Invasive Plant Management and Restoration of Protected Areas

Project Number: COL-F21-W-3265

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Executive Summary

Invasive species have numerous negative impacts on natural ecosystems: they threaten the health of British Columbia and Canada's limited native grasslands, may displace or extirpate endangered plant and animal species, negatively impact wildlife habitats, reduce productivity in forestry, agriculture and fisheries, and overall have a negative impact on ecosystem function and health. Sensitive habitats, typically those that have been selected for protection and conservation, can be particularly vulnerable to the impacts of invasive species; they can establish quickly and spread easily across landscapes and attribute to overall ecosystem alteration and habitat change. Mitigating the impacts of invasive species requires a coordinated and landscape-level approach involving multiple stakeholders and long-term investments on the land base.

The objective of the East Kootenay Invasive Species Council's (EKISC) Invasive Plant Management and Restoration of Protected Areas (IPMRPA) Project (hereafter referred the "the Project") is to contribute to the prevention and control of high priority terrestrial and aquatic invasive species on upland and riparian sites that have the potential to negatively impact high-value conservation lands, including Fish and Wildlife Compensation Program (FWCP) project investments on, or adjacent to, conservation properties and FWCP restoration sites. EKISC has been working with FWCP on the IPMRPA project since 2014, when the need to collaboratively bolster invasive plant management efforts across high value conservation lands was identified.

The IPMRPA Project aligns closely with FWCP-identified habitat-based Priority Actions and intended outcomes in the Upland/Dryland and Wetland/Riparian Action Plans. In Upland/Dryland and Riparian/Wetland habitats, this project aims to protect conservation lands and FWCP investment sites against the establishment and spread of invasive species, improve understanding of invasive species distribution, and allow early detection and rapid response to new invasive plant infestations. Priority habitats include fire-maintained ecosystems, ungulate winter range, grasslands and deciduous forests existing conservation lands and surrounding areas, and FWCP investment sites within Upland/Dryland and Wetland/Riparian habitats.

This work was completed directly in partnership with the FWCP, Nature Trust of British Columbia (NTBC), Nature Conservancy of Canada (NCC), Columbia Basin Trust (CBT), the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD), and BC Parks, and as such, has enabled a substantial amount of leveraged funds to be directly applied to invasive plant management on and adjacent to high value conservation lands.

In 2020, invasive plant inventories, treatments, and monitoring visits were completed on and adjacent to 12 conservation properties that were identified as high priority by Project partners. A total of 185 invasive plant treatments were completed with combined funders (FWCP, NCC, NTBC, MFLNRORD, BC Parks), for a total area of 42.9 ha. Of that, 113 sites were funded exclusively by FWCP, covering an area of 20.5 ha. Additional invasive plant surveys, treatment efficacy monitoring, and grass seeding activities took place throughout the field season to ensure completion and effectiveness of management practices and to help inform future treatment recommendations.

This Project primarily aims to decrease the establishment and spread of new invasive species on high value conservation lands and works to create benefits to the landscape such as reduction of propagule pressure from neighbouring invasive species populations, wildlife habitat conservation, and long-term cost savings

through collaborative invasive species management action. EKISC is confident that collaborative invasive plant management planning will continue to benefit conservation lands across the East Kootenay region.

Introduction

Invasive species are widely known as a significant threat to global biodiversity (IUCN 2004, 2011), and have the potential to impose significant negative social, economic, and environmental impacts on ecosystems and communities across the East Kootenay Region. Sensitive habitats, typically those that have been selected for protection and conservation, can be particularly vulnerable to the impacts of invasive species; they can establish quickly and spread easily across landscapes, displacing native wildlife and plants, and attributing to overall ecosystem alteration and habitat change (MFLNRORD 2019). The Global Invasive Species Program (GISP) recognizes invasive species "as one of the greatest threats to the ecological and economic well-being of the planet" (Mooney 1999).

The East Kootenay Invasive Species Council (EKISC) is a non-profit organization that strives to reduce the negative impacts caused by invasive species across the region (EKIPC 2013). EKISC has been delivering an efficient and effective partnership delivery program across multiple jurisdictions since the East Kootenay Invasive Plant Pilot Program began in 2005 (Liepa 2013). To do this, EKISC coordinates invasive species management on public and private lands, delivers invasive species education and outreach, and fosters expanded support of invasive species management in the region. EKISC is comprised of various stakeholders including provincial ministries, regional governments, community associations, and environmental groups with the common goal of invasive species management.

EKISC has been working in partnership with the FWCP, NTBC, NCC, CBT, MFLNRORD, and BC Parks on the Invasive Plant Management and Restoration of Protected Areas (IPMRPA) Project since 2014, managing invasive species on important high-value conservation lands and adjacent areas (Note: funding was not awarded by FWCP in 2017). EKISC works with these partners to identify priorities and recommendations for invasive plant treatment areas and to facilitate informed, landscape-level planning. Previous years have shown successes in Project areas not only in managing and reducing the spread of existing invasive species populations but have also enabled contractors and EKISC staff to quickly identify and respond to new high priority invasive plant populations and assist with reducing the introduction of invasive species with targeted education and outreach through regular programming.

The 2020 field season marks the 6th year of the IPMRPA Project. The following report will identify all invasive plant management efforts (surveys, treatments, monitoring, grass seeding) that were completed as a part of this collaborative Project and recommendations for future programming.

Goals and Objectives

Mitigating the impacts of invasive species requires a coordinated and landscape-level approach involving multiple stakeholders (MFLNRORD 2019). The objective of the Project is to contribute to the prevention and control of high priority terrestrial and invasive species on upland/dryland and riparian/wetland sites that have the potential to negatively impact FWCP project investments on, or adjacent to, conservation properties and FWCP restoration sites. The Project aligns with Habitat-Based, Ecosystem Actions as outlined in the Dryland/Upland and Wetland/Riparian Action Plans for the Columbia Region (FWCP 2019a, FWCP 2019b).

Specifically, this Project aims to achieve the following:

1. Work with project collaborators to identify and prioritize high-value wildlife sites in Project areas for invasive species inventory, treatments, and monitoring.
2. Reduce the size and number of invasive plant sites in the East Kootenay through an integrated plant management plan approach.
3. Monitor Project treatments to ensure treatment completion and efficacy.
4. Restore sites with appropriate seed mixes to outcompete weed establishment and increase wildlife forage.

EKISC works with adjacent land managers to coordinate invasive plant treatments and provide the most efficient and effective invasive species manage possible with available funds.

Management Area

Invasive plant treatments occurred within the Regional District of East Kootenay (RDEK), which has been divided by EKISC into five primary Invasive Plant Management Areas (IPMAs), as shown in Figure 1. Each IPMA may be sub-divided into sub-IPMAs. The intent of delineating these units is to provide a more localized approach to prioritizing invasive plant species. For example, a certain species may be a Priority 1 in one sub-IPMA due to its extremely limited distribution (where the goal is to eradicate the species), whereas it may be considered a Priority 2 or 3 in another sub-IPMA if it has a much broader distribution (and it may be treated for annual control or containment purposes).

Invasive plant management sites that were visited under the Project in 2020 are within the Columbia Region of the RDEK (as defined by the FWCP), and include: Bummer's Flats – Cherry Creek Conservation Property, Bummer's Flats – Zirnhelt Conservation Property (dyke and wetland areas), Columbia Lake Eastside Wildlife Management Area, Columbia Lake Westside Conservation Property, Columbia Lake Westside - Sun Lakes Conservation Property, Columbia Lake Provincial Park, Hoodoos Conservation Property, Kootenay River Ranch Conservation Property, Bull River - Lower Norbury Creek Conservation Property, Luxor Linkage, Marion Creek, and NTBC Woodlot and Woodlot Access.

Methods

Project Planning

Prior to the 2020 field season, EKISC facilitated a planning meeting with all Project partners to select, prioritize, and strategize invasive plant management activities on high-value lands across the Columbia Region. Priority treatment units and target species were identified by EKISC staff and Project partners using information on previous invasive plant management activities, monitoring notes, site-specific management objectives, and available funding.

EKISC used this information, along with information from the Provincial Alien Plant Program (IAPP) and adjacent land manager invasive plant management efforts to develop and share a Project work plan that was used to initiate management efforts for 2020. Invasive plant treatments are typically coordinated so they occur at the same time as nearby treatments to increase efficiency and better utilize a landscape-level approach.

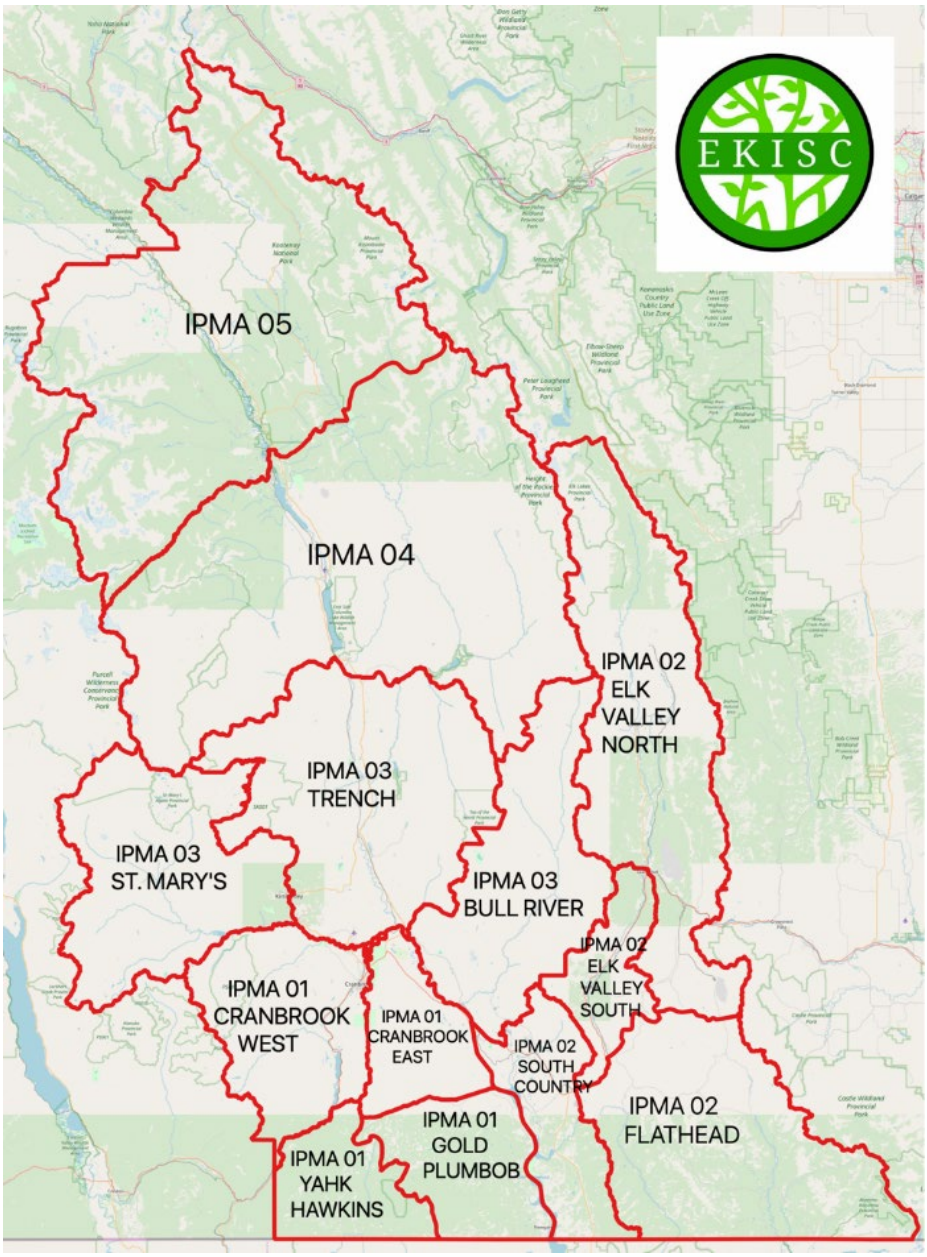

Figure 1. Invasive Plant Management Areas (IPMAs) within the Regional District of East Kootenay. Note that IPMA's 1 through 3 are further divided into sub-IPMAs.

Invasive Plant Surveys & Treatments

Invasive plant surveys and treatments at priority Project sites in Upland/Dryland areas and Riparian/ Wetland areas were completed between June 17th and October 10th, 2020. Survey data for invasive plant sites are collected during initial treatment visits, and include collecting data on species present, infestation size and density, and relevant site characteristics.

The majority of invasive plant treatments were accomplished by applying an appropriate herbicide to the site using either a vehicle (e.g., an all-terrain vehicle or truck boom spray) or by hand (e.g., using a hand nozzle or backpack sprayer) depending on the terrain and ensuring to disturb the site as little as possible.

Herbicides were selected based on the target species and site characteristics such as soil type, slope, and distance to water. Additional invasive plant treatments (primarily within Pesticide Free Zones (PFZs)) were completed using mechanical methods such as hand pulling, digging, cutting, and whipper-snipping. All invasive plants treated mechanically were carefully bagged, removed from the site, and discarded in appropriate way at a local landfill.

All invasive plant surveys and treatments were conducted by qualified and licensed pesticide applicator contractors or by EKISC field staff. Invasive plant inventory and treatment data were entered into the Provincial IAPP database prior to the Provincial deadline of December 1, 2020.

Grass Seeding

Candidate sites for native grass seed application were prioritized by EKISC field staff based on the amount of bare ground and site disturbance present. Sites that underwent mechanical treatments or had experienced consecutive years of herbicide application were prioritized for grass seed application in 2020 in efforts to deter new or existing invasive plants from establishing. Available funding enabled the application of grass seed to 2 of the 12 treatment areas, varying from small spot treatments where existing native grasses were already reestablishing at the site, to larger applications where bare ground was a concern. Grass seed was also purchased for and applied at a pollinator garden project at one of the treatment sites: Bummer's Flats – Zirnhelt (Dyke). Seed mix recommendations were provided by NCC and the consultants working on the pollinator garden project.

Monitoring

Approximately 15% of all invasive plant treatments completed under this project were monitored for treatment efficacy (e.g., *how effective was the herbicide application or manual removal in controlling the target species this year*?), treatment completion (e.g., *were treatments considered complete at the site*?), and overall treatment response. Monitoring site visits occurred from July through September 2020, by EKISC field staff.

Treatment Results & Outcomes

Invasive plant surveys and treatments were completed at the following high value conservation lands within the Columba Region: Bummer's Flats – Cherry Creek Conservation Property, Bummer's Flats – Zirnhelt Conservation Property (dyke and wetland areas), Columbia Lake Eastside Wildlife Management Area, Columbia Lake Westside Conservation Property, Columbia Lake Westside - Sun Lakes Conservation Property, Columbia Lake Provincial Park, Hoodoos Conservation Property, Kootenay River Ranch Conservation Property, Bull River - Lower Norbury Creek Conservation Property, Luxor Linkage, Marion Creek, and NTBC Woodlot and Woodlot Access.

A total of 113 treated sites were funded exclusively by FWCP, accounting for 20.5 L and 3.0 kg of undiluted chemical and covering an area of 20.49 ha. The total number of treated sites detailed in this report, including all funders, is 185, for a combined area of 42.9 hectares. Three additional sites were treated mechanically: Bummer's Flats – Zirnhelt (Dyke), Bummer's Flats – Zirnhelt (Wetland), Bummer's Flats – Cherry Creek, and Marion Creek. Tables 1 through 19 and Figures 2 through 17 summarize the treatments that occurred within each invasive plant management area.

EKISC conducted post-treatment monitoring of invasive plant control activities at 7 of the 12 properties that FWCP contributed funds to managing. Individual treatment sites were monitored for treatment efficacy and site completion and scores were multiplied together to generate an overall score. All visited treatments sites passed monitoring exams and no re-treatments by EKISC staff or contractors was required. On average, treatments had a combined efficacy and completion score of 94%. No new Priority 1 species (as defined in EKISC Invasive Plant Priorities by IPMA 2020) were observed at project sites in 2020 during treatment or monitoring visits. However, a new satellite infestation of Wild parsnip, a highly toxic invasive plant found at Bummer's Flats - Zirnhelt was identified and treated by EKISC field staff in 2020 during a scheduled site visit.

Bummers Flats - Cherry Creek Conservation Property (NTBC)

Invasive plant chemical and mechanical treatments on the Bummer Flats - Cherry Creek Conservation Property were completed on June 26th and July 8th, 2020 and funded by FWCP. The EKISC in-house field crew completed a mechanical treatment for Spotted knapweed within the PFZ (0-1m from riparian/high water mark). This treatment was followed by a glyphosate treatment from the 1m – 10m mark. Figure 2 and Table 1 provide details of the treatments that occurred.

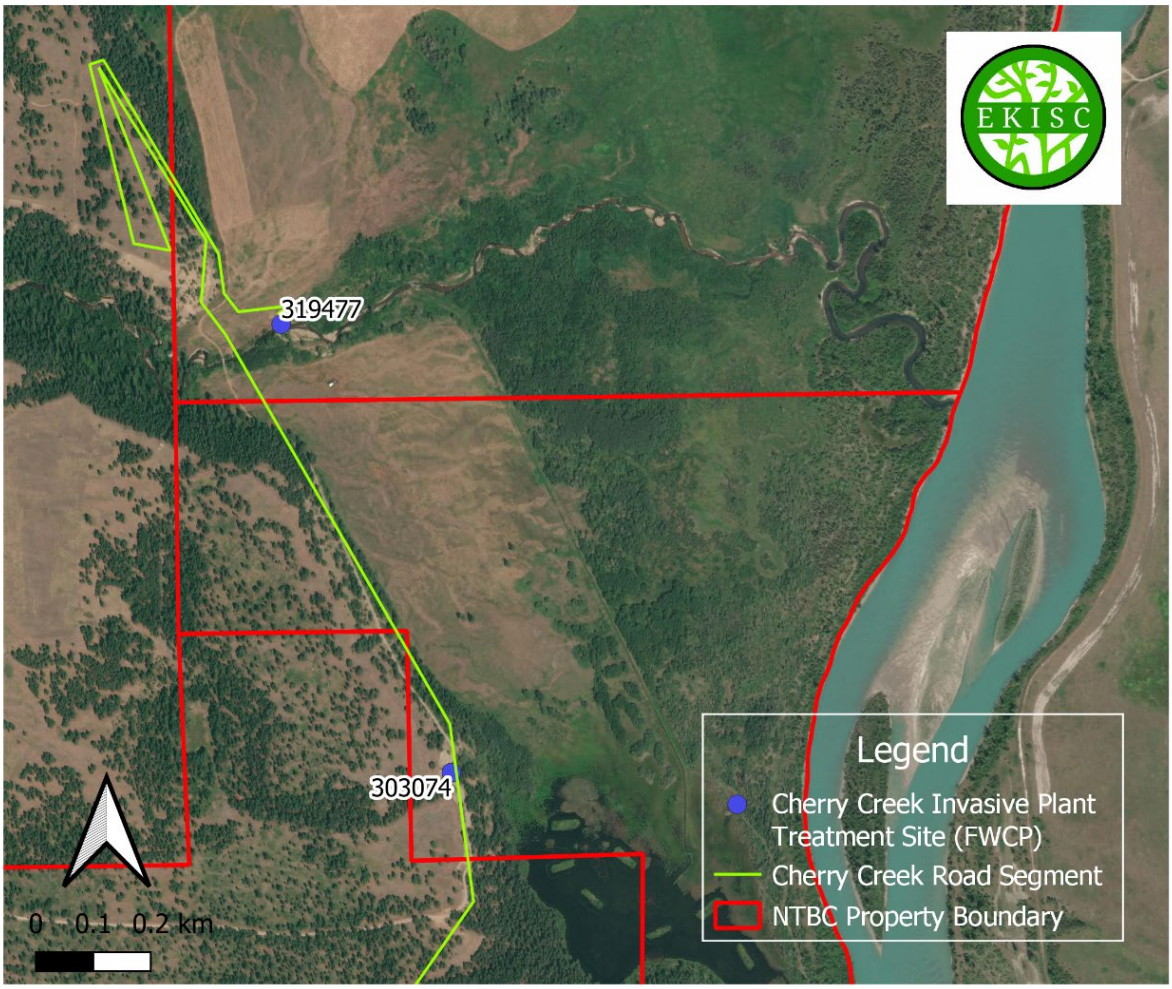

Figure 2. Map of the 2020 chemical and mechanical invasive plant treatment site at the NTBC Bummers Flats Cherry Creek Conservation Property, FWCP.

Table 1. Details of the chemical and mechanical invasive plant treatments that occurred on the NTBC Bummers Flats Cherry Creek Conservation Property, funded by FWCP.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (Kg or L)
319477	Spotted knapweed	Vantage XRT	Boomless Nozzle	0.13	0.4
319477	Spotted knapweed	--	Hand pulling	0.001	--
303074	Spotted knapweed, Burdock spp.	Milestone	Hand Gun	0.5	0.2

Monitoring and Site-Specific Recommendations for the NTBC Bummer Flats Cherry Creek Conservation Property

Mechanical and chemical invasive plant treatments were used to target a large riparian Spotted knapweed infestation at the Cherry Creek Conservation Property. A total of 13 bags of Spotted Knapweed were pulled in the area downstream of the bridge, followed by a glyphosate product application between the 1-10m mark. Overall, mechanical treatments went well, but it was difficult to pull the entire root even though the soil is a sandy soil type. It is recommended that NTBC continues with 1-2 days of hand pulling/mechanical treatment at this site annually, and to include an inventory downstream of the bridge to assess how far the infestation has spread. If pulling the entire infestation is not feasible on an annual basis, a biocontrol inventory should be conducted to assess the presence of Spotted knapweed biocontrol agents. If the biocontrol *Cyphocleonus* is not present it is recommended to request agents from MFLNRORD to release them at areas that will not be mechanically treated to decrease the seed spread and stunt the growth of germinating plants.

The area directly across from the Spotted knapweed pull and chemical treatment (across creek, south) is an area that should have treatment focus in subsequent years due to high density of Spotted knapweed.

Monitoring done of the Vantage XRT treatment scored high for treatment efficacy and site completion. However, application of a small amount of herbicide was found within the 1-meter high-water mark, and as such was within the PFZ. This was immediately reported to the Province and discussed with the contractor. Because this area is private land, the treatment did not violate the Provincial Pest Management Plan (PMP) for the Southern Interior (MFLNRORD 2019) and no mitigation or follow-up was required through the Ministry of Environment. However, EKISC still submitted a detailed report to MFLNRORD, and thoroughly discussed preventative measures with the contractor to minimize the risk of this happening again.

Bummers Flats - Zirnhelt (Dyke & Wetland Areas) Conservation Property (NTBC/MFLNRORD)

Chemical and mechanical treatments on the Bummer's Flats – Zirnhelt Conservation Property were completed on June 11th and July 8th, 2020 and were funded by FWCP. The EKISC field crew completed a mechanical treatment for Spotted knapweed within the PFZ (0-1m from riparian/high water mark). This treatment was complimented by a glyphosate treatment from the 1m – 10m mark of Spotted knapweed and Burdock species. Figure 3 and Table 2 provide details of the treatments that occurred.

EKISC also partnered with NTBC to completed mechanical treatment of the Purple loosestrife infestation that is present in the manmade wetland portion of the property (see the large purple polygon in Figure 2). The infestation was accessed by canoes and plant material was bagged and removed from the property.

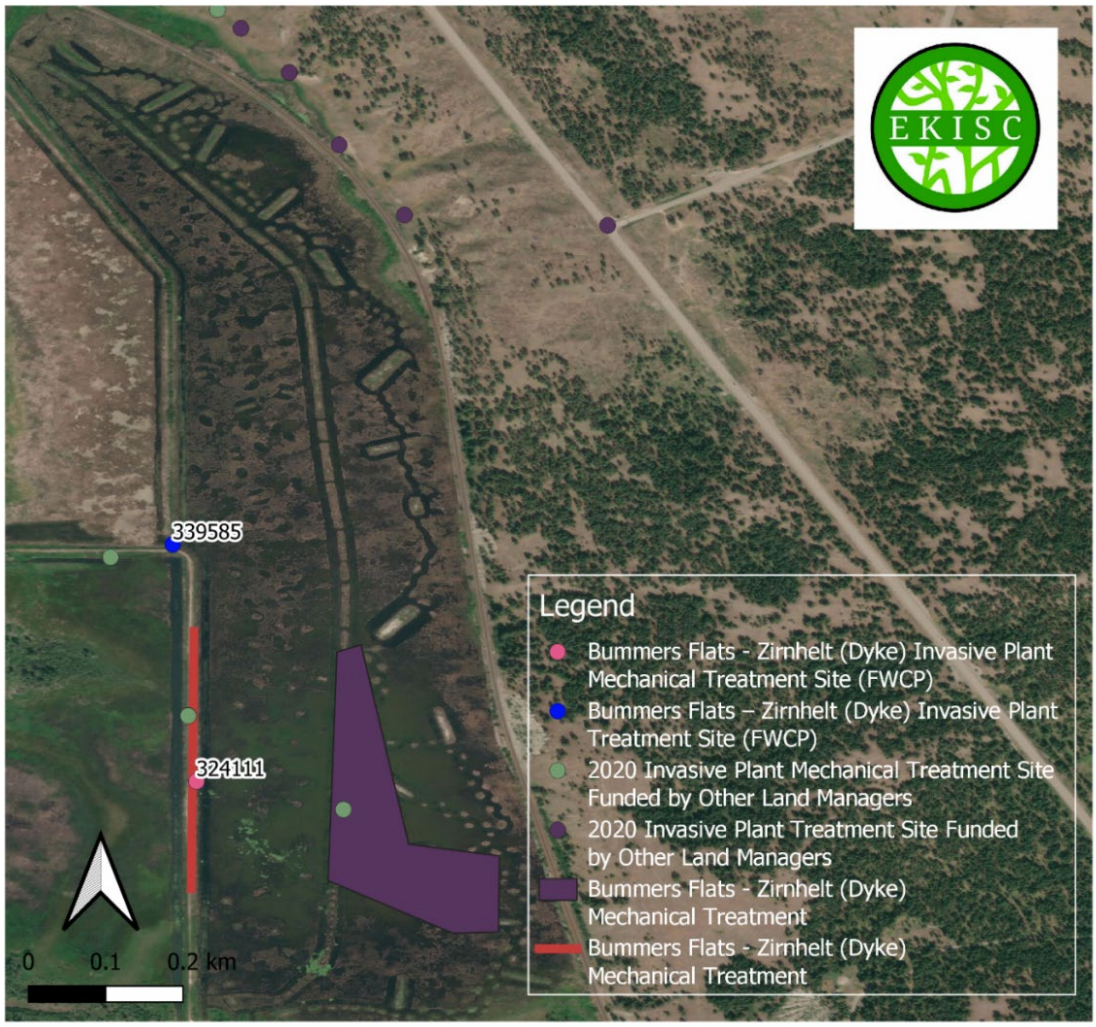

Figure 3. Map of the 2020 chemical and mechanical invasive plant treatment site at the NTBC Bummers Flats - Zirnhelt (Dyke) Conservation Property, FWCP.

Table 2. Details of the chemical and mechanical invasive plant treatments that occurred on the NTBC Bummers Flats - Zirnhelt (Dyke) Conservation Property, funded by FWCP.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (Kg or L)
339585	Spotted knapweed, Burdock species	Vantage XRT	Boomless Nozzle	1.4	4.2
324111	Spotted knapweed	Hand pulling	NA	0.001	NA

Monitoring and Site-Specific Recommendations for the NTBC Bummers Flats Zirnhelt (Dyke) Conservation Property

The Bummers Flats Dyke was monitored on August 20th, 2020. Herbicide efficacy and site completion was high (100%), and no viable Burdock or Spotted knapweed plants were found. This is historically an incredibly difficult area to manage, with limited treatment options due to the entire dyke being within a PFZ. NTBC is currently working with a consulting firm to restore and create a pollinator-friendly plant community along the Dyke area; FWCP funds were contributed to purchase and apply native plant seed to support the project. EKISC is hopeful these restoration efforts will aid in reducing invasive plant pressures at the property and prevent Spotted knapweed and Burdock from reestablishing. The satellite new Wild parsnip site was observed along the Dyke and should be managed annually to prevent further spread.

The Purple loosestrife work was challenging due to COVID-19 protocols (additional shuttling of vehicles and canoes was required, and group participation was limited to just EKISC and NTBC staff). Therefore, not as much time was spent conducting mechanical work. Subsequent years should aim for 1-2 full field days of treatment depending on the number of people on site. EKISC will continue to discuss this priority site with NTBC and MFLNRORD to ensure the infestation does not spread into other areas of the property.

East Side Columbia Lake Wildlife Management Area (MFLNRORD)

Invasive plant surveys and treatments at East Side Columbia Lake Wildlife Management Area (WMA) were supported both by MFLNRORD (HCTF) and by FWCP. MFLNRORD-funded work was conducted on July 14th, 15th, and 23rd, 2020 (Figures 4, 5, and 6). Table 3 provides details of the treatments that were funded by FWCP, and occurred on July 13th, and August 19-20th, 2020 (Figures 4, 5, and 6). Table 4 provides details of the treatments that were funded through MFLNRORD. A comprehensive Yellow hawkweed survey was also completed at this location.

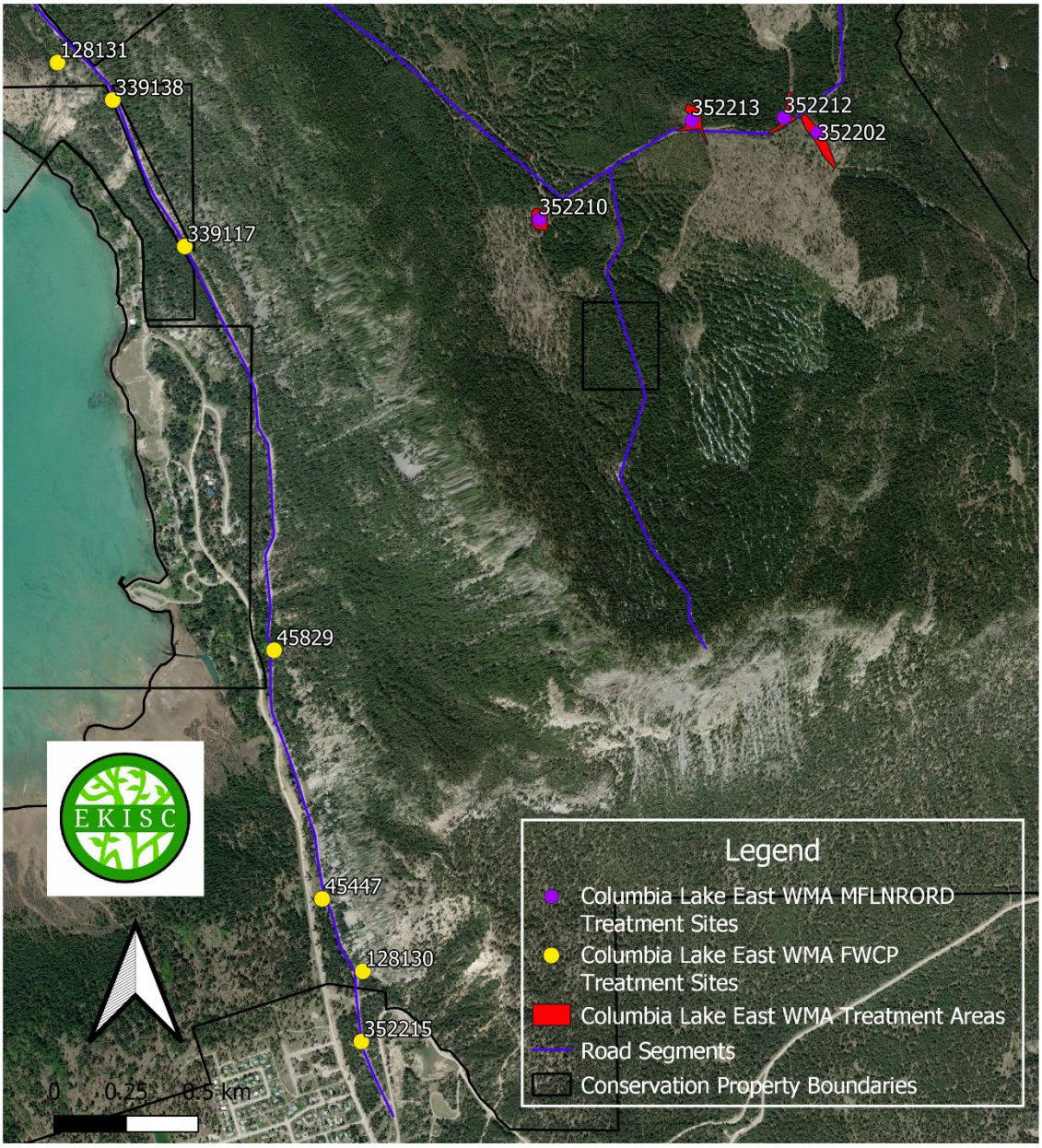

Figure 4. East Side Columbia Lake WMA treatments sites and areas. Pink polygons represent treatment areas. Blue lines represent road segments travelled in search of, and to treat, invasive plants.

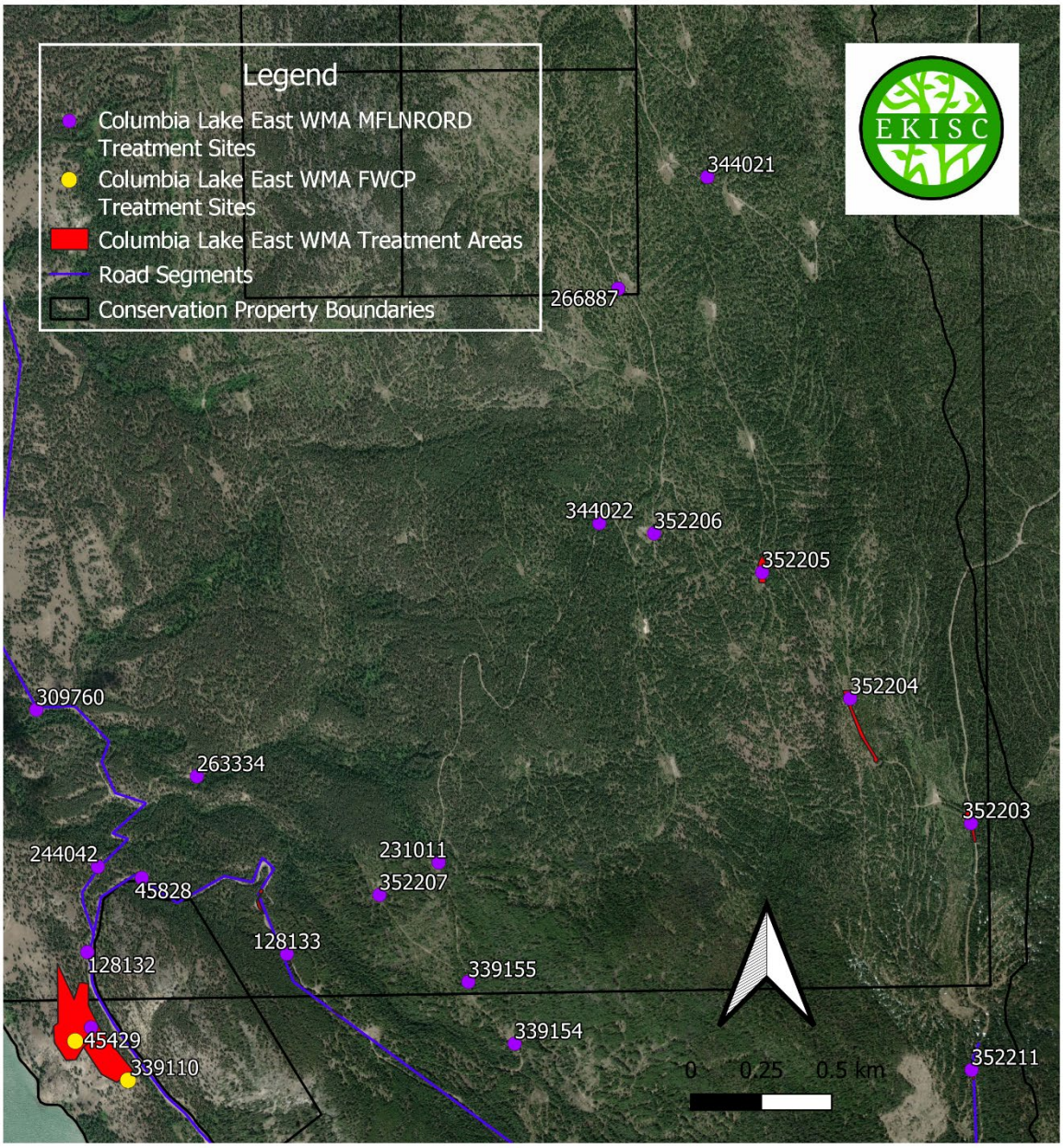

Figure 5. East Side Columbia Lake WMA treatments sites and areas. Pink polygons represent treatment areas. Blue lines represent road segments travelled in search of, and to treat, invasive plants.

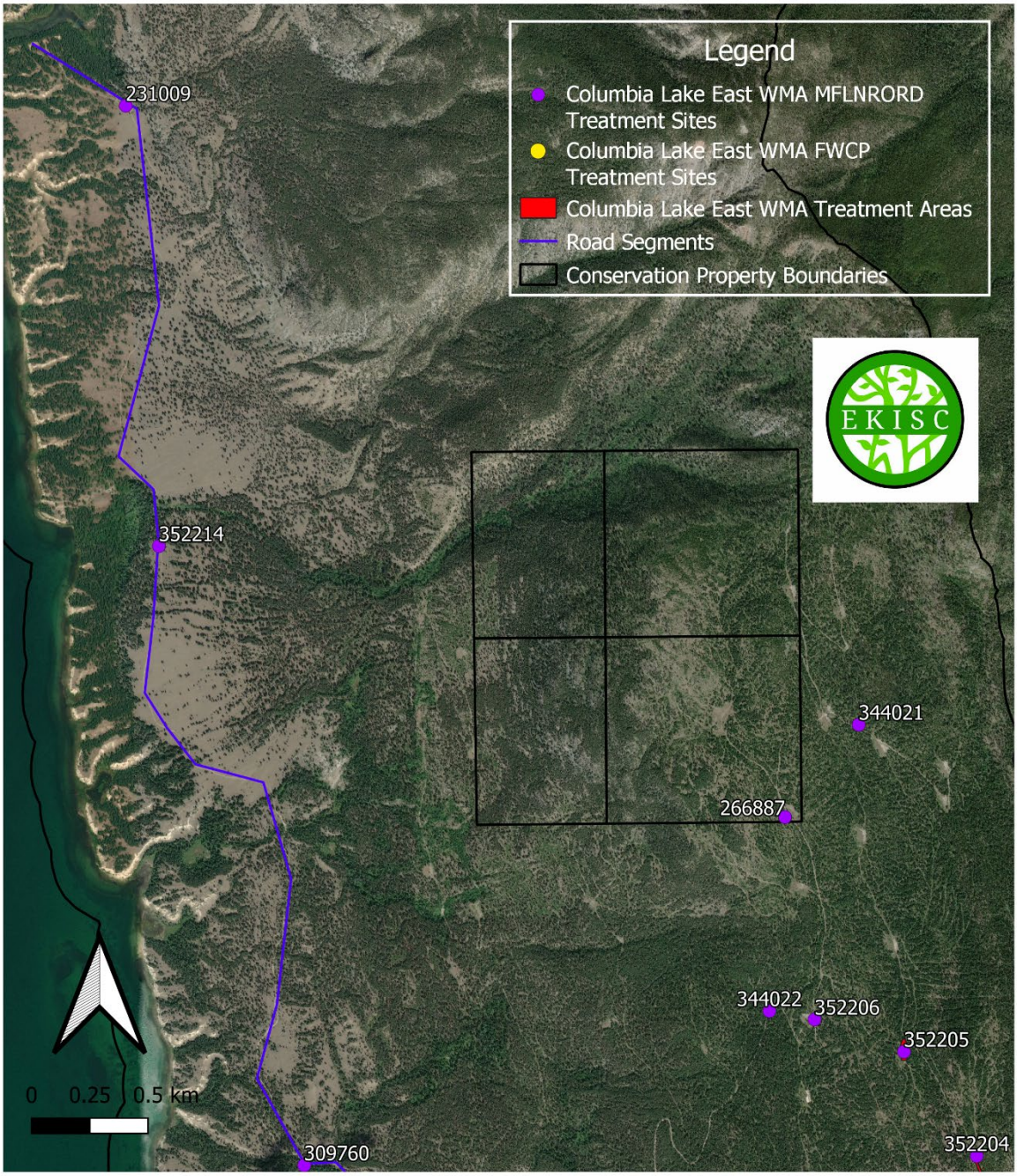

Figure 6. East Side Columbia Lake WMA treatments sites and areas. Pink polygons represent treatment areas. Blue lines represent road segments travelled in search of, and to treat, invasive plants.

Table 3. Details of the invasive plant treatments that occurred adjacent to the East Side Columbia Lake WMA that was funded by FWCP.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (Kg and L)
45447	Oxeye daisy, Spotted knapweed	Milestone	Hand Gun	0.40	0.20
45829	Oxeye daisy, Spotted knapweed	Milestone	Hand Gun	0.58	0.12
128130	Spotted knapweed	Milestone	Hand Gun	0.15	0.17
128131	Oxeye daisy	Milestone	Hand Gun	0.03	0.08
230908	Diffuse knapweed, Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.01
242788	Spotted knapweed	Milestone	Hand Gun	0.15	0.08
251405	Diffuse knapweed	Lontrel XC	Hand Gun	0.02	0.01
251406	Diffuse knapweed	Lontrel XC	Boomless Nozzle	0.01	0.003
251407	Diffuse knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
251408	Diffuse knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
251409	Diffuse knapweed, Spotted knapweed	Lontrel XC	Back Pack	0.02	0.01
339110	Oxeye daisy, Spotted knapweed	Milestone	Hand Gun	0.05	0.03
339117	Oxeye daisy, Spotted knapweed	Milestone	Hand Gun	0.20	0.10
339138	Oxeye daisy, Spotted knapweed	Milestone	Boomless Nozzle	0.05	0.03
352215	Blueweed, Burdock, Spotted knapweed	Milestone	Boomless Nozzle	0.55	0.28
Total				2.26	1.11

Table 4. Details of the invasive plant treatments that occurred adjacent to the East Side Columbia Lake WMA that was funded by MLNRORD.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (Kg and L)
45429	Oxeye daisy, Spotted knapweed	Milestone	Hand Gun	1.20	0.60
45828	Spotted knapweed, Yellow hawkweed	Milestone	Hand Gun	0.05	0.03
128132	Oxeye daisy, Spotted knapweed	Milestone	Boomless Nozzle	0.10	0.05
128133	Spotted knapweed, Yellow hawkweed	Milestone	Boomless Nozzle	0.18	0.09
231009	Spotted knapweed	Milestone	Boomless Nozzle	0.02	0.01
231011	Spotted knapweed, Yellow hawkweed	Lontrel XC	Hand Gun	0.02	0.01
244042	Oxeye daisy, Spotted knapweed	Milestone	Boomless Nozzle	0.07	0.03
263334	Spotted knapweed	Milestone	Boomless Nozzle	0.06	0.03
266887	Spotted knapweed, Yellow hawkweed	Lontrel XC	Boomless Nozzle	0.04	0.02
309760	Oxeye daisy	Milestone	Boomless Nozzle	0.01	0.01
339154	Yellow hawkweed	Lontrel XC	Boomless Nozzle	0.01	0.003
339155	Yellow hawkweed	Lontrel XC	Boomless Nozzle	0.03	0.02
344021	Yellow hawkweed	Lontrel XC	Boomless Nozzle	0.03	0.01
344022	Yellow hawkweed	Lontrel XC	Boomless Nozzle	0.01	0.01
352202	Yellow hawkweed	Lontrel XC	Boomless Nozzle	0.33	0.16
352203	Orange hawkweed, Yellow hawkweed	Lontrel XC	Boomless Nozzle	0.16	0.08
352204	Yellow hawkweed	Lontrel XC	Boomless Nozzle	0.18	0.09
352205	Yellow hawkweed	Lontrel XC	Boomless Nozzle	0.15	0.08
352206	Yellow hawkweed	Lontrel XC	Hand Gun	0.05	0.03
352207	Yellow hawkweed	Lontrel XC	Boomless Nozzle	0.02	0.01
352210	Yellow hawkweed	Milestone	Hand Gun	0.08	0.04

352211	Yellow hawkweed	Milestone	Boomless Nozzle	0.11	0.06
352212	Yellow hawkweed	Milestone	Boomless Nozzle	0.14	0.07
352213	Yellow hawkweed	Milestone	Boomless Nozzle	0.35	0.18
352214	Yellow hawkweed	Milestone	Hand Gun	0.01	0.003
Total				3.35	1.68

Monitoring and Site-Specific Recommendations for the East Side Columbia Lake WMA

Invasive Plant treatments at the East Side Columbia Lake WMA have occurred consecutively for five years. In 2020, surveys and treatments focused on the road from Canal Flats to Armstrong Bay (including parking areas and the radio tower), the road that continues down to the Rod and Gun Club, and the road that branches past the radio tower, and continues to the "hand glider launch pad."

The Spotted knapweed infestation along the main road from Canal Flats to the radio tower, and at the radio tower, has been successfully reduced in distribution and density in much of this area. In 2017, 1.42 ha of Spotted knapweed was treated in this area, compared to 0.37 ha in 2019. However, more Spotted knapweed treatments occurred in 2020, for a total of 2.8 hectares treated (this is likely due to an increase in funding, and ability to follow the infestation further up the roadside banks where the infestation is pervasive but difficult to treat). The EKSIC contractor treating this area in 2020 recommended continuing Spotted knapweed treatments in 2021. However, further discussion will be needed to determine how far up the bank treatments should occur and what is feasible with a hose reel and backpack crew. To treat most of the bank using a backpack crew would take an estimate of 2-2.5 days with two people.

Yellow hawkweed, though in abundance, is considered to be manageable. Because a creek/riparian area is present along part of the infestation (near site 352212), the PFZs would have to be considered, as all infestations are not treatable by herbicide application. The contractor suggested that hand-wicking with glyphosate within 1-10 m from the PFZ could be an option in these areas, with the remainder of Yellow hawkweed being boom sprayed. Oxeye Daisy treatments were successful, with the main infestation along the access road treated; the infestations become less dense as you move towards the radio tower.

Monitoring was completed September 1st, 2020 at 12% of treatment sites. Site completion and site efficacy were both scored at 100%.

Columbia Lake Westside Conservation Property (NTBC)

Invasive plant treatments on the Columbia Lake Westside Conservation Property were completed on July 24th and August 8th, 2020, and were funded by NTBC, FWCP, and BC Hydro. The total area treated was 0.20 hectares, using 0.02 L and 0.072 Kg undiluted herbicide. Figure 7 , Table 5 (FWCP funded) Table 6 (NTBC funded) provide details of the treatments that occurred.

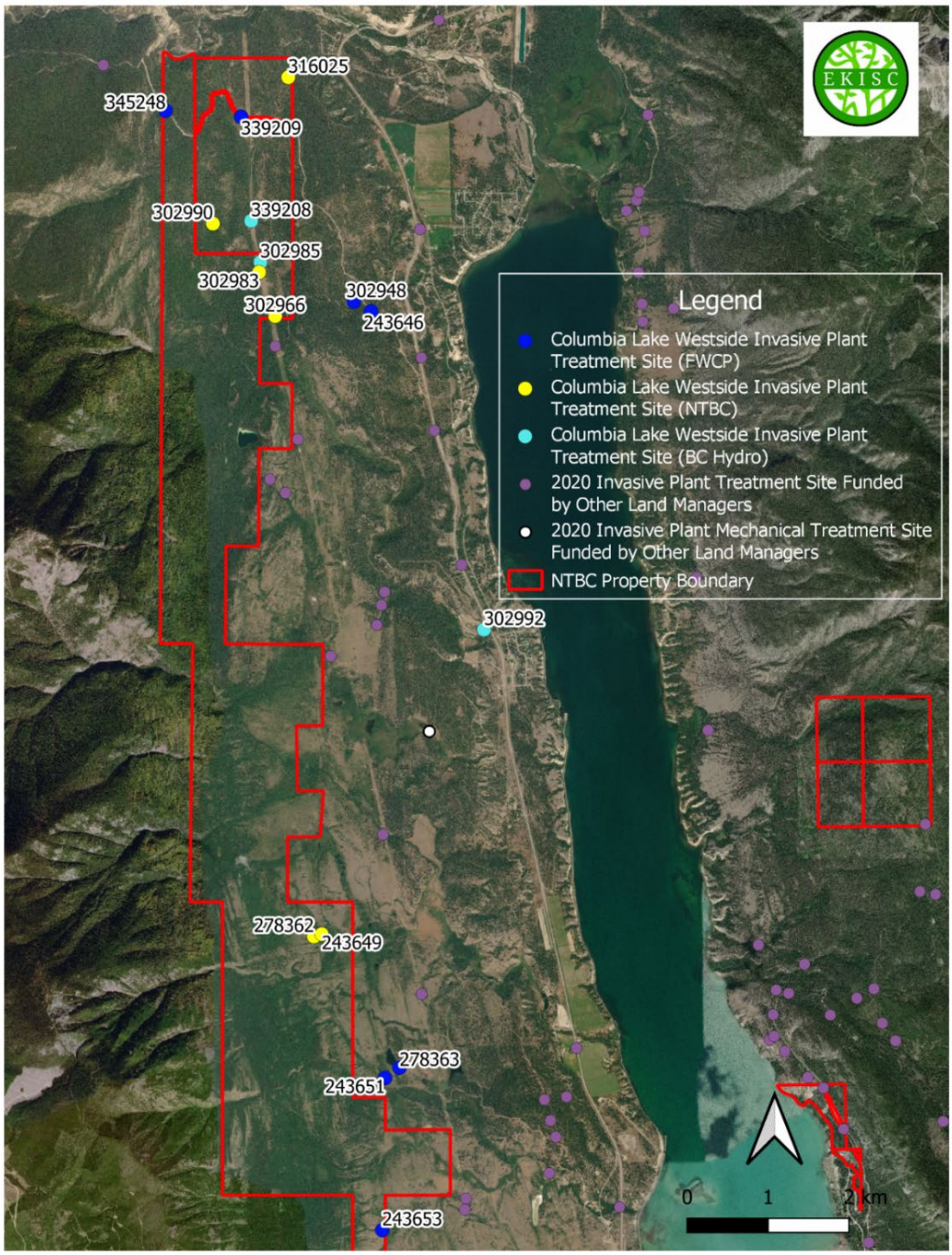

Figure 7. Map of the 2020 invasive plant treatment sites at the Columbia Lake Westside Conservation Property.

Table 5. Details of the invasive plant treatments that occurred on the Columbia Lake Westside Conservation Property that were funded by FWCP.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (Kg or L)
243646	Common tansy	Clearview	Hand Gun	0.01	0.01
243651	Spotted knapweed	Clearview	Hand Gun	0.01	0.01
243653	Spotted knapweed	Milestone	Boomless Nozzle	0.04	0.02
278363	Spotted knapweed	Clearview	Boomless Nozzle	0.02	0.01
302948	Common tansy	Clearview	Boomless Nozzle	0.01	0.01
339209	Common tansy	Clearview	Hand Gun	0.01	0.01
345248	Scentless chamomile	Clearview	Boomless Nozzle	0.01	0.01
Total:				0.09	0.08

Table 6. Details of the invasive plant treatments that occurred on the Columbia Lake Westside Conservation Property that were funded by NTBC.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (Kg)
243649	Spotted knapweed	Clearview	Boomless Nozzle	0.01	0.0007
278362	Spotted knapweed	Clearview	Boomless Nozzle	0.01	0.0007
302966	Common tansy	Clearview	Hand Gun	0.01	0.0007
302983	Spotted knapweed	Clearview	Boomless Nozzle	0.03	0.004
302990	Spotted knapweed	Clearview	Boomless Nozzle	0.01	0.0007
316025	Spotted knapweed	Clearview	Boomless Nozzle	0.03	0.004
Total:				0.1	0.01

Monitoring and Site-Specific Recommendations for the Columbia Lake Westside Conservation Property

The entire Columbia Lake Westside property was surveyed in 2019, and all high and medium priority invasive plant infestations were successfully treated. In 2020, Yellow hawkweed was noted to be expanding significantly, especially in the southern end of the property and in forested areas. Similar to 2019, other invasive plants such as Spotted knapweed, Common tansy, Dalmatian toadflax, and Scentless chamomile, were noted as manageable and were treated. However, the Yellow hawkweed sites were found in too great distribution and densities to treat all infestations. It is recommended to continue annual invasive plant treatments at the Columbia Lake Westside property to manage the higher priority

infestations like Common tansy, Scentless chamomile, and Spotted knapweed. An increase in funding would enable Yellow hawkweed sites to be further targeted and prevent spread to neighboring areas. Three sites were monitored adjacent to the Columbia Lake Westside property, but access is an issue for monitoring further into the actual property.

Columbia Lake Westside - Sun Lakes Conservation Property (NTBC)

Invasive plant chemical and mechanical treatments on the Columbia Lake Westside – Sun Lakes Conservation Property were completed on August 5th, 2020 and funded by FWCP (Figure 8, Table 7).

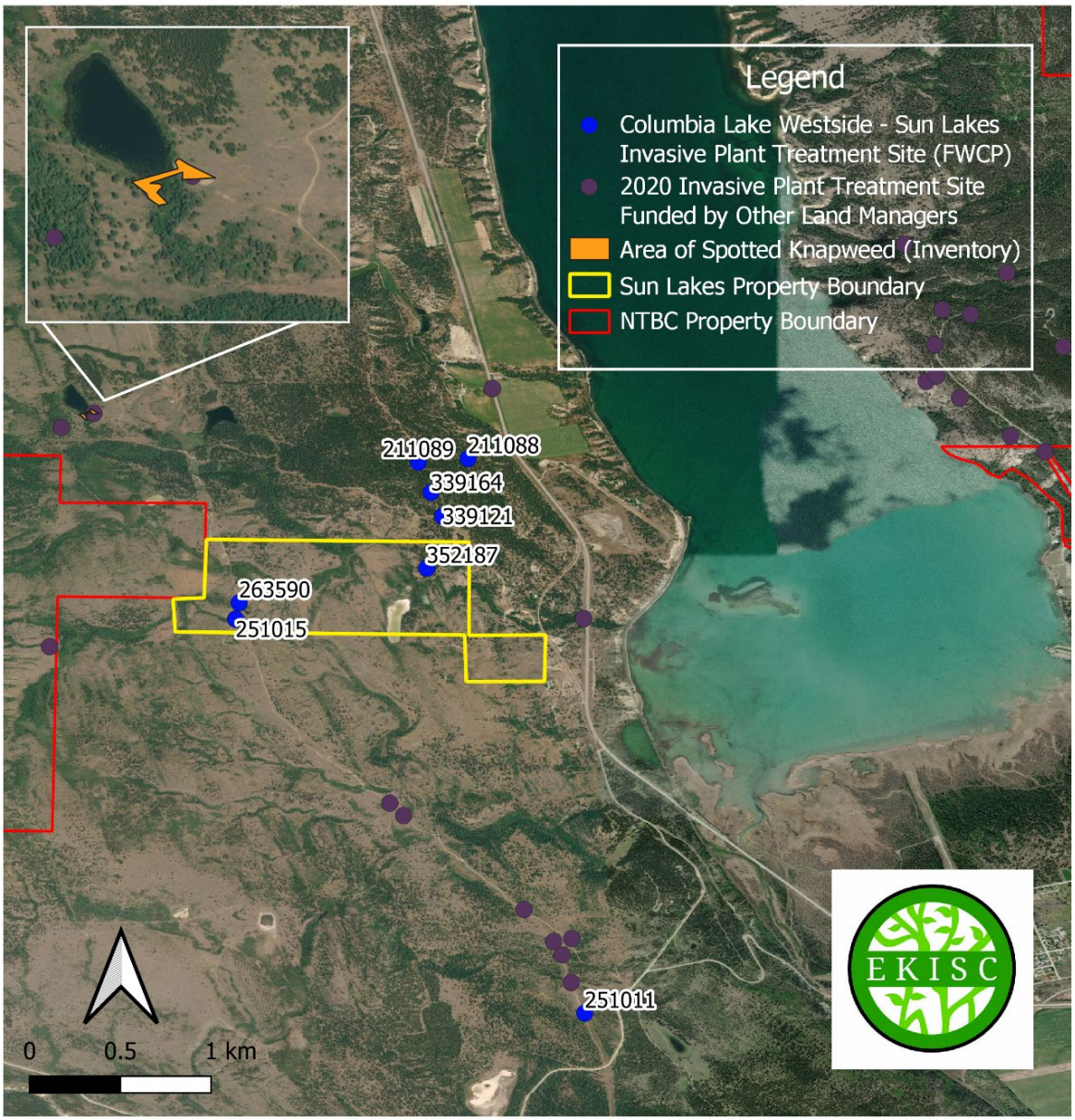

Figure 8. Map of the 2020 chemical and mechanical invasive plant treatment site at the Columbia Lake Westside (Sun Lakes) Conservation Property, FWCP.

Table 7. Details of the chemical invasive plant treatments that occurred on the Columbia Lake Westside (Sun Lakes) Conservation Property, FWCP.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (L)
211088	Spotted knapweed	Milestone	Boomless Nozzle	0.03	0.01
211089	Spotted knapweed	Milestone	Boomless Nozzle	0.03	0.01
251011	Spotted knapweed	Milestone	Boomless Nozzle	0.04	0.02
251015	Spotted knapweed	Milestone	Boomless Nozzle	0.06	0.03
263590	Spotted knapweed	Milestone	Hand Gun	0.02	0.01
339121	Spotted knapweed	Milestone	Boomless Nozzle	0.01	0.01
339136	Spotted knapweed	Milestone	Boomless Nozzle	0.03	0.02
339164	Spotted knapweed	Milestone	Boomless Nozzle	0.02	0.01
352187	Spotted knapweed	Milestone	Hand Gun	0.02	0.01
Total:				0.24	0.12

Monitoring and Site-Specific Recommendations for the Columbia Lake Westside Sun Lakes Conservation Property

Infestations located within ecological restoration areas around the Sun Lakes Conservation Property were noted by the contractor to have improved from previous years treatments. It is recommended that treatments in 2021 focus on continuing to treat the Spotted knapweed infestations. Yellow hawkweed is expanding in the greater Columbia Lake Westside properties, and will eventually encroach into the Sun Lakes area unless further attention and funding is provided. One site within the Sun Lakes property was monitored on September 2nd, 2020. Spotted knapweed was treated with high efficacy and site completion.

An inventory was also completed by the contractor around a disturbed wetland within the Sun Lakes pasture on August 5th, 2020 (see polygon in Figure 8). Spotted knapweed throughout an area of approximately 200 m^2 with several sporadic individuals in low density (<1 plant/m^2) was observed and recorded. Canada thistle was also found in approximately 500 m^2, in several well-spaced patches of medium density (2-5 plants/m^2). Other invasive species of note are Sulphur cinquefoil, Bull thistle, and Mullein, with Bull thistle and Mullein present in riparian areas. Note: EKISC does not typically treat these low priority species. Management of the Spotted knapweed should be discussed further with NTBC.

Columbia Lake Provincial Park (BC Parks)

Treatments at Columbia Lake Provincial Park occurred on August 19th and 20th, 2020, and were aligned with treatments taking place at other nearby conservation properties (i.e., East Side Columbia Lake WMA (MFLNRORD), Columbia Lake Lot 48 (NCC)). Chemical invasive plant treatments at Columbia Lake Provincial Park targeted historic Spotted knapweed and Diffuse knapweed sites, as well as all species along roads, parking areas, and newly disturbed areas where new infestations are establishing. Details of treatments are shown in Figure 9 and Table 8.

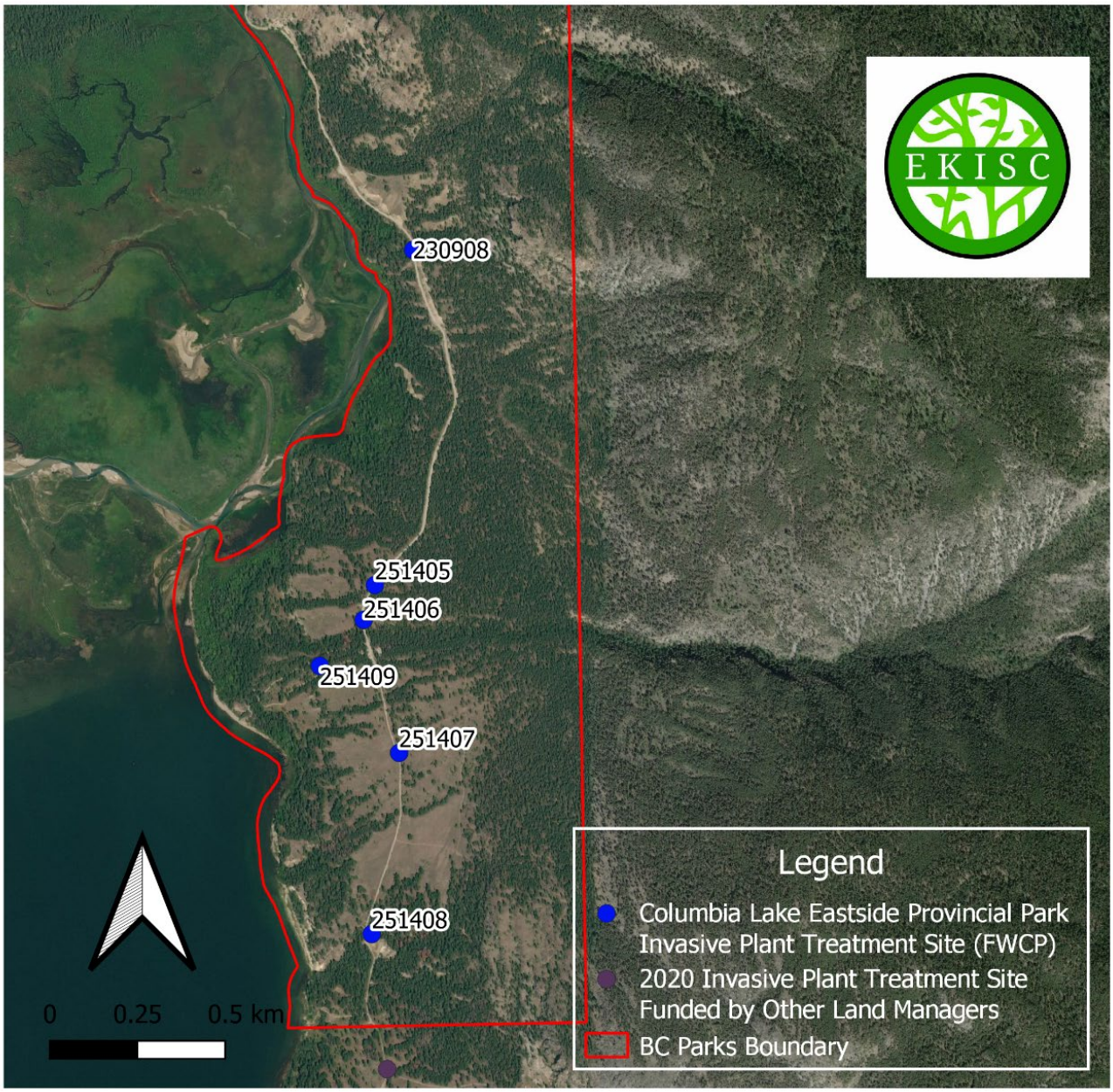

Figure 9. Map of the 2020 chemical and mechanical invasive plant treatment site at the Columbia Lake Eastside Provincial Park.

Table 8. Details of the chemical invasive plant treatments that occurred on the Columbia Lake Eastside Provincial Park.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (L)
230908	Diffuse knapweed, Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.02
251405	Diffuse knapweed	Lontrel XC	Hand Gun	0.02	0.01
251406	Diffuse knapweed	Lontrel XC	Boomless Nozzle	0.01	0.00
251407	Diffuse knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
251408	Diffuse knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
251409	Diffuse knapweed, Spotted knapweed	Lontrel XC	Back Pack	0.02	0.01
Total:				0.11	0.06

Monitoring and Site-Specific Recommendations for Columbia Lake Provincial Park

Spotted knapweed and Yellow hawkweed have continued to colonize the area, but existing infestations are manageable. Funding provided by FWCP in 2020 was deemed adequate for treatments, which included approximately two large garbage bags hand-pulled from along the road and lake, as this area is a PFZ. A community weed pull should be considered here as part of outreach/education regarding invasive plants in Provincial Parks.

Hoodoos Conservation Property (NTBC)

Invasive Plant treatments on the Hoodoos Conservation Property were completed on July 7th, July 20-21st, and August 7th, 2020 and funded by FWCP, BC Hydro, and NTBC. In total, 1.76 hectares was treated with 0.003 kg and 0.91 L of undiluted herbicide. Figures 10, 11, and 12 and Table 9 (funded by FWCP), Table 10 (funded by NTBC), and Table 11 (funded by BC Hydro) provide details of the treatments that occurred.

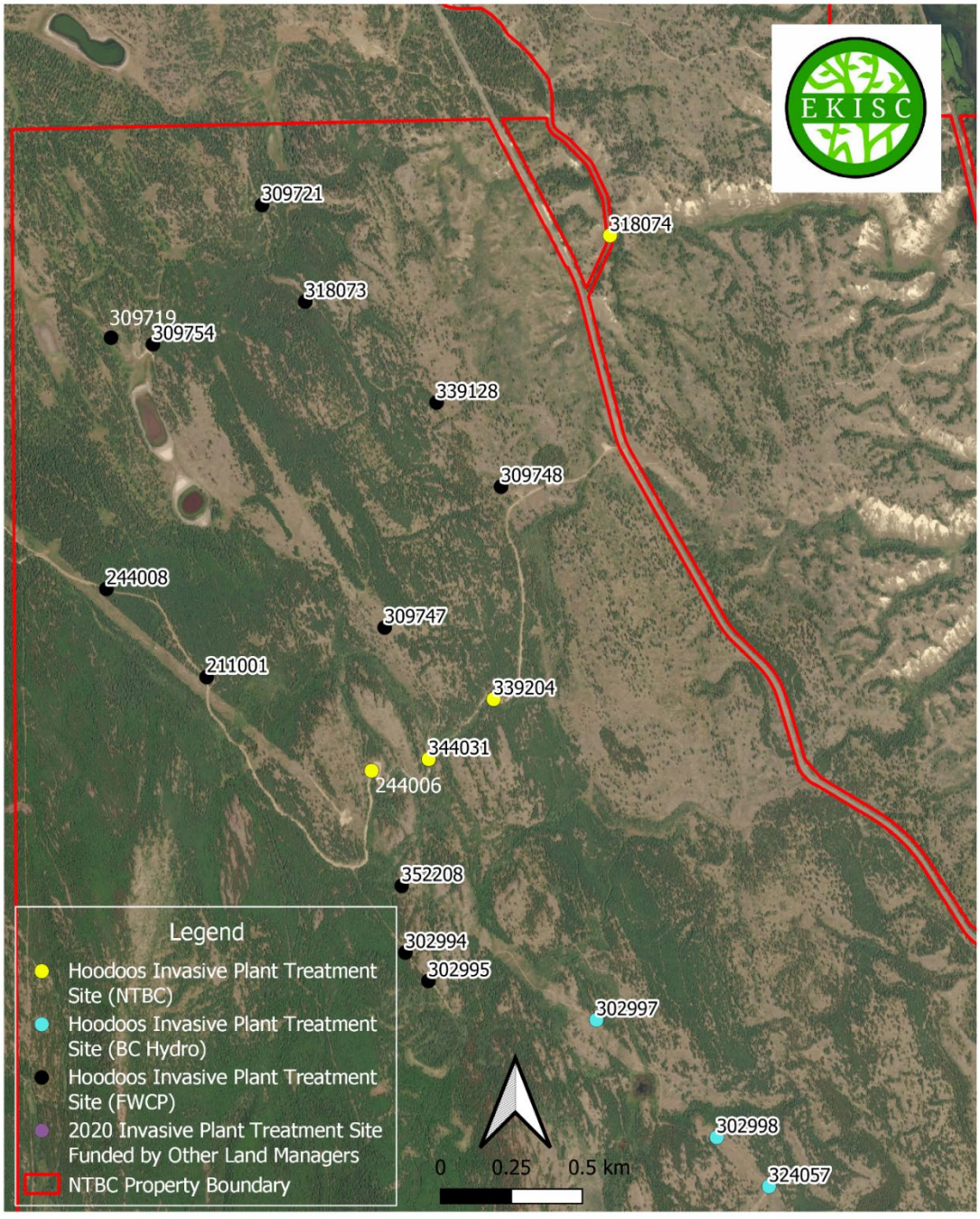

Figure 10. Map of the 2020 invasive plant treatment sites at the NTBC Hoodoos Conservation Property, north portion.

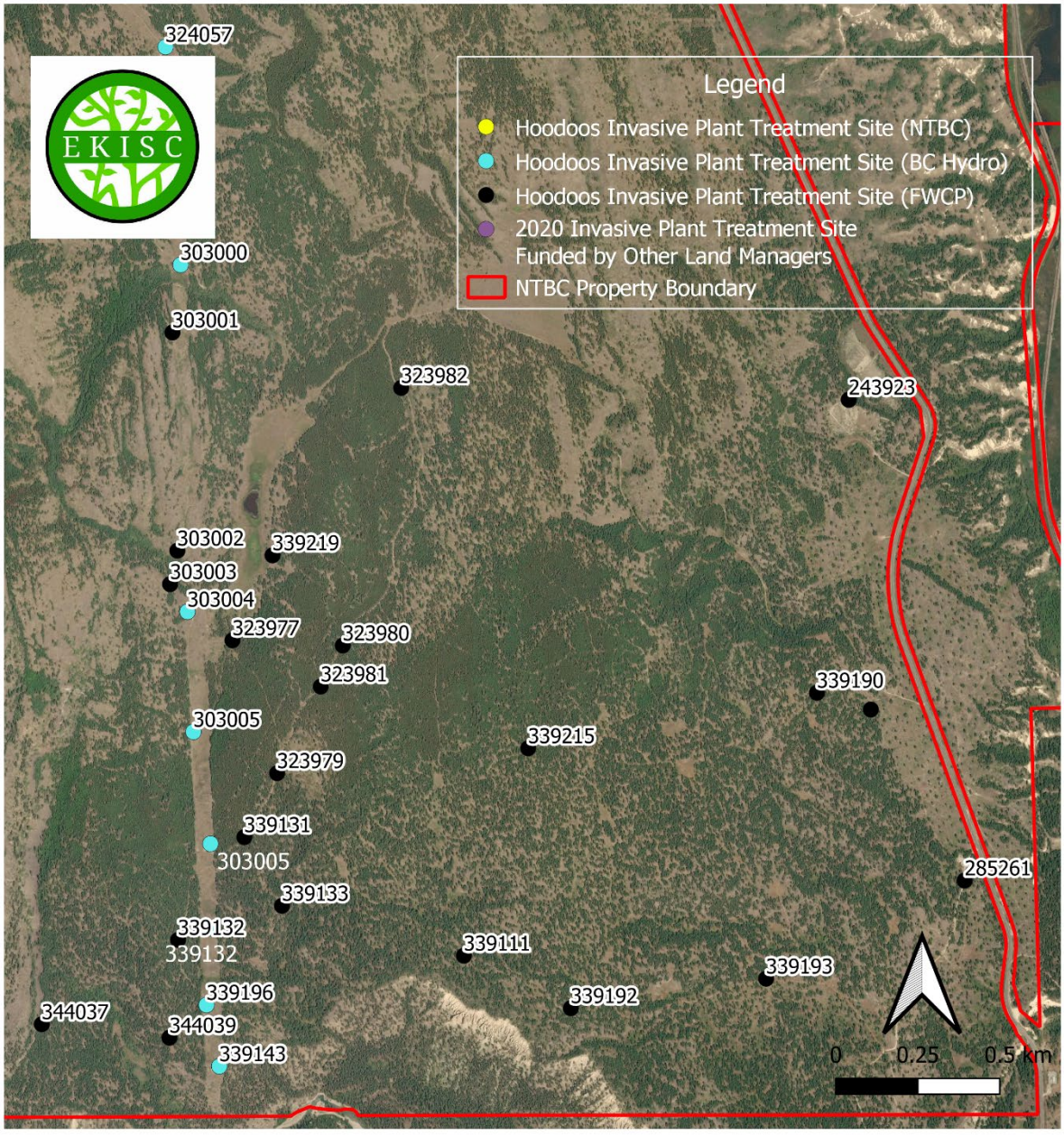

Figure 11. Map of the 2020 invasive plant treatment sites at the NTBC Hoodoos Conservation Property, central portion.

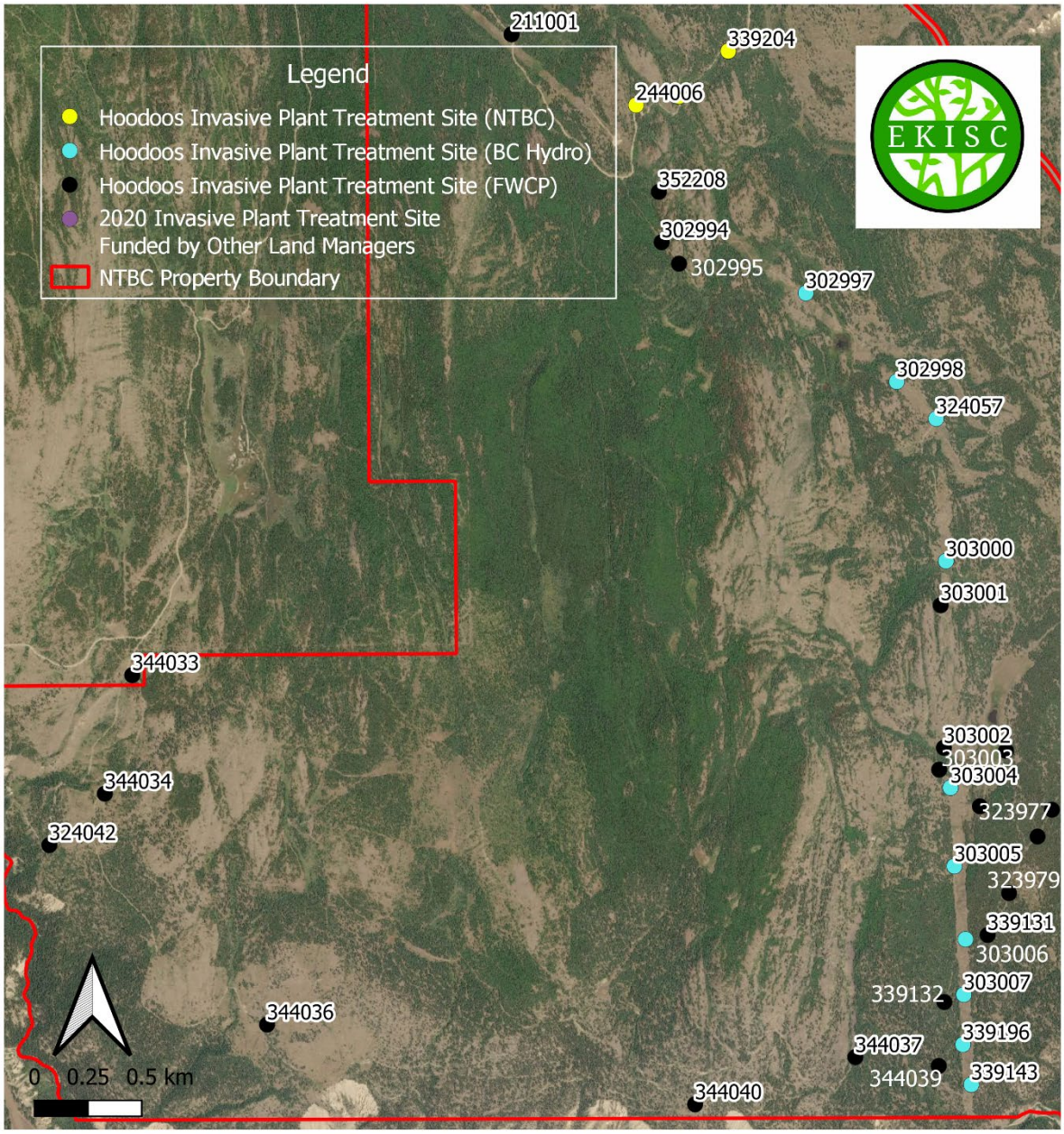

Figure 12. Map of the 2020 invasive plant treatment sites at the NTBC Hoodoos Conservation Property, western portion.

Table 9. Details of the invasive plant treatments that occurred on the NTBC Hoodoos Conservation Property, funded by FWCP.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (Kg or L)
211001	Burdock spp, Spotted knapweed	Lontrel XC	Boomless Nozzle	0.05	0.03
243923	Diffuse/Spotted knapweed	Lontrel XC	Boomless Nozzle	0.23	0.11
244008	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.05	0.03
285261	Diffuse/Spotted knapweed	Lontrel XC	Boomless Nozzle	0.08	0.04
302994	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
302995	St. John's wort	Clearview	Boomless Nozzle	0.01	0.001
303001	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.01
303002	Spotted knapweed	Lontrel XC	Hand Gun	0.01	0.01
303003	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
309719	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
309721	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
309747	Spotted knapweed	Lontrel XC	Hand Gun	0.01	0.01
309748	Spotted knapweed	Lontrel XC	Hand Gun	0.01	0.003
309754	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
318073	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.003
323977	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
323978	Spotted knapweed	Lontrel XC	Hand Gun	0.03	0.01
323979	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
323980	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.01

323981	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
323982	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.10	0.05
324042	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.01
339111	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
339128	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.01
339131	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
339132	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.01
339133	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.003
339190	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
339192	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
339193	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.003
339203	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
339215	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
339219	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
344033	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.04	0.02
344034	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.02
344036	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.003
344037	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
344039	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.01
344040	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
352208	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.02
Total:				1.05	0.52

Table 10. Details of the invasive plant treatments that occurred on the NTBC Hoodoos Conservation Property, funded by NTBC.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (L)
318074	Spotted knapweed	Lontrel XC	Hand Gun	0.02	0.01
339204	Spotted knapweed, St. John's wort	Lontrel XC	Boomless Nozzle	0.135	0.07
344031	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.015	0.008
244006	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.04	0.02
Total				0.21	0.108

Table 11. Details of the invasive plant treatments that occurred on the NTBC Hoodoos Conservation Property, funded by BC Hydro.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (Kg or L)
302997	Spotted knapweed	Tordon 22K	Hand Gun	0.01	0.045
302998	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.025	0.0125
303000	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.005
303004	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.05	0.025
303005	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.075	0.0375
303006	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.2	0.1
303007	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.05	0.025
324057	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
339143	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.05	0.025
339196	St. John's wort	Clearview	Back Pack	0.01	0.002
Total				0.5	0.29

Monitoring and Site-Specific Recommendations for the NTBC Hoodoos Conservation Property

Several days of treatment in 2020 were spent focusing on Spotted knapweed sites and it is recommended to sustain this level of funding to continue maintaining the infestation that spans a large area of land. A new recreation trail along Westside Road, the Legacy Trail, was built during the summer of 2020, and is expected to introduce more invasive plants to the area. Recommendations for 2021 are to increase treatments along the new trail and Westside Road (Ministry of Transportation and Infrastructure; EKISC to discuss with the Province), which may help reduce access points as potential vectors of spread in the Hoodoos property. All sites monitored for efficacy and site completion passed, including two sites of "No Weed Found" for Spotted knapweed. One "Priority 1" site for Hoary alyssum was a "No Weed Found" as well (by the contractor); however, access did not allow this site to be monitored by EKISC staff.

Kootenay River Ranch (NCC)

Invasive plant treatments on the NCC Kootenay River Ranch conservation property were completed on July 16th, 18th, and 19th, August 23rd and 25th, and September 3rd and 4th, 2020. Treatments primarily took place on the "original" Kootenay River Ranch parcels that run north – south along Hwy 95. A comprehensive invasive plant inventory was also completed on the two new parcels in the southwest part of the complex, and additional follow-up treatments took place. Treatments and inventories were funded by FWCP and NCC. Figure 13, Table 12 (funded by FWCP) and Table 13 (funded by NCC) provide details of the inventory and treatments that occurred.

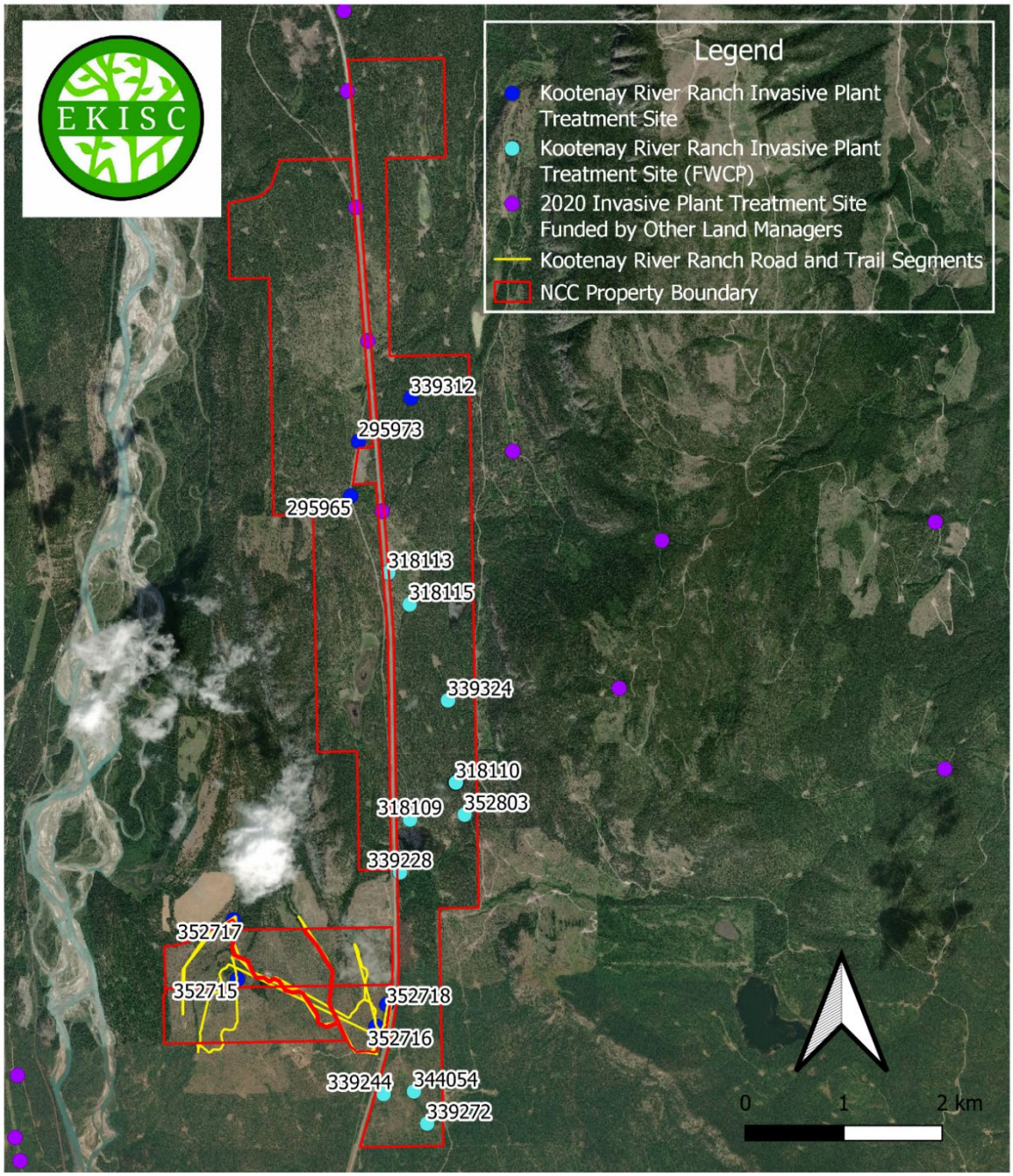

Figure 13. Map of 2020 invasive plant treatment sites at the NCC Kootenay River Ranch Property.

Table 12. Details of the invasive plant treatments that occurred on NCC Kootenay River Ranch property funded by FWCP.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (L or Kg)
318109	Diffuse knapweed	Milestone	Boomless Nozzle	0.13	0.05
318110	Spotted knapweed	Milestone	Boomless Nozzle	0.15	0.06
318113	Spotted knapweed	Milestone	Boomless Nozzle	0.18	0.07
318115	Spotted knapweed	Milestone	Boomless Nozzle	0.15	0.06
339228	Diffuse knapweed, Spotted knapweed, Yellow hawkweed	Milestone	Boomless Nozzle	0.50	0.20
339244	Spotted knapweed	Clearview	Boomless Nozzle	0.05	0.01
339272	Spotted knapweed	Clearview	Boomless Nozzle	0.05	0.01
339324	Spotted knapweed	Milestone	Boomless Nozzle	0.08	0.03
344054	Spotted knapweed, St. John's wort,	Clearview	Boomless Nozzle	0.15	0.03
352803	Spotted knapweed	Milestone	Boomless Nozzle	0.08	0.03
Total:				1.50	0.55

Table 13. Details of the invasive plant treatments that occurred on NCC Kootenay River Ranch property funded by NCC.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (L or Kg)
295965	Diffuse knapweed, Spotted knapweed	Clearview	Boomless Nozzle	2.10	0.48
295973	Spotted knapweed	Milestone	Boomless Nozzle	2.05	0.82
339312	Spotted knapweed	Milestone	Boomless Nozzle	1.50	0.60
352715	Spotted knapweed, Sulphur cinquefoil	Clearview	Boomless Nozzle	0.60	0.14
352716	Spotted knapweed, Sulphur cinquefoil, Yellow hawkweed	Clearview	Boomless Nozzle	0.90	0.21
352717	Chicory, Spotted knapweed, Sulphur cinquefoil	Clearview	Boomless Nozzle	0.80	0.18
352718	Spotted knapweed, Yellow hawkweed	Clearview	Boomless Nozzle	0.70	0.16
Total:				8.65	2.59

Monitoring and Site-Specific Recommendations for the NCC Kootenay River Ranch Property

The Kootenay River Ranch property is a difficult area to manage due to widespread, established infestations of invasive species. Various species were targeted for treatment in 2020, such as Spotted and Diffuse knapweed, Sulphur cinquefoil, Yellow hawkweed, and St. John's wort. The focus for 2020 included the southeast portion of the property where there has been progress from past treatments, restoration/disturbed areas, infested right of ways within the new parcels, and the heavily infested right-of-way that runs adjacent to the west side of the highway. Although there has been progress in the east/southeast part of the complex, many areas are seeing growth in infestation, including where there have been new disturbances. Yellow hawkweed infestations have become too widespread across the landscape and are not recommended for targeted treatment with limited funds.

During the invasive plant inventory of the two new parcels, no Priority 1 or 2 species were observed. Species found in abundance included Spotted knapweed, Yellow hawkweed, Sulfur cinquefoil, Bull thistle and Common mullein. Species were well established along rights of ways and open areas, including the entrance to the property, an area along Hwy 95. Approximately 6 kg of grass seed was also spread at four locations in the newly inventoried parcels, focusing on existing bare ground or highly disturbed areas, including areas close to riparian zones. A recommended grass seed mix was provided by NCC. Additional seeding in 2021 would benefit this conservation property. Unfortunately, EKISC field staff were not able to complete a biocontrol inventory for Hound's tongue bioagents.

Monitoring on this property was done on August 13th, 2020. Sites were monitored for Spotted knapweed and Diffuse knapweed treatments and all passed site completion and treatment efficacy scoring. Overall, EKISC recommends revisiting invasive species management objectives at Kootenay River Ranch. There are many widespread species across the complex, including within the new parcels, and significant funds will be required to effectively reduce them. Subsequent treatments should continue to focus on priority Spotted and Diffuse knapweed sites along the main access roads and trails throughout the property and disturbed areas, and also shift some focus to large vectors of spread on the west side of the complex. This will help to manage the continued spread of invasive plants within the property and to adjacent jurisdictions.

Bull River – Lower Norbury Creek Conservation Property (NTBC)

Treatments for noxious and invasive plants at the Bull River - Lower Norbury Creek Conservation Property occurred on June 17th, July 13th, and July 16th, 2020. A total of 6 sites were treated chemically across property, using 38.15 L and 2.66 kg of undiluted herbicide, and covering an area of 20.06 ha. Figure 14 summarizes the treatment locations, and Tables 14 (funded by FWCP) and Table 15 (funded by NTBC) detail treatments. Treatments focused primarily on existing Blueweed infestations, but also addressed Spotted knapweed and Yellow hawkweed.

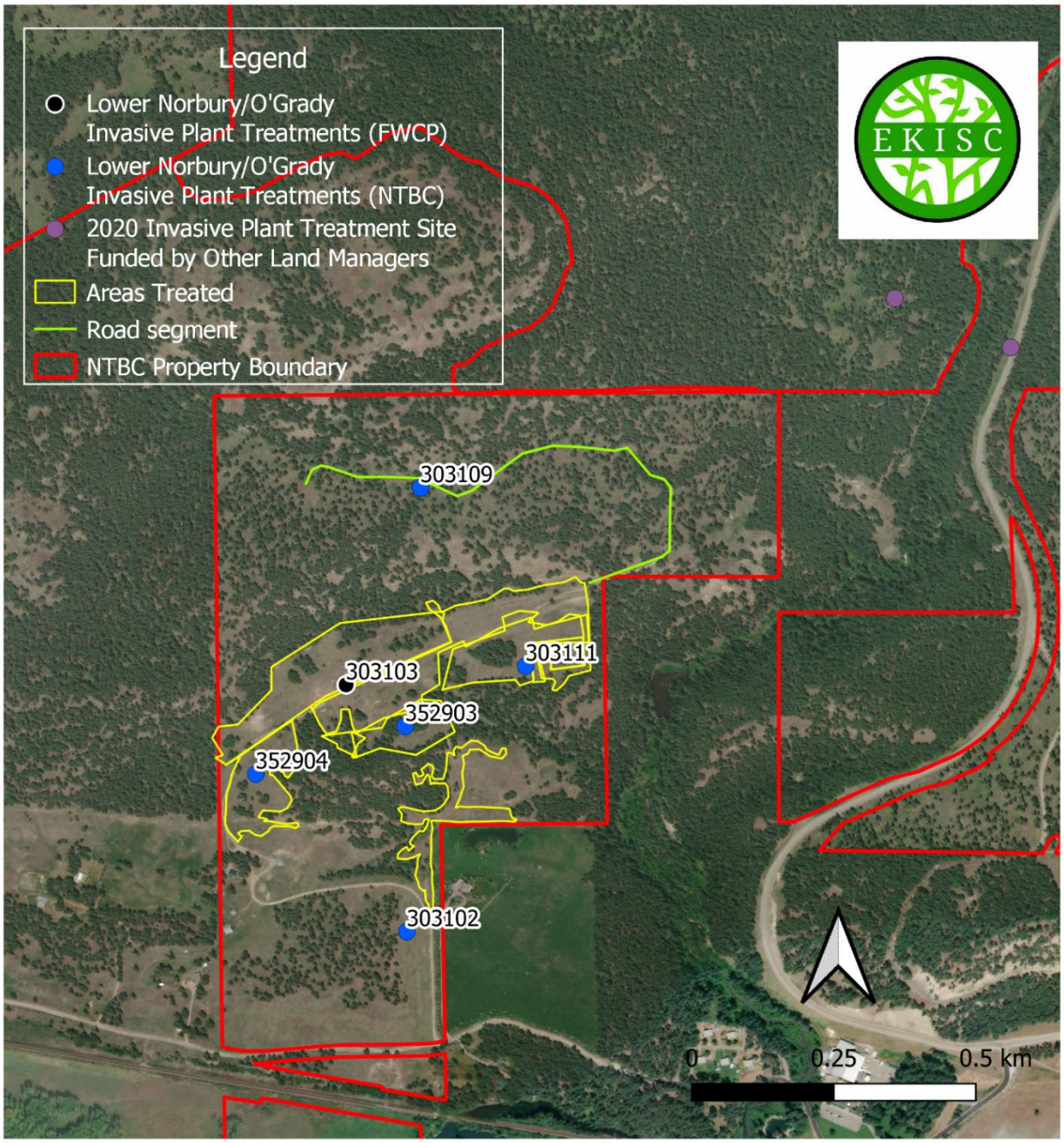

Figure 14. Map of the 2020 invasive plant treatment sites at the NTBC Bull River - Lower Norbury Creek Conservation Property.

Table 14. Details of the invasive plant treatments that occurred at the Bull River - Lower Norbury Creek Conservation Property, funded by FWCP.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (Kg)
303103	Blueweed, Spotted knapweed, Yellow hawkweed	Clearview	Boomless Nozzle	11.58	2.66

Table 15. Details of the invasive plant treatments that occurred at the Bull River - Lower Norbury Creek Conservation Property, funded by NTBC.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (L)
303111	Blueweed	Tordon 22K	Boomless Nozzle	0.38	1.69
352904	Blueweed	Tordon 22K	Boomless Nozzle	2.75	12.38
352903	Blueweed	Tordon 22K	Boomless Nozzle	1.38	6.19
303102	Blueweed, Dalmatian toadflax	Tordon 22K	Boomless Nozzle	2.58	11.62
303109	Blueweed, St. John's wort	Tordon 22K	Boomless Nozzle	0.79	3.56
303103	Blueweed	Tordon 22K	Boomless Nozzle	0.6	2.72
Total				8.48	38.15

Monitoring and Site-Specific Recommendations for the Bull River - Lower Norbury Creek Conservation Property

The Blueweed infestation at the Bull River - Lower Norbury Creek Conservation Property is the primary target for invasive species management activities. The herbicide contractor followed direction from NTBC and was able to accomplish all priority treatments along roads, trails and in open areas, except for all areas adjacent to private land. There was more Blueweed towards the NTBC Woodlot Access property than anticipated, likely due to not all Blueweed plants being treated in 2019 and favourable seed germination conditions in 2020.

It is recommended that the Mill Site be treated annually, including the entrance area in 2021. The large Blueweed infestation on the hill, as well as all satellite infestations, should also receive significant attention in 2021 to ensure all rosettes are treated. Areas that have been treated in the last two years have a noticeable reduction, but the existing seed bank is persistent and will need ongoing treatments. Grass seeding is also recommended as an ongoing strategy to assist with covering bare ground caused by successive herbicide treatments. An estimate of funding required to address all infestations in 2021 is 6-7 days. This would include a follow-up treatment in the fall to treat any rosettes that were missed during earlier treatments.

Luxor Linkage (NCC)

Invasive plant treatments on the NCC Luxor Linkage property were completed on August 10th and 18th, 2020 and was a joint effort from NCC and FWCP. Figure 15, Table 16 (funded by FWCP), and Table 17 (funded by NCC) provide details of the treatments that occurred.

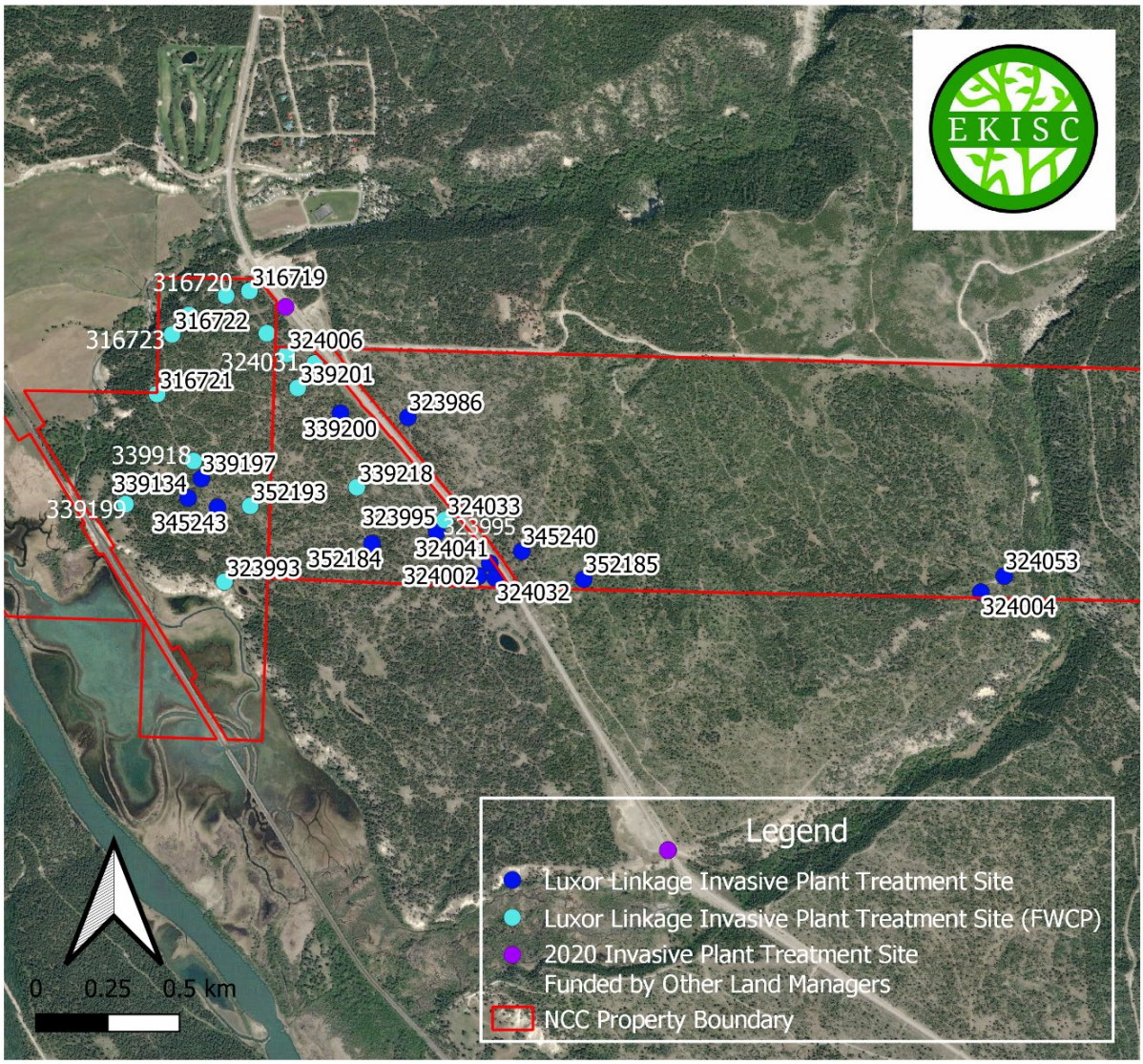

Figure 15. Map of the 2020 invasive plant treatment sites at the NCC Luxor Linkage Property.

Table 16. Details of invasive plant treatments that occurred at Luxor Linkage funded by FWCP.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (L or Kg)
316718	Chicory, Spotted knapweed	Lontrel XC	Boomless Nozzle	0.08	0.04
316719	Spotted knapweed	Lontrel XC	Hand Gun	0.02	0.01
316720	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.07	0.03

316721	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
316722	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
316723	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
323993	Spotted knapweed	Lontrel XC	Hand Gun	0.03	0.01
324006	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.01
324031	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.16	0.08
324033	Diffuse knapweed, Spotted knapweed	Lontrel XC	Boomless Nozzle	0.18	0.09
339198	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
339199	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
339201	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
339218	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
352193	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.02	0.01
Total:				0.67	0.34

Table 17. Details of invasive plant treatments that occurred on NCC Luxor Linkage property funded by NCC.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (L or Kg)
323986	Leafy spurge	Aspect	Boomless Nozzle	0.15	0.68
323995	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.02
324002	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.01	0.01
324004	Spotted knapweed	Aspect	Boomless Nozzle	0.01	0.02
324032	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.13	0.06
324041	Diffuse knapweed, Spotted knapweed	Lontrel XC	Boomless Nozzle	0.03	0.02
324053	Spotted knapweed	Aspect	Hand Gun	0.04	0.16
339134	Leafy spurge	Aspect	Hand Gun	0.06	0.27
339197	Leafy spurge	Aspect	Boomless Nozzle	0.03	0.14
339200	Leafy spurge	Aspect	Hand Gun	0.02	0.07
345240	Spotted knapweed	Aspect	Boomless Nozzle	0.01	0.02
345243	Leafy spurge	Aspect	Hand Gun	0.10	0.45
352184	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.05	0.03
352185	Spotted knapweed	Aspect	Boomless Nozzle	0.02	0.07
Total:				0.66	2.00

Monitoring and Site-Specific Recommendations for the NCC Luxor Linkage Conservation Property

Invasive plant treatments occurred on both the west and east side of the Luxor Linkage property in 2020. Leafy Spurge is the priority for treatment on this property and was noted to be improved in 2020 when compared to previous years, along with various Spotted knapweed infestations. Treatments throughout this property typically take more than one visit, as Leafy spurge requires a more aggressive herbicide than other species present such as Spotted and Diffuse knapweed. There are also challenges with treating Leafy spurge that has spread under the 'dripline' of trees, as the herbicide that is used to effectively treat can cause damage to non-target shrubs and trees. Potential damage to trees should continue to be discussed with NCC.

An area of concern is the Canadian Pacific Railway right-of-way, and the creek that runs next to the track which is infested with Spotted and Diffuse knapweed. A large portion of the area is within the PFZ which would require mechanical treatment to remove; funding for a day of hand-pulling should be considered. The rest of the property received an adequate amount of funding to accomplish all planned invasive plant treatments – it is recommended to continue with a similar level of funding in 2021.

Monitoring on this property was completed on September 29th, 2020. Sites were monitored for Spotted knapweed and Diffuse knapweed treatments and all passed site completion and treatment efficacy scoring. Approximately 6 Kg of grass seed was spread at five locations on the west side of the highway, focusing on disturbed areas and historic invasive plant treatment areas to assist with outcompete existing infestations. A recommended grass seed mix was provided by NCC. Additional seeding in 2021 would benefit this conservation property.

Marion Creek

Chemical and mechanical invasive plant treatments on the NCC Marion Creek Benchland conservation property were conducted on July 16th and 27th, 2020 and was funded jointly by NCC (mechanical work) and FWCP (chemical treatments). Figure 16 and Table 18 provide details of the treatments that occurred.

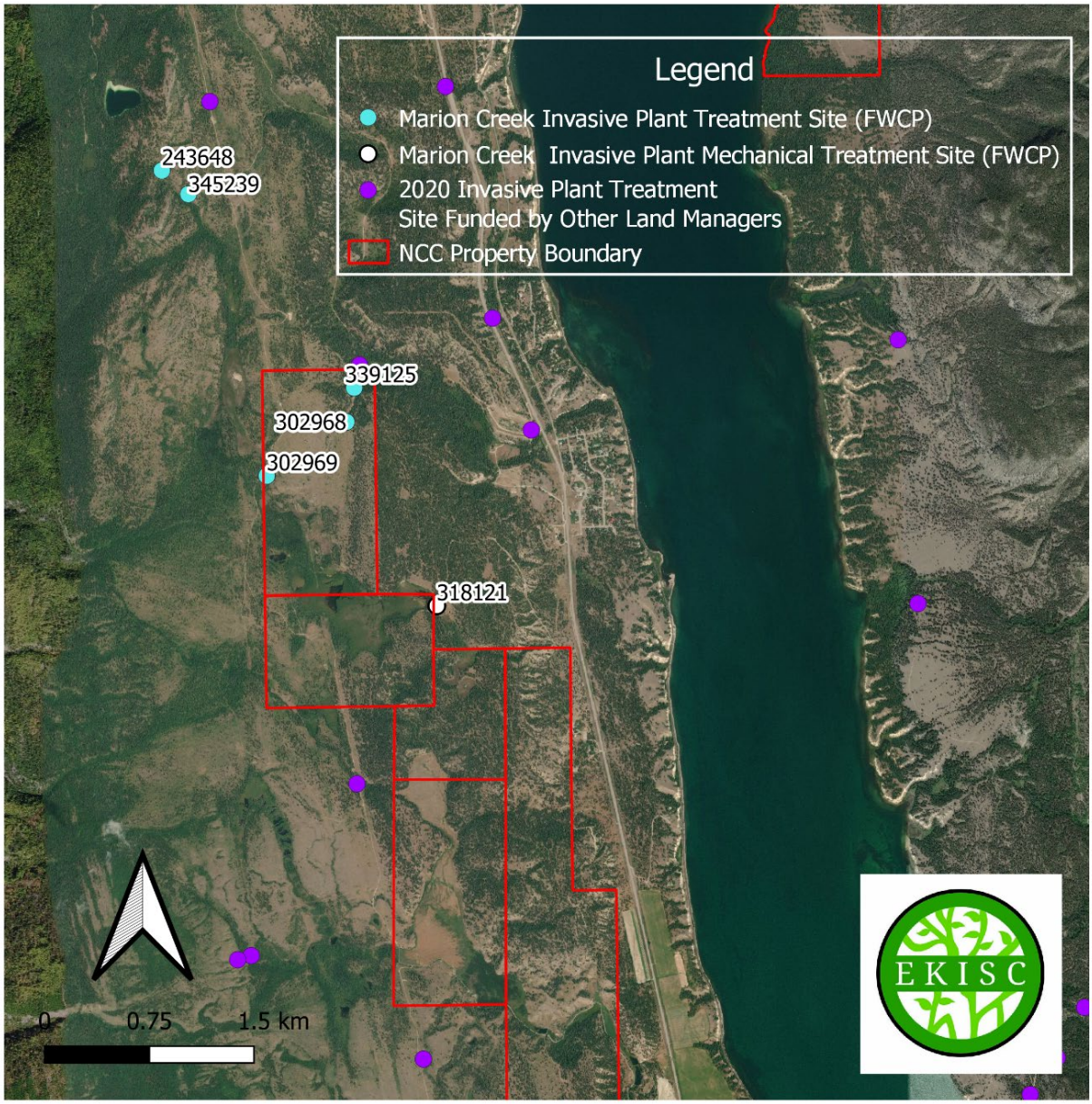

Figure 16. Map of the 2020 invasive plant chemical and mechanical treatment site at the NCC Marion Creek Benchland conservation property.

Table 18. Details of the chemical and mechanical invasive plant treatment that occurred on the NCC Marion Creek Benchland conservation property.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (L or Kg)
243648	Spotted knapweed	Lontrel XC	Hand Gun	0.15	0.08
302968	Burdock species, Spotted knapweed	Lontrel XC	Boomless Nozzle	0.28	0.14
302969	Spotted knapweed	Lontrel XC	Hand Gun	0.005	0.003
339125	Burdock species, Spotted knapweed	Lontrel XC	Boomless Nozzle	0.15	0.08
345239	Spotted knapweed	Lontrel XC	Boomless Nozzle	0.005	0.003
318121	Spotted knapweed	NA	Hand Pulling	0.08	NA
Total:				0.67	0.31

Monitoring and Site-Specific Recommendations for the NCC Marion Creek Benchland Conservation Property

In 2020, chemical treatment targeted existing Spotted knapweed and Burdock infestations that were observed by a treatment contractor in 2019. Infestations had grown since 2019, but funding was adequate to effectively manage the area and should continue in 2021. NCC has prioritized efforts to mechanically hand pull the established infestation on Frocklage Dam (includes Spotted knapweed, Bluebur, Burdock and Canada thistle infestations) for several years. Although it may seem to be a slow process to see results, a decrease in infestation along the dam has been observed.

Native grass seed has been spread at this site for consecutive years and is germinating in some areas, but not covering as much bare ground as needed to provide adequate competition for the germinating Spotted knapweed plants. The grass seed may be vulnerable to the local waterfowl and adding fertilizer to the seeded areas to assist the germinating native grasses may improve grass seed response. It is strongly recommended to continue invasive plant management at this property (mechanical and chemical treatments and grass seeding) as the surrounding area is very limited in Spotted knapweed and continued treatment at the Frocklage Dam would reduce further spread throughout the property.

Monitoring at Marion Creek Benchlands was completed on September 2nd, 2020. Spotted knapweed sites were monitored, and all passed site treatment completion and efficacy scoring.

NTBC Woodlot (and Woodlot Access)

Invasive Plant treatments on the NTBC Woodlot property were completed on October 10th, 2020 and were funded jointly by NTBC and FWCP. Figure 17 and Table 19 provide details of the treatments that occurred.

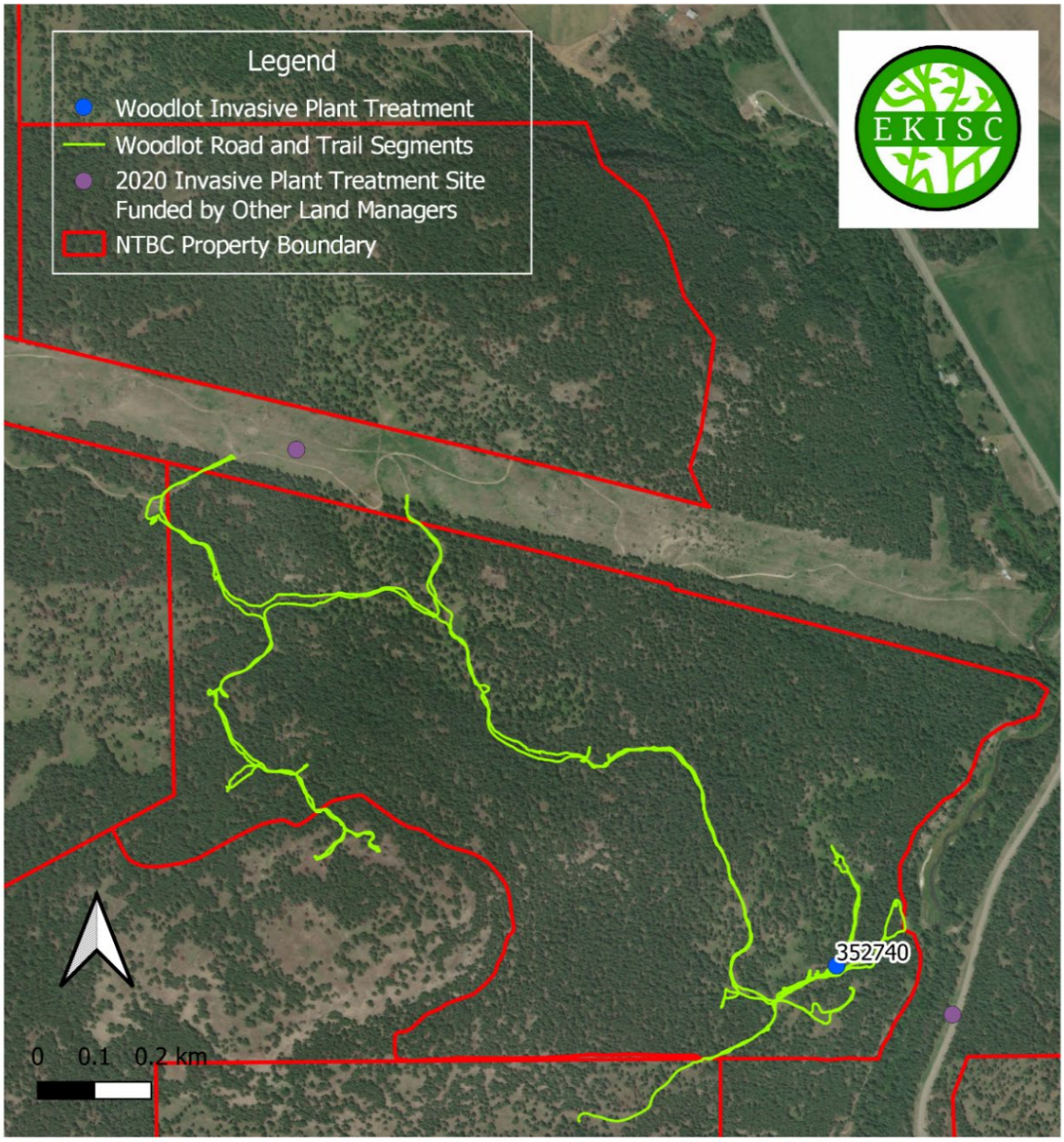

Figure 17. Map of the 2020 invasive plant treatment sites at the NTBC Woodlot and Woodlot Access property.

Table 19. Details of the invasive plant treatments that occurred on NTBC Woodlot and Woodlot Access property funded by NTBC and FWCP. A single treatment record was collected by the contractor.

Site #	Invasive Plants Treated	Herbicide Used	Treatment Method	Area Treated (Ha)	Undiluted Herbicide Used (Kg)
352740	St. John's wort, Spotted knapweed, Yellow hawkweed, Blueweed	Clearview	Boomless Nozzle	1.00	0.23

Monitoring and Site-Specific Recommendations for the NTBC Woodlot (and Woodlot Access) Conservation Property

2020 was the second year EKISC administered invasive plant treatments at the NTBC Woodlot property. This area has a relatively manageable level of invasive plants (compared to the adjacent Bull River Lower Norbury Creek Conservation Property) and should be re-visited annually to maintain minimal spread. The existing Blueweed infestation should be an annual priority, and if funding permits, treatments should continue to the north and west part of the property. Approximately 2-3 days of treatment is recommended to treat all existing infestations in 2021. The Blueweed infestation to the north of the property will also be prioritized for treatment in 2021 by EKISC via BC Hydro funding.

Additional Treatment and Survey Locations

EKISC conducted additional invasive management activities on the following areas that are aligned with the IPMRPA Project, but did not specifically use IPMRPA Project funds:

- Field scabious control in Radium. As a follow-up to previous restoration efforts, Field scabious was removed from the site to manage the invasive plant and support growth of planted native trees, shrubs, grass, and sedge plugs.
- All Blueweed sites in the Columbia Valley were prioritized for treatment to reduce its spread and further introduction (this aggressive invader is relatively limited in the area).
- The Columbia Wetlands Wildlife Management Area (CWWMA) was prioritized for Leafy spurge treatments, and the Canadian Wildlife Service (CWS) Wilmer Subunit was treated for Leafy spurge and other high priority species.
- The high priority species Water parsnip was treated twice at Bummers Flats. EKISC whipper-snipped the entire infestation twice to prevent further spread and completed a survey of the entire Bummers Flats Dyke and Wetland area. An additional satellite infestation was found on the Dyke and treated.
- Additional invasive plant inventory and treatments were completed in Upland/Dryland areas in the Wigwam Flats area Big Horn Sheep winter range and Bull River Ungulate Winter Range.
- EKISC partnered with BC Parks, NTBC, and NCC to complete additional surveys and treatments on high value conservation lands throughout the Columbia Region.

Funding

FWCP funds were utilized for survey, treatment, and monitoring at all Project areas discussed within this report. Additional dollars, as outlined within the 2020 Statement of Account, were used for purchasing grass seed, field expenses, and for project administration. In addition to funds provided by FWCP for invasive plant management activities at the 12 project sites, NTBC contributed funds to four of the Project properties (Bull River - Lower Norbury Conservation Property, Columbia Lake Westside Conservation Property, Hoodoos Conservation Property, and NTBC Woodlot and Woodlot Access), NCC contributed funds to three of the Project properties (Kootenay River Ranch, Luxor Linkage, and Marion Creek), MFLNRORD contributed funds to one of the Project properties (East Side Columbia Lake Wildlife Management Area), and BC Hydro contributed funds to two properties (Hoodoos Conservation Property, and Columbia Lake Westside Property).

Additional funds were contributed by MFLNRORD, NTBC, NCC, and BC Parks to treat adjacent high value conservation lands and Provincial Parks. MFLNRORD and MOTI also funded treatments adjacent to conservation lands.

Discussion and Program Recommendations

EKISC worked with Project partners to identify and prioritize high-value conservation lands for invasive species surveys, treatments, and monitoring during the 2020 field season, marking year six of the IPMRPA Project. Eleven conservation lands and one Provincial Park were identified for treatments to take place and treatments were coordinated so they occurred at the same time as nearby properties to maximize funding dollars and better utilize a landscape-level approach. Additional management activities occurred on NTBC, NCC, MFLNRORD, and BC Parks managed properties but were not included in this report.

Invasive plant surveys and treatments occurred between June 17th and October 10th, 2020 and were prioritized for summer herbicide application when plants were in flower or fully "greened-out." Additional treatments were completed later in the fall, as some plants still respond favorably to later herbicide applications. Across the 12 project areas, 185 invasive plant treatments were completed by contractors and EKISC staff, covering an area of 42.9 hectares. To assess success of invasive species management at project sites, EKISC looks at: 1) short term success of invasive plant treatments through seasonal efficacy and completion monitoring of a minimum of 10% of Project treatment sites; 2) long term success of invasive plant treatments through permanent plot monitoring (EKISC has permanent sample plots located throughout the Regional District of East Kootenay linked to other projects which are monitored for change in invasive species presence and density over time; 3) prevention of new invasive species introductions through education and outreach and promoting best management practices; and 4) stakeholder engagement and participation.

At treatment locations, post treatment efficacy and completion monitoring by EKISC staff indicate that where herbicide application is taking place, treatments are complete and invasive species are responding favorably. On average, treatments had a combined efficacy and completion score of 93.9%, illustrating that contractors and EKISC staff are efficiently treating targeted invasive plant locations, and selected herbicides and application methods are effective in plant management. In 2020, no new Priority 1 species were observed by contractors or EKISC staff in IPMRPA Project areas. Though we did not visit all previous project areas, we can still see this as a positive result of the overall invasive plant management for the IPMRPA project and adjacent areas, as we are not seeing new introductions of high priority invasive species. Most treatment locations are managing existing infestations. Although one new satellite

infestation of the Priority 1 species Wild parsnip was observed and treated at the Bummer's Flats property, this occurrence and follow-up actions highlights the importance of annual site visits to high value conservation lands; the new satellite infestation was responded to quickly and will be visited again in 2021.

At some project treatment locations, we have observed a reduction in both the amount of herbicide applied and the overall treatment area. However, some treatment locations increased in 2020 compared to 2019. This may be due to several reasons, such as the invasive species response (e.g., Leafy spurge infestations often increase in size after the first treatment in an attempt to "outgrow" the stress), previous allocated funding did not enable treatment of the entire area, or the site increased in size due to favorable conditions for release of the species seed bank. In addition, because funding varies from year to year, and priorities for invasive species management across the landscape can change based on land manager site-specific objectives, we often do not have resources to inventory, treat, and monitor the same treatment sites year after year. Therefore, we apply a rotating and/or triage approach to many of our treatment locations.

Based on 2020 treatment monitoring visits conducted by EKISC staff, there are various site-specific recommendations for subsequent Project years:

- Bummers Flats - Cherry Creek: Mechanical treatments should continue at this property, and additional surveys across the creek and downstream will be helpful to plan subsequent treatments. Aggressive grass seeding or planting should also help with outcompeting the established Spotted knapweed infestation in the area. Bummers Flats - Zirnhelt (Wetland): In 2020 this Purple loosestrife pull was compromised due to the Covid-19 virus and restrictions. Typically, 8-10 people are involved in the pull, but in 2020 this number was reduced to only 6 people, with a shorter field day. Ideally two days, with smaller crews, is best for this site due to access challenges and travel time. As the Bummers Flats wetland is currently the only known occurrence of Purple loosestrife on Crown land in the East Kootenay region, it is recommended that treatments continue in subsequent years. EKISC is working on finding additional partners to work on this initiative to reduce site size and enable additional inventory of the area and has requested a biocontrol agent for release from the MFLNRORD Invasive Plant Specialist. Though mechanical treatment is not ideal, as Purple loosestrife is difficult to completely remove and can reproduce through fragmentation, chemical control is not an option due to its riparian habitat.
- Bummers Flats - Zirnhelt (Dyke): Glyphosate treatment was successful in 2020, with hand-pulling occurring in the 1m PFZ; additional time (1 full day) would be beneficial to this site annually to assist with the newly established pollinator project.
- Columbia Lake East WMA: Inventories for Yellow hawkweed were completed in 2020 from Canal Flats to Armstrong Bay and coverage is deemed manageable in most areas. However, Yellow hawkweed also exists in PFZ areas and careful consideration of treatment needs to occur. EKISC recommends continuing to prioritize treatments for this conservation property to keep momentum going on the large Spotted knapweed infestation at, and adjacent to, the radio tower. Though the infestation has decreased in size from successful consecutive treatments, we anticipate a large seed bank being present that will need continued management. In areas beyond the radio tower, Yellow hawkweed is starting to become established in open areas and roadsides. Including the management of Spotted knapweed (some of which is in challenging high bank

terrain), continued funding for approximately 6 days would be needed in this area (which would include hand-pulling and backpack work).

- Columbia Lake Westside: It is recommended to continue annual invasive plant treatments at the Columbia Lake Westside property to manage the higher priority infestations like Common tansy, Scentless chamomile, and Spotted knapweed. All existing sites of Spotted knapweed, Common tansy, and Scentless chamomile were treated, but Yellow hawkweed is continuing to expand, especially in the southern portion of the property and into forested areas. The northern end does not seem to be as badly infested with Yellow hawkweed. If Yellow hawkweed is deemed a priority to control, an increase in funding will be required.
- Columbia Lake Westside – Sun Lakes: The property area has seen some progress, with Spotted knapweed being treated and only Canada thistle existing with the PFZ area. A maintained level of funding is required to continue treatment of Spotted knapweed. Concerns exist that Yellow hawkweed may encroach onto this property from the Columbia Lake Westside properties. Hoodoos Conservation Property: Spotted knapweed treatments are continuing to do well, but existing seed banks seem to replenish each year. Consistent funding is recommended annually to address continued growth and cover the large area. A new recreational trail (New Legacy Trail) running through and adjacent to the property will need to be considered when planning further invasive plant management.
- Kootenay River Ranch Property: Inventories of new parcels was completed in 2020 and found lesser priority species, namely Spotted knapweed, Yellow hawkweed, Sulphur cinquefoil, Canada thistle, Bull thistle, and Mullein. EKISC recommends revisiting invasive species management objectives at Kootenay River Ranch. There are many widespread species across the complex, including within the new parcels, and significant funds will be required to effectively reduce them. Subsequent treatments should continue to focus on priority Spotted and Diffuse knapweed sites along the main access roads and trails throughout the property and disturbed areas, and shift some focus to large vectors of spread on the west side of the complex. This will help to manage the continued spread of invasive plants within the property and to adjacent jurisdictions.
- Bull River - Lower Norbury Creek: It is recommended to continue treatment of the Mill Site, including the entrance area in 2021. Blueweed appeared to increase with larger infestations up the large hill. Funding in 2021 should reflect approximately 6-7 days of work, with the focus being Blueweed on the hillside and satellite locations. Areas that have been treated in the past have seen a noticeable reduction, but large open areas will need further attention. The existing herbicide residual is expected to deter Blueweed seed germination for 1-2 years.
- Luxor Linkage Conservation Property: Although annual treatments are going well at this property, an area of concern is the Canadian Pacific Railway right-of-way, and the creek that runs next to the track which is infested with Spotted and Diffuse knapweed. Funding for a day of hand-pulling should be considered for the riparian/PFZ area, and additional grass seeding is recommended.
- Marion Creek – Spotted knapweed and Burdock were larger than anticipated in 2020. Maintenance of funding is necessary for continued work in reduce infestation sizes. The mechanical pull at Frocklage Dam had many mature plants but all were pulled before plants went to seed. It is strongly recommended to continue invasive plant management at this property (mechanical and chemical treatments, and grass seeding) as the surrounding area is very limited in Spotted knapweed and continued treatment at the Frocklage Dam would reduce further spread throughout the property.

EKISC also recommends continuing to prioritize areas for grass seed application, and to allocate more project funds toward this project component. In 2020, grass seed was applied to three of the project areas, in locations where bare ground exists and native grasses and forbs are not readily reestablishing treatment sites. In some of these locations, such as Kootenay River Ranch, grass seed is assisting with native cover establishment. Areas of seed application should be monitored again in 2021.

Challenges and Lessons Learned

There are many challenges of a long-term invasive species management program. The primary challenge of this program has been to quantify successes in invasive species management across a large landscape, and due to the nature of invasive species, it can be difficult to measure effectiveness of treatments. Invasive plants can spread quickly and be introduced to new areas easily. EKISC works hard to reduce the distribution and density of existing invasive species populations, however new introductions and spread of new infestations in many areas across the East Kootenay continues. This makes it difficult to illustrate a reduction in both the number of invasive plant populations, the size of infestations, and the amount of herbicide or mechanical effort used on the ground. EKISC is diligent in annually quantifying successes by conducting thorough monitoring visits to sites, completing sites treatment and inventory records, and communicating with area contractors and EKISC staff to measure project outcomes.

In addition, EKISC believes the Project is managing and reducing the spread of existing invasive species populations and allowing contractors and EKISC staff to quickly identify and respond to new high priority invasive plant populations; however, acknowledgment also exists that each year there are areas that do not have funding to visit or treat on an annual basis. EKISC connects with regional land managers and stakeholders throughout the year to foster increased support for invasive species management and secure suitable, durable funding for projects such as IPMRPA.

In the fall of 2020, EKISC held contractor and Project partner debrief sessions. These sessions are instrumental in discussing the successes of the 2020 field season and capturing recommendations for invasive plant management moving forward. Debrief meetings also provide an opportunity to discuss important regulations and legislation, for example the importance of properly flagging out and providing a buffer for Pesticide Free Zones. It is recommended to continue facilitating these valuable meetings moving forward.

Additional Project Recommendations

In addition to site-specific recommendations for invasive plant management activities, it is recommended that EKISC continue to develop monitoring activities to better communicate success of invasive plant management on the various areas associated with this Project. EKISC should also complete more comprehensive monitoring visits at grass seed application sites in order to quantify seed establishment and better evaluate if grass seeding efforts are leading to establishment of favorable forage species. Finally, although EKISC has successfully grown and maintained a level of stakeholder participation throughout the duration of this project, it is important that we actively seek new participants and collaborators, and work to better engage First Nations in the IPMRPA Project.

Acknowledgements

EKISC would like to knowledge the generous support of the Fish and Wildlife Compensation Program, without whom it would not be possible to support the ongoing invasive species management at many conservation properties and areas on and adjacent to existing FWCP investment sites. This project is also possible due to support from the Nature Trust of British Columbia, the Nature Conservancy of Canada, and Ministry of Forests, Land, Natural Resource Operations and Rural Development. The Ministry of Environment (BC Parks) and the Rocky Mountain Trench Natural Resource Society also works with EKISC to coordinate invasive species management that complement the treatments related to this Project.

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