-	-	-	-
	Total	200					
40	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
ELO	>17.4	1	52.0	47.8	13.4		
Average	12.5 - 17.4	20	14.8	19.6	7.3		
	7.5 - 12.4	40	9.3	13.8	5.3		
	0 - 7.4	133	4.1	7.5	3.2		
	< 1.3 m tall	53	-	1.1	0.8		
	Total	248					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ETM							
11	>17.4	24	46.4	47.0	16.2	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	100	7.5	15.5	5.2	G	100
	0 - 7.4	100	4.2	8.7	3.0	F	100
	< 1.3 m tall	0	-	-	-	-	-
	Total	224					
12	>17.4	59	57.6	64.9	13.8	F	55
	12.5 - 17.4	300	15.4	19.2	9.1	G	95
	7.5 - 12.4	300	9.5	14.4	6.3	G	100
	0 - 7.4	200	5.2	8.7	3.8	G	100
	< 1.3 m tall	800	-	2.1	1.7	G	100
	Total	1659					
13	>17.4	327	24.7	29.9	11.8	G	95
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	100	2.0	5.0	2.0	F	100
	< 1.3 m tall	200	-	4.0	1.0	F	95
	Total	627					
14	>17.4	0	-	-	-	-	-
	12.5 - 17.4	100	15.7	20.9	7.9	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	100	3.6	9.0	3.0	G	100
	< 1.3 m tall	100	-	1.0	0.3	G	100
	Total	300					
15	>17.4	19	71.8	83.9	20.1	G	90
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	100	7.9	11.6	4.8	G	100
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	100	-	0.0	0.2	P	100
	Total	219					
18	>17.4	187	28.5	34.4	14.6	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	100	8.9	12.5	6.1	G	100
	0 - 7.4	400	3.2	6.6	2.9	G	100
	< 1.3 m tall	200	-	2.5	1.0	G	100
	Total	887					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ETM							
19	>17.4	337	24.1	29.0	11.9	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	100	9.9	12.9	7.6	G	100
	0 - 7.4	100	4.4	6.7	3.6	G	100
	< 1.3 m tall	400	-	2.2	0.8	G	100
	Total	937					
25	>17.4	216	26.5	33.5	14.0	?	?
	12.5 - 17.4	100	13.2	15.8	8.0	G	?
	7.5 - 12.4	100	8.5	9.9	5.5	G	?
	0 - 7.4	800	3.6	5.0	3.2	?	?
	< 1.3 m tall	1600	-	1.4	0.6	?	?
	Total	2816					
ETM Average	>17.4	146	28.3	34.2	13.0		
	12.5 - 17.4	63	15.0	18.9	8.6		
	7.5 - 12.4	100	8.9	13.2	6.0		
	0 - 7.4	225	3.7	6.3	3.1		
	< 1.3 m tall	425	-	1.8	0.7		
	Total	959					
ETD							
31	>17.4	249	28.6	32.1	12.6	G	60
	12.5 - 17.4	200	15.5	18.4	8.8	G	40
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	449					
32	>17.4	380	24.3	27.2	12.6	G	90
	12.5 - 17.4	300	13.6	16.1	8.3	?	?
	7.5 - 12.4	700	9.8	11.8	8.2	?	?
	0 - 7.4	1600	3.2	4.7	3.5	F	?
	< 1.3 m tall	200	-	1.8	1.0	F	?
	Total	3180					
33	>17.4	380	22.9	27.2	13.0	G	75
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	100	-	1.0	0.6	G	100
	Total	480					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ETD							
34	>17.4	472	23.0	28.2	13.1	G	?
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	300	9.8	11.7	7.5	G	?
	0 - 7.4	100	4.2	5.6	3.5	G	?
	< 1.3 m tall	0	-	-	-	-	-
	Total	872					
35	>17.4	247	22.8	26.7	12.3	G	90
	12.5 - 17.4	200	14.8	18.2	11.1	G	100
	7.5 - 12.4	200	8.8	11.6	8.0	G	100
	0 - 7.4	700	2.2	3.9	2.6	G	100
	< 1.3 m tall	300	-	1.5	0.7	G	100
	Total	1647					
ETD	>17.4	345	24.0	28.1	12.8		
Average	12.5 - 17.4	140	14.5	17.4	9.2		
	7.5 - 12.4	240	9.6	11.7	8.0		
	0 - 7.4	480	3.0	4.4	3.2		
	< 1.3 m tall	120	-	1.4	0.8		
	Total	1325					
EMM							
28	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	200	8.0	11.6	5.3	G	100
	0 - 7.4	100	1.5	3.8	2.2	G	100
	< 1.3 m tall	100	-	2.0	1.1	G	100
	Total	400					
29	>17.4	85	34.7	39.7	12.9	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	300	4.4	7.1	3.1	G	100
	< 1.3 m tall	800	-	1.4	0.6	G	100
	Total	1185					
30	>17.4	0	-	-	-	-	-
	12.5 - 17.4	100	14.8	22.0	6.9	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	400	3.4	5.6	3.1	G	100
	< 1.3 m tall	300	-	1.7	0.6	G	100
	Total	800					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
EMM							
38	>17.4	30	41.2	47.5	14.4	G	100
	12.5 - 17.4	200	14.8	19.4	7.6	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	230					
39	>17.4	164	24.9	29.0	11.6	G	100
	12.5 - 17.4	100	15.3	18.8	8.8	G	100
	7.5 - 12.4	300	10.6	13.2	7.7	G	100
	0 - 7.4	500	2.6	5.3	2.5	G	100
	< 1.3 m tall	1000	-	1.2	0.5	G	100
	Total	2064					
EMM	>17.4	70	29.6	34.2	12.3		
Average	12.5 - 17.4	80	14.9	19.9	7.7		
	7.5 - 12.4	100	9.6	12.6	6.7		
	0 - 7.4	260	3.2	5.7	2.8		
	< 1.3 m tall	440	-	1.4	0.6		
	Total	950					

Appendix 2: Post-treatment Stand Characteristics. All stems were Douglas-fir.

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ETO							
1	>17.4	268	26.4	36.4	13.7	G	85
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	268					
2	>17.4	7	83.5	90.0	19.0	F	75
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	7					
3	>17.4	59	29.4	48.2	12.0	G	90
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	59					
4	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
5	>17.4	28	42.5	48.3	15.6	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	28					
16	>17.4	296	22.7	27.0	11.5	G	90
	12.5 - 17.4	100	13.0	17.0	7.0	F	90
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	396					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ETO							
17	>17.4	18	54.0	58.0	15.0	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	318					
ETO	>17.4	97	37.2	44.9	14.4		
Average	12.5 - 17.4	14	13.0	17.0	7.0		
	7.5 - 12.4	0					
	0 - 7.4	0					
	< 1.3 m tall	0					
	Total	111					
ELO							
6	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
7	>17.4	19	52.0	47.8	13.4	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	19					
8	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
9	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ELO							
10	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
20	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
21	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	200	-	0.3	0.3	G	100
	Total	200					
22	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	100	-	-	0.2	G	100
	Total	300					
23	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	100	-	1.0	0.4	G	100
	Total	100					
24	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ELO							
26	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
27	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
36	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
37	>17.4	0	-	-	-	-	-
	12.5 - 17.4	100	15.9	21.5	7.5	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	100					
40	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
ELO	>17.4	1	52.0	47.8	13.4		
Average	12.5 - 17.4	7	14.8	19.6	7.3		
	7.5 - 12.4	0	-	-	-		
	0 - 7.4	0	-	-	-		
	< 1.3 m tall	27	-	0.4	0.3		
	Total	35					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ETM							
11	>17.4	24	46.4	47.0	16.2	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	100	-	0.1	0.4	G	100
	Total	124					
12	>17.4	59	57.6	64.9	13.8	F	55
	12.5 - 17.4	100	17.0	20.5	9.3	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	400	-	0.9	0.5	G	100
	Total	559					
13	>17.4	327	24.7	29.9	11.8	G	95
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	327					
14	>17.4	0	-	-	-	-	-
	12.5 - 17.4	100	15.7	20.9	7.9	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0					
	< 1.3 m tall	600	-	0.2	0.1	G	100
	Total	700					
15	>17.4	19	71.8	83.9	20.1	G	90
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	19					
18	>17.4	187	28.5	34.4	14.6	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	187					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ETM							
19	>17.4	337	24.1	29.0	11.9	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	337					
25	>17.4	216	26.5	33.5	14.0	?	?
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	100	-	1.0	0.6	G	100
	Total	316					
ETM	>17.4	146	28.3	34.2	13.0		
Average	12.5 - 17.4	25	16.4	20.7	8.6		
	7.5 - 12.4	0	-	-	-		
	0 - 7.4	0	-	-	-		
	< 1.3 m tall	150	-	0.5	0.3		
	Total	321					
ETD							
31	>17.4	249	28.6	32.1	12.6	G	60
	12.5 - 17.4	200	15.5	18.4	8.8	G	40
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	449					
32	>17.4	380	24.3	27.2	12.6	G	90
	12.5 - 17.4	100	13.4	17.3	9.0	?	?
	7.5 - 12.4	100	9.3	12.2	8.0	?	?
	0 - 7.4	0					
	< 1.3 m tall	0					
	Total	580					
33	>17.4	380	22.9	27.2	13.0	G	75
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	380					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
ETD							
34	>17.4	472	23.0	28.2	13.1	G	?
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	472					
35	>17.4	247	22.8	26.7	12.3	G	90
	12.5 - 17.4	200	14.8	18.2	11.1	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	447					
ETD	>17.4	345	24.0	28.1	12.8		
Average	12.5 - 17.4	100	14.8	18.1	9.8		
	7.5 - 12.4	20	9.3	12.2	8.0		
	0 - 7.4	0	-	-	-		
	< 1.3 m tall	0	-	-	-		
	Total	465					
EMM							
28	>17.4	0	-	-	-	-	-
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	0					
29	>17.4	85	34.7	39.7	12.9	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	300	-	1.2	0.4	G	100
	Total	1185					
30	>17.4	0	-	-	-	-	-
	12.5 - 17.4	100	14.8	22.0	6.9	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	100					

Habitat/ Plot	Tree Size (dbh)	Stems/ha.	Diameter (m)		Height (m)	Tree Condition	% Live Crown
			1.3 (m)	0.3 (m)			
EMM							
38	>17.4	30	41.2	47.5	14.4	G	100
	12.5 - 17.4	0	-	-	-	-	-
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	0	-	-	-	-	-
	Total	30					
39	>17.4	164	24.9	29.0	11.6	G	100
	12.5 - 17.4	100	15.3	18.8	8.8	G	100
	7.5 - 12.4	0	-	-	-	-	-
	0 - 7.4	0	-	-	-	-	-
	< 1.3 m tall	400	-	1.3	0.6	G	100
	Total	664					
EMM	>17.4	70	29.6	34.2	12.3		
Average	12.5 - 17.4	40	15.1	20.4	7.9		
	7.5 - 12.4	0	-	-	-		
	0 - 7.4	0	-	-	-		
	< 1.3 m tall	140	-	1.3	0.5		
	Total	250					

Appendix 3: Observations of invasive plants at Airport Flats.

Early detections of invasive plants with ID numbers were obtained from the Province of BC HabitatWizard, an online map based tool that allows users to spacially access detailed fish, wildlife and ecosystem data. Invasive plant codes include: DK = Diffuse Knapweed (*Centaurea diffusa*), HT = Hound's Tongue (*Cynoglossum officinale*), SK = Spotted Knapweed (*Centaurea biebersteinii*) and BU = Burdock species (*Arctium spp*.).

Site ID	Date	Area (sq m)	Easting	Northing	Species
41027	09 Jun 1999	?	0547664	5700641	DK
206682	30 Sep 2005	3.12	0547619	5700551	DK
228256	29 Nov 2006	3.12	0547557	5700650	DK
228257	29 Nov 2006	3.12	0547590	5700636	DK
228305	30 Nov 2006	3.12	0547577	5700670	DK
228306	30 Nov 2006	3.12	0547673	5700640	DK
228307	30 Nov 2006	3.12	0547670	5700653	DK
228308	30 Nov 2006	3.12	0548027	5700454	HT
228309	30 Nov 2006	3.12	0547982	5700421	HT
228310	30 Nov 2006	3.12	0547627	5700551	DK
244016	13 Aug 2007	3.12	0547670	5700450	DK/SK
249376	15 Aug 2007	3.12	0547500	5700000	DK/BU
N/A	13 Sep 2015	3.12	0548349	5700193	HT
N/A	03 Apr 2017	3.12	0548035	5699970	HT
N/A	03 Apr 2017	3.12	0548032	5700456	HT
N/A	25 Apr 2017	3.12	0548197	5699739	HT
N/A	04 Jun 2017	50.00	0547654	5700866	BU/HT
N/A	25 Oct 2017	100.00	0547532	5699613	BU
N/A	07 Sep 2018	3.12	0546912	5700066	BU
N/A	07 Sep 2018	100.00	0547532	5699613	BU/HT
N/A	19 Sep 2018	3.12	0547182	5700467	BU
N/A	19 Sep 2018	3.12	0547618	5700538	DK
N/A	27 Sep 2018	3.12	0547432	5699636	BU
N/A	27 Sep 2018	3.12	0547237	5699846	HT
N/A	27 Sep 2018	3.12	0547224	5699851	BU
N/A	27 Sep 2018	3.12	0547214	5699862	BU
N/A	27 Sep 2018	3.12	0547141	5699883	HT
N/A	27 Sep 2018	3.12	0547110	5699884	HT
N/A	27 Sep 2018	3.12	0546811	5700092	BU
N/A	27 Sep 2018	3.12	0546706	5700265	BU
N/A	27 Sep 2018	3.12	0546762	5700256	BU
N/A	27 Sep 2018	3.12	0547657	5700867	BU
N/A	27 Sep 2018	3.12	0547579	5700653	DK
N/A	27 Sep 2018	3.12	0547558	5700648	DK
N/A	27 Sep 2018	3.12	0547588	5700638	DK
N/A	27 Sep 2018	3.12	0547613	5700633	DK
N/A	27 Sep 2018	3.12	0547608	5700615	DK
N/A	27 Sep 2018	3.12	0548348	5700197	HT

N/A	27 Sep 2018	3.12	0548034	5699974	HT
N/A	06 Sep 2019	3.12	0547667	57000834	DK
N/A	06 Sep 2019	1.0+ hectare	See Fig. 15	See Fig. 15	DK
N/A	20 Sep 2019	3.12	0547684	5700608	BU
N/A	20 Sep 2019	3.12	0547993	5699320	HT/BU