Environment and Climate Change Canada
Canada Nature Fund: Community-Nominated Priority Places for Species at Risk

Kootenay Connect: 6CW Columbia Wetlands: Restoration of Habitats and Species at Risk in the Columbia Valley: Summary report

March 31, 2024. Final Report: Year 6
Columbia Wetlands Stewardship Partners
By, Dr. Suzanne Bayley, Rachel Darvill, Dr. Ryan MacDonald, Brian Gustafson, Catriona Leven, Jessica Holden, Beth Millions, & Rick Hoar

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6CW Summary overview of projects in Columbia Valley Year 6

By

Dr. Suzanne Bayley, Dr. Ryan MacDonald, Rachel Darvill, Brian Gustafson, Catriona Leven, Jessica Holden, Beth Millions, and Rick Hoar

The Columbia Wetlands Stewardship Partners (CWSP) received funding from Kootenay Connect ECCC for four projects in the Columbia Valley, BC. The projects in year 6 of the KC/ECCC projects continue the work from the years 1-5, providing more detailed science, more on the ground conservation actions, and more community involvement.

The projects include **6CW Western Painted Turtle and SAR (6CW WP Turtle & SAR)** to enhance conservation actions that would benefit Western Painted Turtle, American Badger, Lewis's Woodpecker, and Osprey.

The second project is the **6CW Conservation & Mitigation of Wetland Basins Vulnerable to Drought (6CW Hydro & Beaver**) which is composed of 5 main topics: a) restoration of degraded beaver dams to restore wetlands in the uplands of Columbia Valley, and pre and post environmental assessment of 11 sites (8-15 BDA's) where restoration has occurred or is planned, b) assessment of the impact of beaver dams in the Columbia Wetlands, and selection and construction of artificial beaver dams to mitigate the loss of water overwinter on species at risk (SAR) and waterbirds, c) assessment of wetlands and natural beaver dams in the grasslands west of Columbia Lake, d) assessment of hydrologic vulnerability of upland wetlands to determine priority wetlands where management actions like conservation or mitigation should be implemented, and e) hydrological evaluation of wetland vulnerability to climate change in Columbia Wetlands.

The third project **6CW Conservation Lands** has two subprojects, one of which has identified and ranked important biodiversity hotspots in riparian and upland habitat in Columbia Valley (CV). It has identified and prioritized key parcels with conservation opportunities for SAR and species of interest on private and public land adjacent to the

CWWMA. This project has collaborated with Farmland Advantage and Windermere District Farmers' Institute (WDFI) to work with two landowners to develop Environmental Farm Plans and provide on-the-ground fencing and stewardship prescriptions on two properties at the north end of Columbia Lake.

The fourth project **6CW Cottonwoods Subproject** protects important wildlife trees from harvesting by beavers. It includes monitoring and mitigating the impact of beaver on cottonwood/aspen stands and includes the installation of wire guards on important cottonwood trees in Columbia Wetlands.
Overall, all our projects were very successful.

Our projects aim to raise awareness around species at risk in the Columbia Valley and to enhance, restore, and manage the large riparian and wetland complex of the Columbia Wetlands and Valley to support the recovery of target species at risk.

Here are a few highlights of our projects with a summary of each project below.

6CW Species at Risk: Western Painted Turtle, Badger, Osprey, and Lewis's Woodpecker

- We continued to improve and enhance the western painted turtle (WPT) nesting beds in Invermere including protection from predators.
- A new nesting bed was created along the roadside at Spillimacheen to intercept turtles before crossing the road to reach their historic nesting area.
- We monitored turtles on the historic nesting site and two created nesting beds; five wildlife cameras were used for effectiveness monitoring.
- Despite failure of some wildlife camera's during parts of the peak nesting season, a total of 48 turtles were observed, including 38 turtles crossing the road to reach the historic nesting area. The threats of predation and road mortality continue to be high.
- Inventories for American Badger burrows found 1807 functional burrows this year as we continued to work towards establishing new badger WHFs and WHAs under

the Forest and Range Practices Act. Badger burrows were observed at three locations. At Lake Lillian West we recorded 22 burrows, 14 of which were functional. At Jubilee, 25 badger burrows in functional condition were observed. At Findlay Creek, 1,768 badger burrows were recorded in functional condition. There were so many badger burrows that we could not complete the assessment at Findlay in 2024. The government recommended that we complete the inventory of badger burrows at Findlay Creek before submitting the 2024 sites to the government to become WHF's.

- We continued our work to submit the badger burrow locations to the provincial WSI Survey Observations layer from the sites identified in 2024. Due to issues with the government submission platform, some of the badger burrow data submitted by CWSP has been uploaded while other contributed data remains to be uploaded. Since the provincial government changed their online submission platform, we are waiting on the government to transfer our previously created 'historical' SAR projects to their new platform. This transfer needs to be done by government before 2024 datapoint submissions can be completed.
- Monitoring of osprey nesting success was done at 72 locations and found 62 viable locations for nests, three of which were in trees and 59 on poles/platforms. 28 nests were successful. The osprey nesting success rate was between 45.2% - 64.5%. BC Hydro continued to repair nesting platforms and poles that we identified.

6CW Hydro & Beaver

Restoration of upland wetlands on benchlands west of Columbia River

- In 2023, CWSP surveyed 371 sites by drone on the western benchlands of the Columbia Valley. With in-person site assessments we determined that nine may be suitable for restoration using Beaver Dam Analogues (BDAs). In 2024, we continued this work and assessed 30 wetlands in-person and selected two more potential restoration sites. In total we have 11 potential sites for restoration.
- In October 2024 we received permits to build four BDAs at two sites, Beaver Channels and S-Land.

- We constructed 4 BDAs, which will store 12,368 m^3 of water. It restored over 52,493 m^2 of wetlands. That is restoration of 5.2 ha of revitalized wetlands in a dry upland area.
- At the S-Land Site our efforts produced 3399 m^3 of stored water and 12,793 m^2 of restored flooded area.
- At the Beaver Chanels site our efforts will produce 8,969 m^3 of stored water and 39,700 m^2 of restored flooded area. That is 3.97 ha of wetlands restored.
- We continued pre-restoration monitoring work at the nine previously selected sites and began pre-restoration monitoring work at the two new sites. Pre-restoration monitoring included measuring water depths, water quality, surveying breeding birds in May/June, surveying vegetation communities to provide community classification, and using wildlife cameras to detect large mammals.
- We detected 77 bird species during our breeding bird surveys, two of which are SAR in BC. 24 of these species are wetland dependent and 5 are wetland associated. This supports our assessment that other wetland habitats could be improved via our BDA restoration to support more wetland dependent species.
- In January 2025, three permit applications for four CWSP sites (Double Dam, Limbo, and Northbound/Big Dam) were prepared and submitted. These applications required a 50-page environmental management plan for each site. If permits are successfully approved for work in 2025, CWSP will be repairing six remnant beaver dams by constructing 39.5 m of BDAs. We estimate that these repairs will allow us to store 17,321 m^3 of water over an additional 41,488 m^2.

Restoration, BDAs and Monitoring in the Columbia Wetlands

- We identified 4 main types of floodplain wetlands based on their hydrology and geomorphology and assessed their vulnerability to ensure that a suite of them can retain permanent water bodies over winter for migrating birds in the spring.
- Beaver dams and the size of the gaps in the natural levees are responsible for ~60% of the variation in water levels in the Columbia Wetlands. Without beaver dams the waters in CW would drain out over winter. We have continued our monitoring program on 37 wetlands with intensive monitoring of 20 wetlands.

- 2023 and 2024 were both dry years with low flood pulses, and wetland water levels were lower than in 2024 than 2023, suggesting that consecutive dry years have a cumulative impact on the wetlands. The Least Connected wetlands showed the smallest water level change between wet and dry years, emphasising the importance of this wetland type in maintaining water in Columbia Wetlands.
- We recorded 164 species of birds in and around the 37 study wetlands between 2021 and 2024, including 14 SAR.
- During spring and fall migratory waterbird counts at 20 wetlands, we have recorded 50 species of waterbirds and raptors (of which four are SAR), and 26,624 individual birds.
- The Partially and Least Connected wetlands are used by more species of birds in the spring than are the Most Connected wetlands (an average of 6 species using Most Connected wetlands vs. 10 to 15 species in the Partially Connected & Least Connected wetland groups). In the fall, there is no difference in the number of species of birds in the different wetland groups (an average of 5 or 6 species across all wetland groups).
- This demonstrates that Partially and Least Connected wetlands are particularly important during the spring, when the wetlands provide open water habitat essential to migratory waterbirds. As beaver dams maintain many of the Partially and Least Connected wetlands, their presence on the landscape is essential for habitats and biodiversity.
- We have focused our restoration efforts on three wetlands (Sites 24, 71, and 145) in which we want to install beaver dam analogues (BDAs). We applied for permits for the sites; they were rejected.
- We continue to apply for permits and are now working with The Nature Trust of Canada for two sites (24 and 71) and will investigation other options for Site 145. If permits are granted, we will store 65,250 m^3 at Site 24 and 23,560 m^3 at Site 145.
- In August 2024, Catriona Leven successfully defended her thesis titled ‘Wetland hydrology and the impacts of beaver dams in the Upper Columbia River floodplain wetlands’. The full thesis is publicly available on the University of Waterloo

UWSpace (https://uwspace.uwaterloo.ca/items/058b8547-b6c6-4316-825c-39196f933695) and this manuscript is currently being redrafted for publication.

- In January 2025, Dr. Suzanne Bayley was a co-author on the paper modeling the effects of a warmer climate on the Columbia Wetlands. Full citation: Rodrigues, I. S., Hopkinson, C., Chasmer, L., MacDonald, R. J., & Bayley, S. E. (2025). Warmer air temperatures predicted to result in wetland drying in the Upper Columbia River Valley, British Columbia, Canada. Science of The Total Environment, 959, 178261. https://doi.org/10.1016/j.scitotenv.2024.178261

Assessment of bench wetlands West of Columbia Lake

- The southern portion of Columbia Valley is very dry and projected to be even drier in future decades. The Columbia Lake benchlands has historically had double the water deficit experienced by the northern extent of the region. Under climate change, this seasonal water loss is expected to get even worse.
- In an assessment of 17 wetlands west of Columbia Lake, only five had surface water present, and only two were considered to have water with a permanent hydroperiod, meaning they will be wet all year round. Of the other wetlands, six had a seasonal hydroperiod, four had an ephemeral hydroperiod, three had a temporary hydroperiod, and two were in fact not wetlands. The entire area was extremely dry and losing water, except for Marion Creek drainage.
- In more detailed surveys of beaver dams and lodges in the Upper Marion Creek West Wetlands we monitored 46 beaver dams, 24 of which were active, and nine beaver lodges, five of which were active.
- These active dams hold approximately 33,447 m^3 of water on the landscape, creating marsh, swamp, and fen wetland habitat, and help regulate the flow and temperature of Marion Creek, which increases biodiversity and is important for species such as the provincially Blue-listed listed and designated as Special Concern under COSEWIC Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) found in Marion Creek.
- The Marion Creek drainage is the only area of significant wetlands west of Columbia Lake and should be protected by the local property owners, stakeholders

and government. It is highly vulnerable and without the beaver and their dams would be likely to become quite dry.

<u>Hydrologic Modelling in Upland and Columbia Wetlands:</u> Assessing the vulnerability of bench wetland projects under climate change

- We created a Wetland Restoration Feasibility Index from a combination of a Wetness Index (a topographic based estimate of where water will accumulate), an Inflow Index (measuring strength of water source), and a Precipitation – Evapotranspiration Score (a dryness index). This assessment is based on surface water connectivity and climatic conditions and does not take into account groundwater.
- The Inflow Index showed that of the 443 wetlands assessed in this study, 179 were isolated, 103 had an intermittent source, 48 had a minor source, 18 had a lake source, and 95 had a major source. A minor source is a stream order of 1, while a major source is a stream order of >1. This indicates how many wetlands on the upland benches have limited water sources and are vulnerable to drying.
- In terms of potential success of restoration, of the 443 wetlands assessed in this study, 168 had a Low Restoration Feasibility Index, 153 were Moderate, 74 were High, and only 48 were Very High. This index provides a first step when assessing restoration sites and provides guidance for sites that should be avoided due to a lack of water availability.
- Of the 11 sites identified by CWSP as having potential for restoration using BDAs, four ranked as Very High, six as High, and one as Low. These high scores are generally to do with high wetness and inflow scores, indicating that restoration efforts at these sites are more likely to be successful. The one Low ranking site (Beaver Channels) has been observed during fieldwork to have a consistent groundwater source which maintains water in this wetland, emphasising the need for desktop and fieldwork analysis to be conducted when choosing restoration sites.
- This approach depends on the accuracy of input data and assumes that the water sources have not been substantially altered.

Characterizing the vulnerability of the Columbia River Floodplain Wetlands to Climate Change

- The hydrologic analysis of CW predicted earlier spring melt and drier summer water levels. The 2023 & 2024 hydrologic years which were very dry matched the predictions from the models. The models showed that to retain water in the wetlands, the levees and beaver dams are essential. The entire Columbia Wetlands is vulnerable to climate change.
- There is a strong geographic relationship in the vulnerability of Columbia Wetlands, as almost all of the vulnerable wetlands are in the southern region, south of the Spillimacheen River. All wetland groups (Most Connected, Partially Connected and Least Connected) are vulnerable to drying because they are all dependant on the climate and flows from the Columbia River. There are few large rivers south of the Spillimacheen River bringing in additional flows and thus there is increasing vulnerability the further south one goes.

6CW Conservation Lands (BCO & fencing subprojects)

- Continued work on property analysis and valuation in the Columbia Valley.
- Mapping was updated and further automated to assess a greater number of properties in the area of interest than were previously possible when property assessments were manually completed.
- Up to date mapping has been related to species at risk, wildlife habitat features, and wildlife habitat areas were updated to reflect the updated analysis.
- The top five ranked properties in the project area are presented.

Conservation Actions in the Columbia Lake Fairmont Wildlife corridor

Farmland Advantage worked with local farmers to improve the wildlife habitat by fencing, weed control and grazing management.

Year 1 (2024) project work on the Haynes property accomplished the following:

- 65 ha of land assessed for health and treatment prescription,
- 65 ha of land fenced,
- 65 ha of land will be grazed strategically for habitat health,

- Over 5 ha of noxious weeds sprayed,
- 2450 m of fence installed.

6CW Protection of high value cottonwood trees from beaver damage

- Installed new wire guards on 32 new trees. 2 of these trees are located near the Golden airport, 18 are around Parson, and 12 are north of the Radium Hot Springs Mill.
- 51 trees with previously installed wire guards were assessed. Wire guards were assessed on trees near Radium (21 trees), Brisco (16 trees), Parson (11 trees), and Golden (3 trees). The wire guards were all in good condition and no beaver damage was seen on these trees.
- We identified additional locations (either high quality wildlife trees or cottonwood stands) for future wire guard installation between Parson and Nicholson.

Overview Summaries of the 6CW Columbia Wetlands Projects are below. Detailed reports for each subproject have been submitted on google drive.

I. 6CW Western Painted Turtle and SAR (6CW WP Turtle & SAR) project Results

Western painted turtle nesting habitat enhancement continued on the private land at Zehnder farm. Successful hatchlings were observed adjacent to the fenced nesting bed every year from 2021-2024, after the predator exclusion fence was installed in 2020. Mortality outside of the enclosure continued. Each year more hatchlings have been observed so in 2024 the nesting habitat was enlarged and expanded. We spread 32 yards of substrate to create and enhance a 9’ x 30’ x 1’ nesting bed and an 8’ x 25’ x 1’ nesting bed inside the fenced enclosure.

In the Spillimacheen area, nesting beds created between 2022-2024 are working to attract turtles, but its likely that more time is needed before increased use is observed. A new nesting bed was created on the MOTI roadside at Spillimacheen in 2024. In May 2024, remote wildlife cameras detected 42 turtles using the historic roadside nesting bed, but technical camera issues produced limited observations and it's probable that many more turtles are still crossing the road to reach their historic nesting bed. Four turtles were observed on the nesting bed created in 2022-23 and one nest was laid. Two turtles and no nests were observed in the bed created in 2023-24, however the remote camera's functionality was limited.

Figure 1: New nesting turtle bed constructed along the roadside in Spillimacheen.

Inventories for American badger burrows were done in four areas in 2024. At Stoddart Creek, no badger activity or burrows were observed. Inventory work at Lake Lillian West recorded 22 burrows, 14 of which were functional. At Jubilee, 25 badger burrows in functional condition were recorded. At Findlay Creek, 1,768 badger burrows were recorded in functional condition. The number and extent of badger burrow activity was so large at Findlay, we could not complete the inventory of the area in 2024 and will continue in 2025. All functional burrows will be submitted to the provincial government to become WHFs after completion of the further inventory work in 2025.

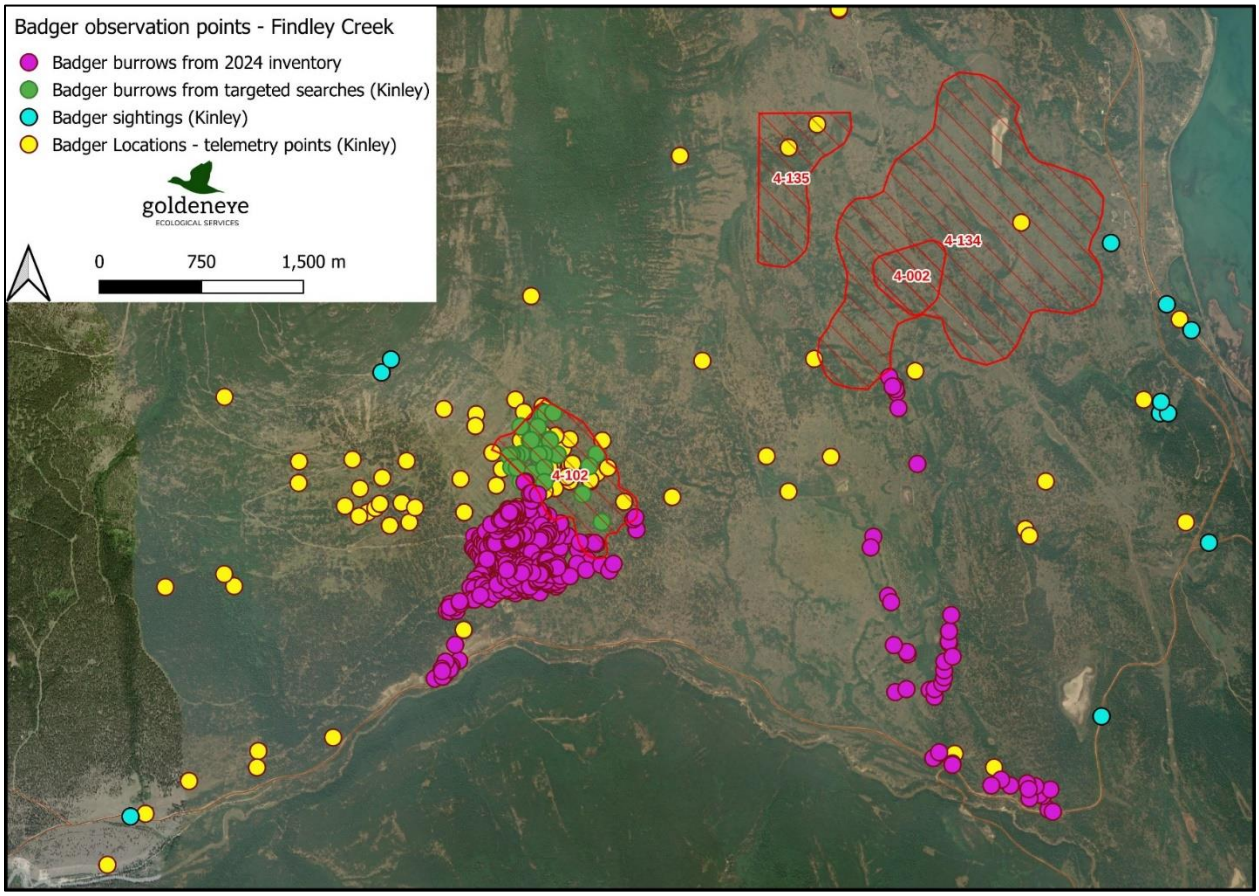

Figure 2: Map displays the burrow activity seen at Findlay Creek during historical surveys and during 2024 surveys.

Monitoring of osprey at 75 nesting trees, platforms, and poles, found that three nests were no longer present, and 10 poles/platforms were in non-functional condition due to inadequate placement (e.g., too close to ground) and surrounding habitat. Three poles/platforms were reported to BC Hydro for repair and two were repaired in March 2024 due to our request. There were 62 viable osprey nests, three were tree nests and

59 were poles/platforms. Of those 62 nests, the osprey nesting success rate was 45.2% - 64.5%, depending on how many of 'unknown' nests produced viable fledglings. 95.8% of the known osprey nests in the study area are built on hydro pole platforms.

Thirteen active Lewis's woodpecker nests were identified between Invermere and Canal Flats in 2024; eight of those were within a concentrated area on private land near Fairmont Hot Springs, including on the golf course. Eleven of the 13 nest locations are on private land, and two are on BC Hydro right of way (nest cavities in hydro poles). Eight nests were in Critical Habitat (CH) as identified in the federal government's recovery strategy, and five of the nest locations were not in CH. None of the active nests were within an established Lewis's woodpecker WHA.

II. 6CW Conservation & Mitigation of Wetland Basins Vulnerable to Drought (6CW Hydro & Beaver)

Upland Wetland Restoration using Beaver Dam Analogues (BDAs)

In October 2024 CWSP built four BDAs at two sites, S-land and Beaver Channels. This restored wetlands in the dry upland benchland of the Columbia Valley. Site assessments completed in 2023 predicted the increase in water level and potential flood perimeter of our restoration sites. Based on this information, we anticipate that the restorations completed at S-Land and Beaver Channels, completed by constructing 4 BDAs, **will store 12,368 m^3 of water flooded over 52,493 m^2 of land within these wetlands.** The total wetland area mapped in the Freshwater Atlas for these two sites is 13.66 hectares. Data collected during the 2025 effectiveness monitoring (i.e., water level monitoring, drone surveys) will allow us to more accurately calculate the volume and area restored at these sites. Unfortunately, due to provincial limitations of only being able to store 10,000 m^3 of water in a system, we had to decrease the height of one of the dams in Beaver Channels which cost the restoration effort approximately 14,264 m^3 of water.

At the S-Land Site our efforts produced 12,793 m^2 of flooded area, 3399 m^3 of stored water, within the 1.17 ha freshwater atlas wetland polygon. At the Beaver Chanels site our efforts will produce 39,700 m^2 of flooded area, 8969 m^3 of stored water, within the 12.49 ha freshwater atlas wetland polygon.

At the Beaver Channels site, the upstream dam is 5 m long, 0.45 m wide, and 0.46 m tall, and the downstream dam is 6.5 m long, 0.45 m wide, and 0.45 m tall. These dams are projected to retain an additional 8969 m^3 of water after spring freshet has filled the wetland areas.

At the S-Land site, the upstream dam is 3.5 m long, 0.66 m wide, and 0.21 m tall. The downstream dam is 1.8 m long, 0.69 m wide, and 0.32 m tall. Within less than one week both wetlands had filled behind the newly constructed BDAs, thereby increasing wetland area in the upland benches. This restoration has thus increased wetland habitat, and we will continue to monitor the sites to see the changes post-restoration.

Figure 3: S-land upper dam site (location 1) post construction. Photo taken from the pool below the dam, looking upstream.

Figure 4: Completed dam construction of the upper dam at Beavers Channels site. Oct 8, 2024.

In January 2025, three permit applications for four CWSP sites (Double Dam, Limbo, and Northbound/Big Dam) were prepared and submitted. The preparation of these applications was similar to 2024 however we also had to submit a 50-page environmental management plan for each site. A summary of the planned BDAs is in Table 1.

Table 1: Plans for Permit application and construction of BDAs in 2025

Site Name	**Number of Remnant Beaver Dams**	**Number of BDA Structures**	**Total Length of BDA Structures (m)**	**Total Freshwater Atlas Wetland Area (ha)**	**Total Potential Flooded Area (m2)**	**Total Potential Water Storage (m3)**
Double Dam	2	7	26.5 m	10.88 ha	16,666 m^2	5760 m^3
Limbo	1	1	2.5 m	1.03 ha	5720 m^2	1716 m^3
Northbound	2	2	6.5 m	2.88 ha	13,776 m^2	6673 m^3
Big Dam	1	1	4.0 m	6.6 ha	5286 m^2	3172 m^3
TOTAL	6	11	39.5 m	21.39 ha	41,448 m^2	17,321 m^3

In 2023, CWSP surveyed 371 sites by drone on the western benchlands of the Columbia Valley and with in-person site assessments determined that nine were suitable for potential restoration using Beaver Dam Analogues (BDAs). In 2024, we continued this work and further assessed 30 wetlands in-person and determined two more are suitable for potential restoration using BDAs.

We also continued pre-restoration monitoring work at the nine previously selected sites and began pre-restoration monitoring work at the two new sites. This pre-restoration monitoring includes logging water depths between April and October, measuring water quality, surveying breeding birds in May/June, surveying vegetation communities both by using $1m^2$ vegetation plots to provide detailed plant presence data and as per the BC Biogeoclimatic Ecosystem Classification (BEC) to provide community classification, and using wildlife cameras to detect large mammals.

We detected 77 bird species during our breeding bird surveys, two of which are considered Species At Risk in BC (Evening Grosbeak and Olive-Sided Flycatcher, both Yellow Listed). 24 of these species are wetland dependent and 5 are wetland associated. Different communities were detected between the Reference Site and our other wetland sites, with 8 species, 5 of them wetland dependent, only being found in the Reference Site. This supports our assessment that these other wetland habitats could be improved via our BDA restoration to support more wetland dependent species. Our wildlife cameras detected four species of wild mammal (Black Bear, Moose, White-tailed Deer, and Mule Deer) and one species of domestic animal (Cow). 46% of observations were of cows, indicating the use of these wetlands by this domestic species.

Restoration, BDA's and Monitoring in Columbia Wetlands

We have continued monitoring the water levels and ecology of 37 individual wetlands in the Columbia Wetlands complex between Invermere and Parson since 2020. In 16 of the wetlands, we have conducted more intense monitoring, including migratory waterbird surveys in spring and fall 2021 to 2024. Thanks to the ECCC we have a longer period of monitoring, and we can now determine differences between high and low water years. In 2020, 2021, and 2022, the mean highest depth of wetlands was more than

2.5m, while in 2023 it was approximately 2.25m and in 2024 approximately 2m, indicating the reduced flood pulse in these low water years. We also observed that in 2024 the Most Connected Wetlands and Partially Connected wetland groups both started and ended with lower water levels than in 2023, indicating that successive dry years magnified the impacts. The Least Connected groups show the least response to these low water years, as might be expected, with baseline water depths in these wetlands remaining at 1.5m.

The beaver dams and the gaps in the natural levees control the water levels and hydrologic dynamics in the 37 wetlands as shown in Figure 5 below.

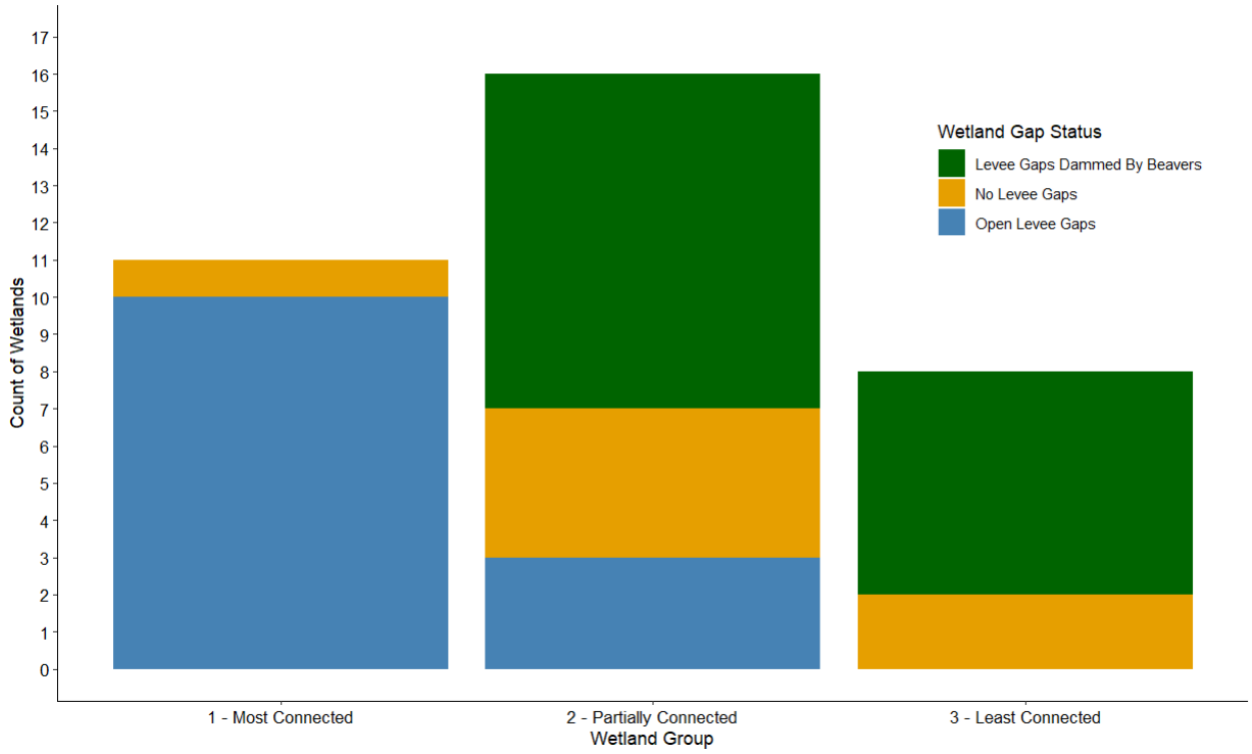

Figure 5: Number of wetlands with open levee gaps (blue), no levee gaps (yellow), or levee gaps dammed by beavers (green) in each of the three wetland groups.

We have recorded 164 waterbird species in and around our study wetlands either during dedicated waterbird counts or incidentally while working in the wetlands between 2021 and 2024. 14 of these are Species at Risk (SAR). The use of wetlands by these species varies widely, from ducks using open water to rest and feed, swallows and other insect eating birds catching food over the wetlands, small passerines such as warblers

nesting in wetland vegetation, and shorebirds using exposed mud and short vegetation around the edges of wetlands to feed.

During our dedicated spring and fall waterbird counts, we recorded 80 species of birds, of which four are SAR, and 29,658 individual birds. In comparing spring and fall counts, we found that in spring more species are recorded (44 species observed in spring compared to 39 in fall). We also found that there are no significant differences in numbers of species using the different wetland groups over the three years for which we have fall data (Figure 6). Further, in the fall, the average number of species is remarkably consistent both between and within groups, while in the spring there is great variation both between and within wetland groups. This supports our hypothesis that Partially Connected wetlands are particularly important to provide suitable habitat for waterbirds in spring, as this is when the wetlands are at their driest, prior to the flood pulse.

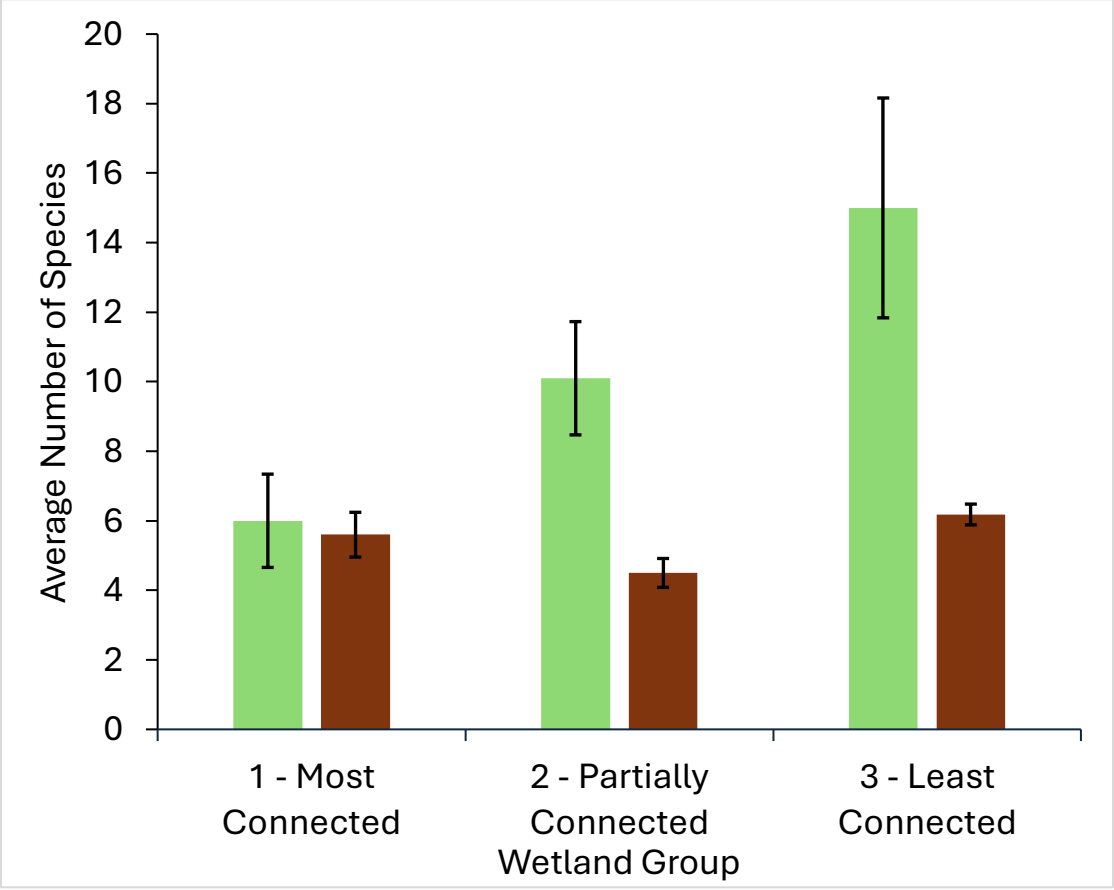

Figure 6: Comparison of 2023 spring and fall counts of mean total number of species across the three wetland groups. Error bars are standard error.

This is why we focused our restoration efforts on three wetlands (145, 71, and 24) that we want to install beaver dam analogues (BDA's) are. We applied for permits for the sites; they were rejected. Then we applied to just install posts that would not block the water, but that beaver could use to build their own dams. Those were rejected by the province because beaver might build a dam there. DFO also required a lengthy report on the fisheries even to put in the posts. We are now working with The Nature Trust of Canada for two sites (24 and 71) and will investigate other options for Site 145. If permits are granted, we will be storing 65,250 m^3 at Site 24 and 23,560 m^3 at Site 145. We will actually not be increasing the storage at Site 71 because beavers have naturally raised the water levels to the maximum possible height, but we wanted to put in posts to prevent the Columbia River from eroding the beaver dams. We are continuing to try to get the permits since the value of a BDA is significant for waterbirds and mitigation of climate change impacts in Columbia Wetlands.

Assessment of Wetlands West of Columbia Lake

In 2024, CWSP conducted two areas of research in wetlands on the upland bench west of Columbia Lake. This area was identified in previous work as particularly vulnerable to climate change. We first visited 17 wetlands and conducted vegetation and soil surveys in collaboration with The Nature Trust of British Columbia. We then focused on the upper reaches of Marion Creek and assessed the impact of beaver dams.

We found that of the 17 wetlands we visited, only five had surface water present, and only two were considered to have water with a permanent hydroperiod, meaning they will be wet all year round. Of the other wetlands, six had a seasonal hydroperiod, four had an ephemeral hydroperiod, three had a temporary hydroperiod, and two were in fact not wetlands. One of these non-wetland areas was mapped in the BC Freshwater Atlas, suggesting that in the time since the FWA was produced, the area has dried and become non-wetland. 12 of the 17 wetlands were palustrine, meaning they are particularly vulnerable to climate change as they are not associated with a water source such as a lake or a stream, so water input is limited. One of the wetlands was lacustrine, along the shores of Spur Lake, while two were riverine; one of these riverine sites is along Marion Creek and we later assessed beaver dams in this area in detail. We made detailed

vegetation assessments of plots in all wetlands (cover and species) but the analyses are not yet completed.

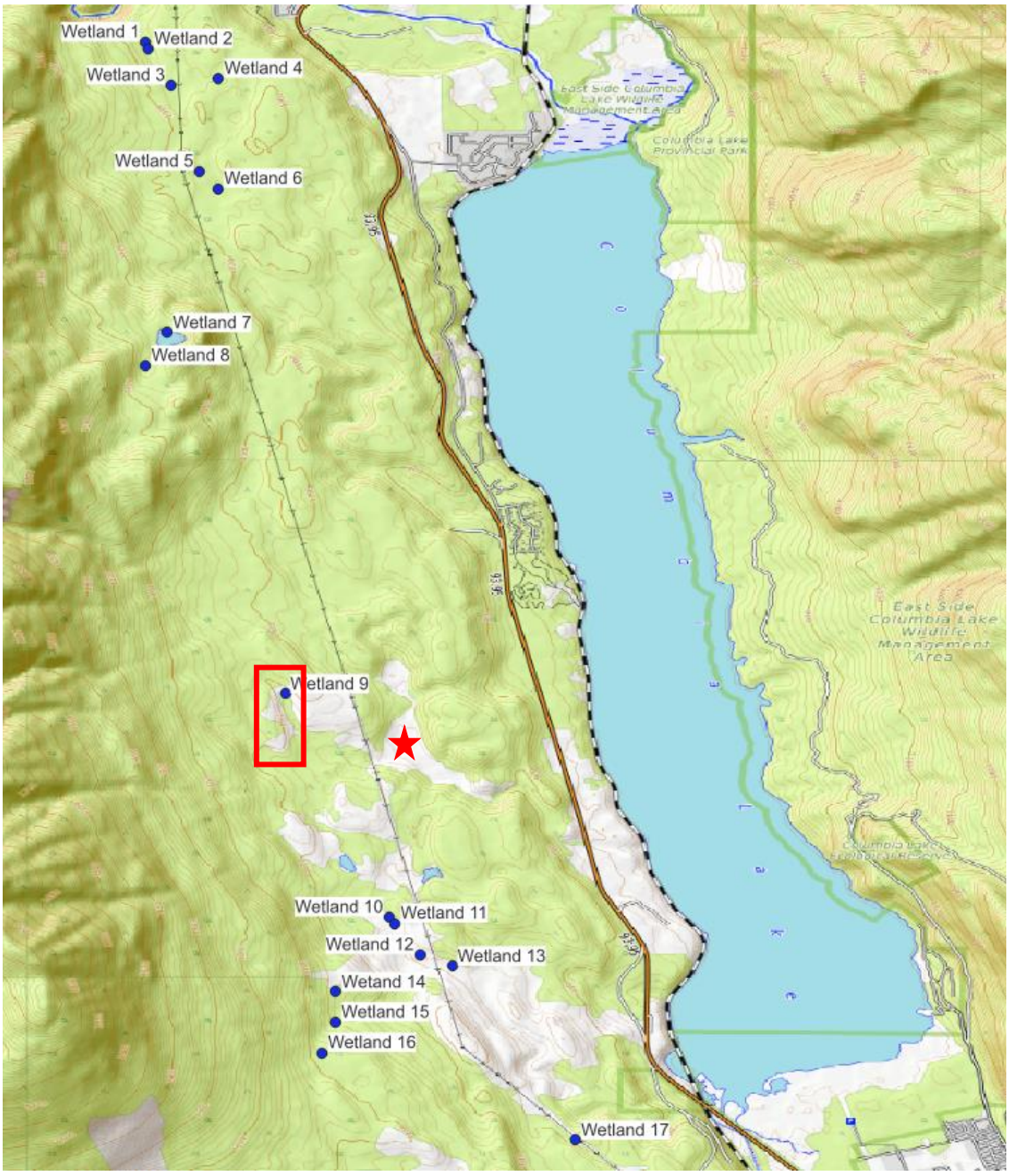

Figure 7: Area of interest to the west of Columbia Lake. Wetlands surveyed are indicated in blue, while area surveyed intensively for beaver dams is indicated with a red box. Approximate location of upcoming Marion Creek wetland and creek restoration project on is indicated with a red star.

This supports our findings from 2023 of the greater moisture deficits in this area, as clearly many of the wetlands in this area are only wet for portions of the year rather than being permanently wet and are likely to be vulnerable to climate change due to drought. We also found evidence of both historic and current disturbance due to agriculture, such as earthworks, water diversions, and cattle trampling, further complicating wetland persistence and restoration in this area. We did not find any rare wetlands or alkaline salt flats that would be suitable for fencing, although we found a lot of destruction of wetland soils and vegetation from cattle grazing.

We conducted more detailed surveys of beaver dams and lodges in the Upper Marion Creek West Wetlands and found 46 beaver dams, 24 of which were active, and nine beaver lodges, five of which were active. The largest dam was 122 m long and the shortest 1 m long. These active dams hold approximately 33,447 m^3 of water on the landscape, creating marsh, swamp, and fen wetland habitat, and help regulate the flow and temperature of Marion Creek, all of which increases biodiversity and is important for species such as the provincially Blue-listed listed and designated as Special Concern under COSEWIC Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) found in Marion Creek. Given our above findings about the lack of permanently inundated wetlands in this area, these wetlands and the beaver dams that maintain them are particularly important in providing wetland habitat and water on the landscape. The Marion Creek drainage is the only area of significant wetlands west of Columbia Lake and should be protected by the local property owners, stakeholders and government. It is highly vulnerable and without the beaver and their dams would be likely to become quite dry.

Figure 8: Drone photograph of series of beaver dams in the more northern area of the Marion Creek West Wetlands.

Figure 9: Aerial photo showing contrast between wetlands maintained by beaver dams along Marion Creek and surrounding dry grasslands.

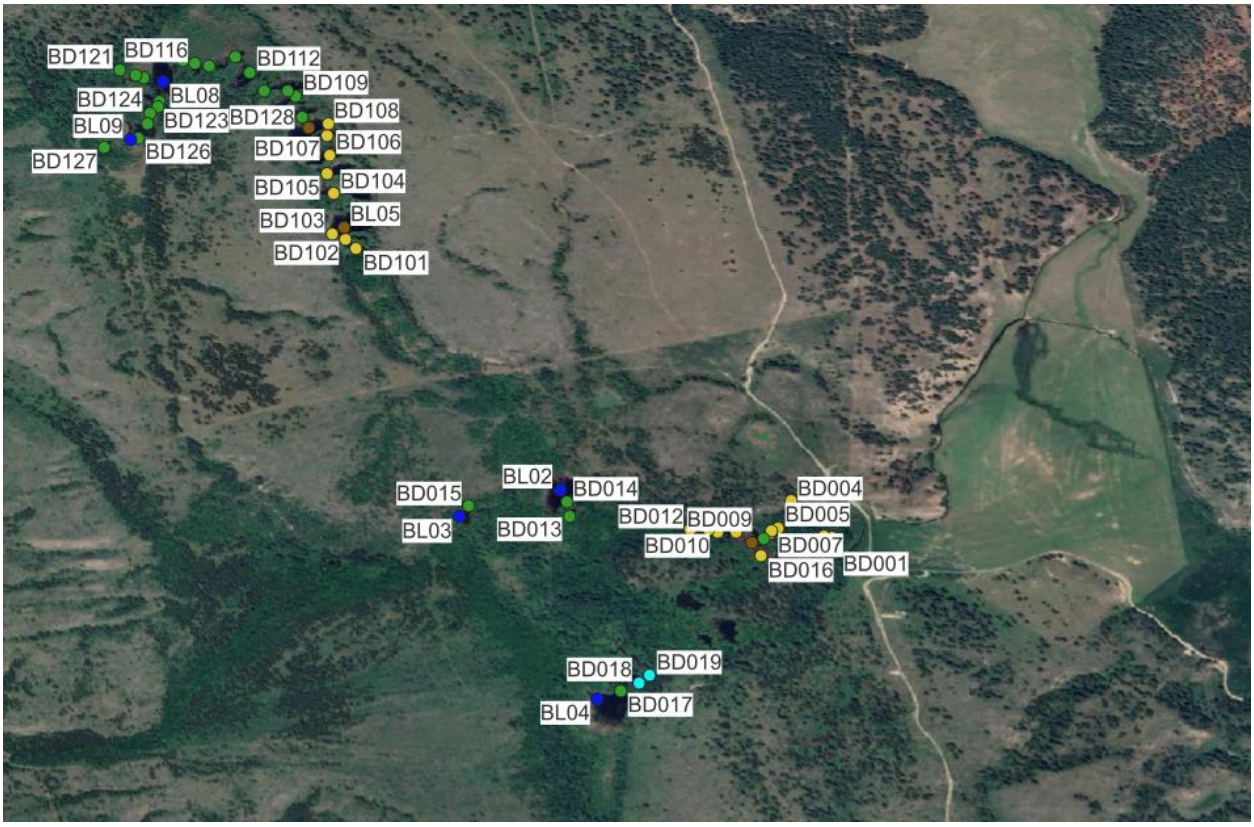

Figure 10. Overview map of the 46 beaver dams surveyed in September 2024 in the Marion Creek West wetlands area.

Assessing the vulnerability of bench wetland projects under climate change: Hydrologic Feasibility of Bench Wetland Restoration in the Upper Columbia Valley

Wetlands provide numerous ecosystem services, including helping mitigate the effects of climate change by taking up carbon and buffering the impacts of changing streamflow regimes. However, wetland numbers are decreasing globally and are expected to decline further due to climate change. In the Upper Columbia River Valley, an area that is internationally recognized for its important wetland ecosystems, wetlands have been drying out. This is mostly occurring within a region known as the bench, which is upslope of the Columbia River and runs north-south through the valley. To combat wetland loss, groups like the Columbia Wetland Stewardship Partners (CWSP) are working to restore these wetlands and improve their ability to hold water with the use of beaver dam analogues (BDAs), which mimic beaver dams. Little is known about the

hydrology of these wetlands and understanding the feasibility of favorable water conditions is an important first step in ensuring long-term success.

In the current study, we develop a quantitative restoration feasibility index to help score wetlands based on their likelihood of long-term restoration success. We use publicly available data to develop an approach that can be modified for other areas. As wetlands within the benchlands of the Columbia Valley have been shown to be highly dependent on reliable water sources, the type of water source contributing to a wetland is the first contributing score, where intermittent streams are the lowest ranked, and larger streams are ranked higher. Measures of the contributing area and slope, which create a wetness index, are taken from a digital elevation model (DEM). And finally, measures for how dry a region might be, taken from climate data to simulate precipitation minus evapotranspiration (P-ET) were used.

All of these combine to provide the restoration feasibility index, which ranks wetlands as having low, moderate, high, or very high potential to be successfully restored. Of the 443 benchland wetlands examined, 168 wetlands were found to have a low wetland restoration feasibility index, 153 had a moderate wetland restoration feasibility index, 74 had a high wetland restoration feasibility index, and 48 had a very high wetland restoration feasibility index. There were a few trends visible in the data, including an inclination for wetlands in the northern region to rank higher than those in the south, which is driven by a climatic gradient, as well as inflow source being the dominant driver of feasibility scores across the region, followed by the wetness index. The results of this study provide CWSP and others with an approach to help focus and prioritize restoration efforts.

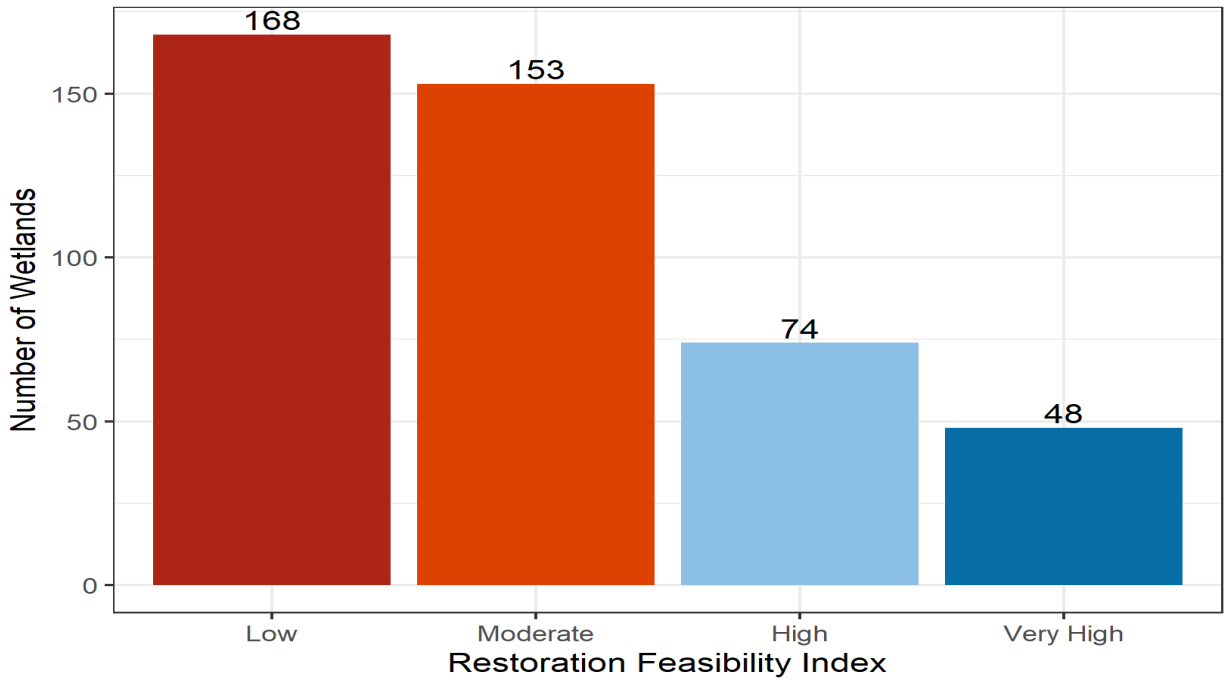

Figure 11: Distribution of Wetland Restoration Feasibility Index values for the bench wetlands.

We developed the Wetland Restoration Feasibility Index to provide conservation managers with a quantitative measure of the relative ability of each wetland to succeed at collecting and holding water. We used a suite of existing indices: the Wetness Index, Water Source Index, and Dryness Index were summed. This gives slightly higher weight to existing connections to water sources as an existing water source is more important in wetland formation than the climate or potential for water to accumulate in an area. Scores were then categorized as having very high, high, moderate, or low restoration feasibility.

An Inflow (Water Source) Index found that 179 of the bench wetlands are isolated giving them an inflow index of one out of five, 103 had an intermittent source giving them a score of two out of five, 48 had a minor source (stream order of 1) with an inflow score of three out of five, 18 wetlands had an inflow score of four out of five due to their lake source, and 95 had the highest inflow score of five as they had a major water source (stream order >1) Figure 12.

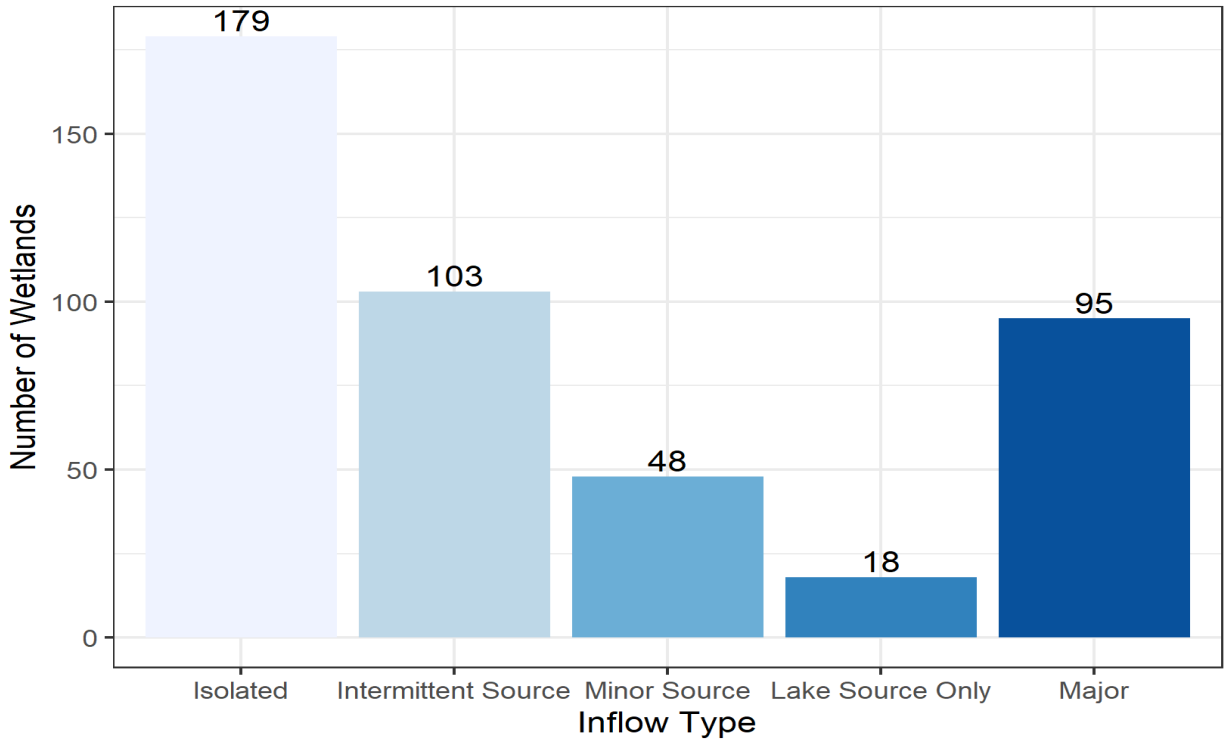

Figure 12: Distribution of wetland inflow sources in the bench wetland study area.

There are some regional trends evident in the data where the wetlands with very high restoration values are primarily found in the northern regions of the study area, with increasing frequency towards the north and the furthest south a wetland is with a very high restoration feasibility is near Invermere. This appears to be largely driven by P-ET, as the further north regions are wetter, whereas the more southern extent of the study area is drier. This may also explain the greater number of wetlands in general in the northern reach, as the further southern areas are not wet enough to support wetlands.

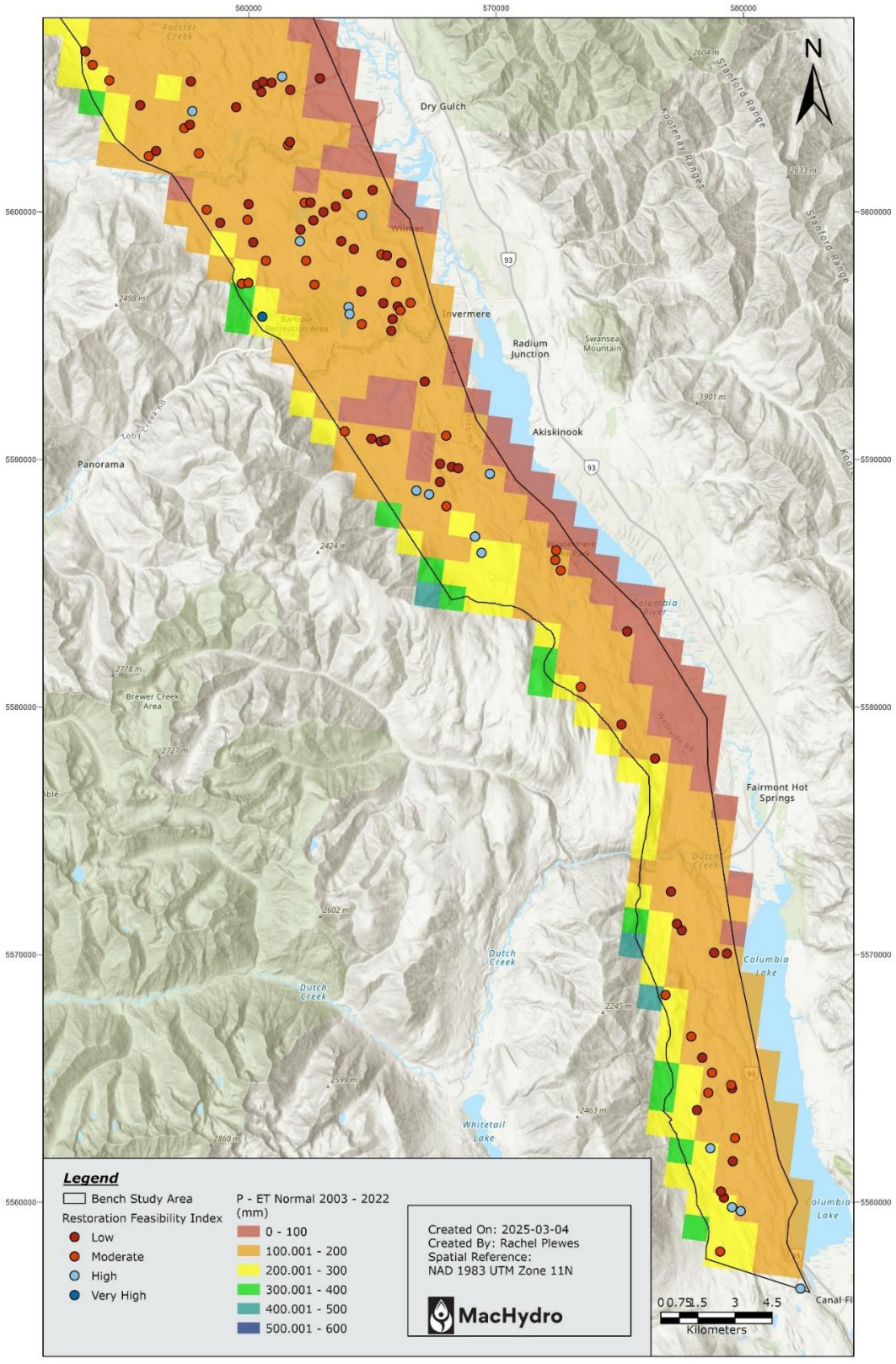

Figure 13: Heat map showing P-ET values for the southern region of the study area from the lowest values (0-100; red) to the highest values (>500-600; blue).

Wetlands with very high wetland restoration scores have high values in all the contributing scores, where they have strong inflow connectivity, a large contributing area, and are relatively damp. The opposite is true of wetlands with low restoration feasibility scores, which are isolated, have small contributing areas, and are relatively dry. Of the wetlands in the moderate and high restoration feasibility categories, the inflow source is the primary driver of the score, followed by wetness index, but only to a small degree which is not statistically significant. This is likely due to all the of the factors being linked to a certain degree, with topography and moisture impacting inflow. However, due to the heavier weighting of the inflow score, isolated wetlands versus those with connections to larger streams or lakes drive different restoration feasibility scores.

Eleven potential restoration wetlands and one reference wetland were examined by CWSP for the purpose of restoration works, primarily involving the use of beaver dam analogues (Leven, 2024). The restoration feasibility scores are provided in the report, as well as a review of the individual scores driving the index value of each wetland. In general, the P-ET score varied the most (with scores ranging from one to three out of three) whereas the wetness score was generally relatively high, as was the inflow score except in the case of Beaver Channels.

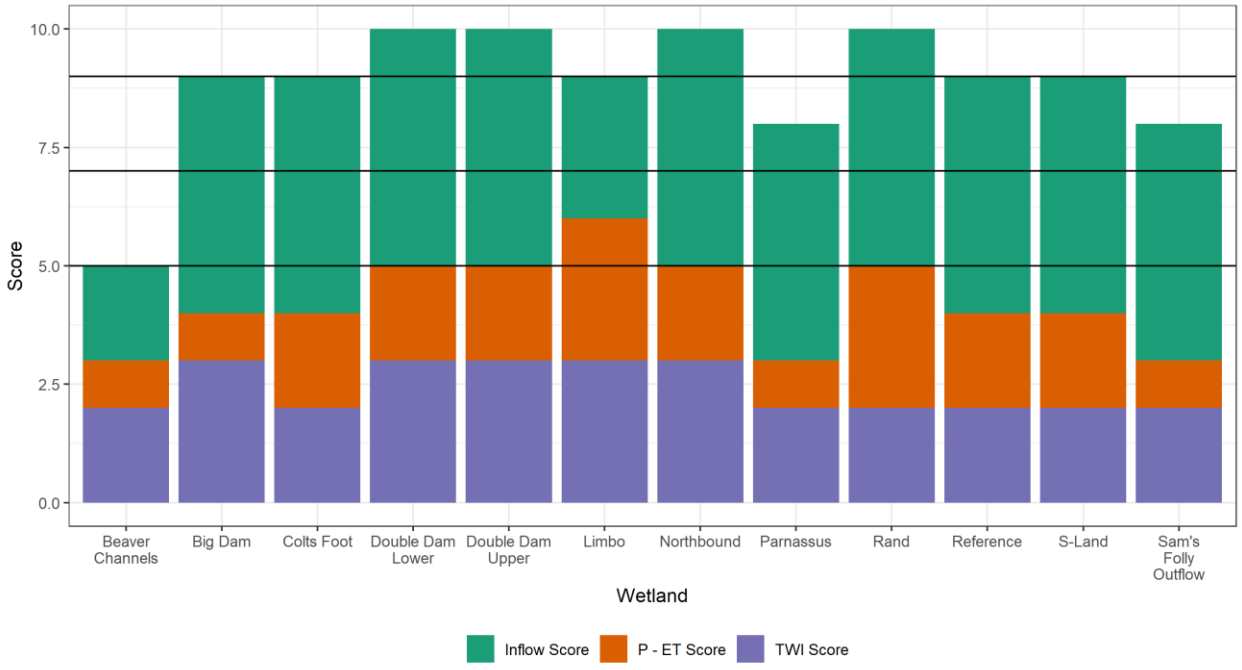

Figure 14: Wetland Restoration Feasibility Index for the proposed or existing restoration wetlands being studied by CWSP.

We assessed the potential success of the proposed restoration sites using the Wetland Feasibility Index (Figure 14). We provided index scores for eleven wetlands that are being investigated for restoration efforts, or which have already been restored, as well as one reference wetland for comparison purposes, and provided insights into their individual scores and what challenges there might be in restoring these wetlands. Of these wetlands, Beaver Channels had the lowest score due primarily to the ephemeral nature of its inflow source. All the other proposed restoration wetlands received a high or very high restoration feasibility scores and are ideal candidates for restoration efforts.

Table 2: Restoration Feasibility Index for proposed BDA sites

Site Name	Restoration Feasibility Index
Beaver Channels	Low
Big Dam	High
Coltsfoot	High
Double Dam Lower	Very High
Double Dam Upper	Very High
Limbo	High
Northbound	Very High
Parnassus	High
Rand	Very High
Reference	High – not actually being restored
S-Land	High
Sam’s Folly Outflow	High

The S-Land wetland, which is the site of two beaver dam analogues that were constructed in 2024, had a restoration feasibility score of nine out of eleven, giving it a high feasibility for successful restoration (Figure 15). The inflow score is the highest possible, and both the wetness index and P-ET scores were two out of three.

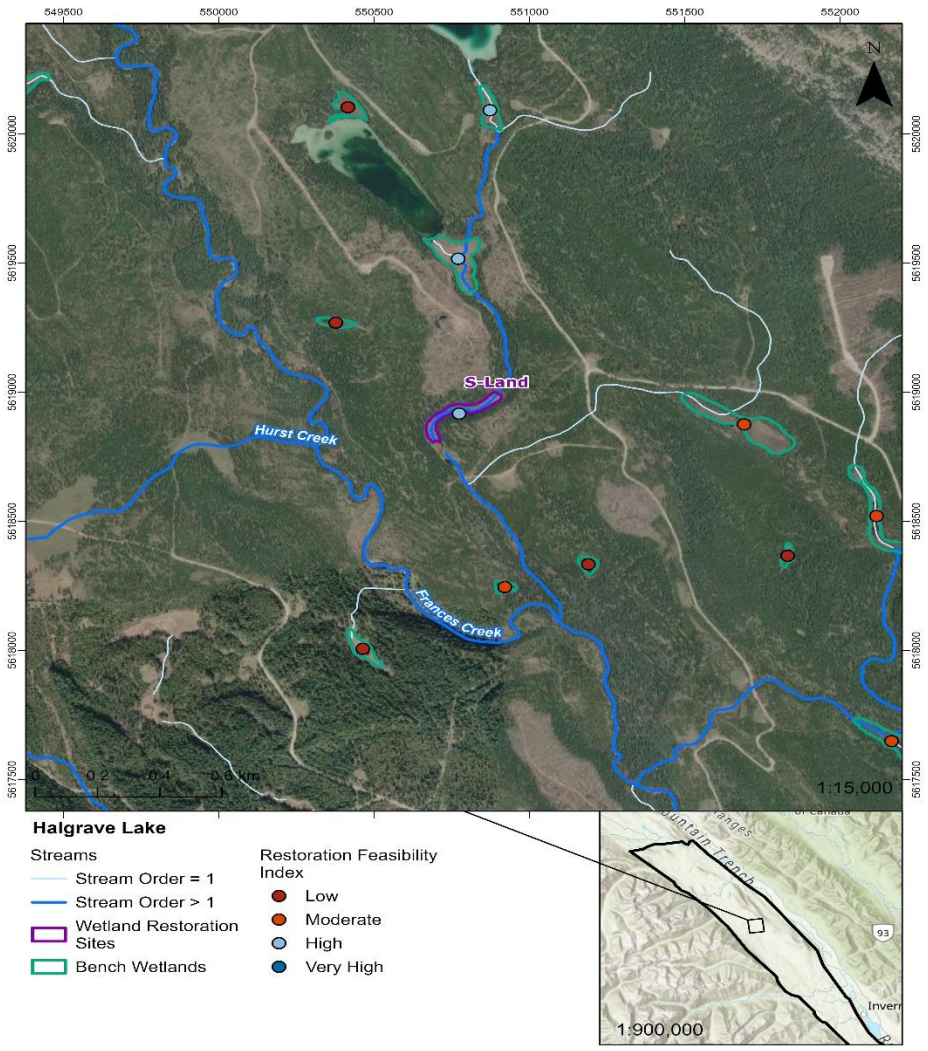

Figure 15: Location and corresponding restoration feasibility index score of the S-Land wetland (high).

There are some limitations to this approach. The index scores are intended to provide a high-level desktop review of wetland restoration potential but should not be used in lieu of site visits and fieldwork. Ground truthing the index scores is critical as water sources are important and in the absence of understanding underlying geology and underground flows, stream connectivity and order provides an indication of inflow source. As such, the index does not appropriately account for shallow or deep groundwater sources and is also reliant on the accuracy of the Freshwater Atlas, which is not always up to date due to landscape and hydrologic changes. Several sites west of Columbia Lake have had major alterations in their hydrology due to drainage or diversions of

streams channels that would have changed their index score had the information been available.

While this approach can be modified to suit other regions, it is currently designed to represent the Benchland region of the Upper Columbia River Valley, and scores are all relative to each other. As many wetlands have already been lost in the region, the values exist relative to each other at the current time and do not represent historic values.

Due to the strong linkages between inflow sources, topography, and climate conditions, our recommendations are to:

- Use the wetland restoration feasibility scores provided in this study to prioritize wetland restoration efforts.
- Ground truth results and visit wetlands to ascertain restoration feasibility.
- Do not attempt to restore isolated wetlands where there is no waterbody connection, unless ground truthing shows a reliable water source, particularly in the southern region.
- Use isotope analysis to determine source water for a range of wetlands across the study region through a targeted field study.

Characterizing the vulnerability of the Columbia River Floodplain Wetlands to Climate Change

Wetlands due to their dependence on the hydrologic cycle, are highly sensitive to changes in local hydrology caused by a changing climate. In the Upper Columbia River Valley there are approximately 26,000 ha of wetlands, recognized as being of international importance under the RAMSAR Treaty. These wetlands have already experienced drying and loss of their wetted area, which is of great concern given their importance ecologically.

Snow accumulation and melt play an important role in shaping the Columbia River and the Columbia Wetlands given that Columbia is a nival (snowmelt driven) system. Climate change is predicted to cause an increase in air temperatures, leading to a reduction in snow accumulation and an advancement of melt. Due to the relative importance in snowmelt in the Columbia Wetland water supply, reductions in winter

snowpack may result in a reduction in wetland recharge from stream water and groundwater sources.

This study examines the vulnerability of the Columbia Wetlands to climate change based on their location using a combination of field investigation and hydrological modelling, with special attention paid to selected wetlands that have either experienced or have planned restoration efforts to improve water retention.

We found there is regional variation in wetland vulnerability, where the northern portion of the study area is likely to be less affected by shifts in climate due to an increase in water supply. The southern portion of the study area is highly vulnerable, with an earlier onset of spring freshet accompanied by very small increases in peak streamflow. All wetland groups (Most Connected, Partially Connected, and Least Connected wetland types or groups) are likely to be equally vulnerable to climate change; however, water retention will be critical to maintain wetland diversity. The Beaver Dam Analogues are an important adaptation measure, particularly in the southern portion of the study area. Without these structures, it is likely that water levels would continue to follow the patterns of the Columbia River. A longer streamflow recession period with hotter and drier summer conditions could lead to a substantial reduction in open water area, which has already been observed in other studies.

There is considerable temporal variation in wetland water level characteristics within each of the groupings (most connected, partially connected, and least connected). Wetland water levels are responding to streamflow in the Columbia River following the regional temporal patterns. 2020 and 2021 had a similar hydrograph pattern, while 2022, 2023, and 2024 had unique patterns. These pattern shifts between years were consistent among groups, suggesting the larger-scale Columbia River conditions are the dominant factor driving wetland hydroperiod. It is likely that wetland vulnerability is independent of wetland grouping and that all floodplain wetlands in the study area are equally susceptible to changes in climate. Overall, these results suggest it is important to understand how large-scale hydrological processes governing hydroperiod may change under future climates to understand wetland vulnerability.

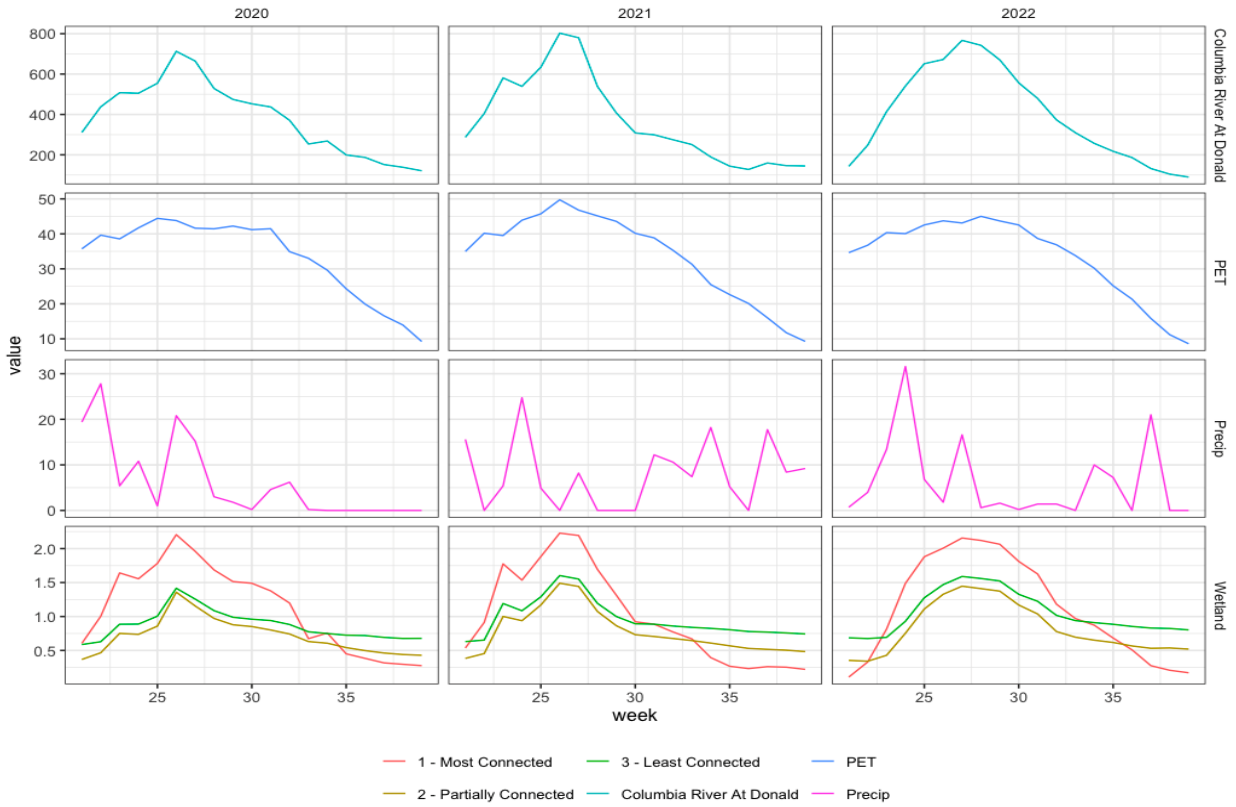

Figure 16: Mean weekly water levels from all wetlands in each grouping, PET, precipitation, and streamflow for 2020, 2021, and 2022. Units are: Precip and PET =mm; Wetlands=m; Columbia River flow at Donald= m3/sec.

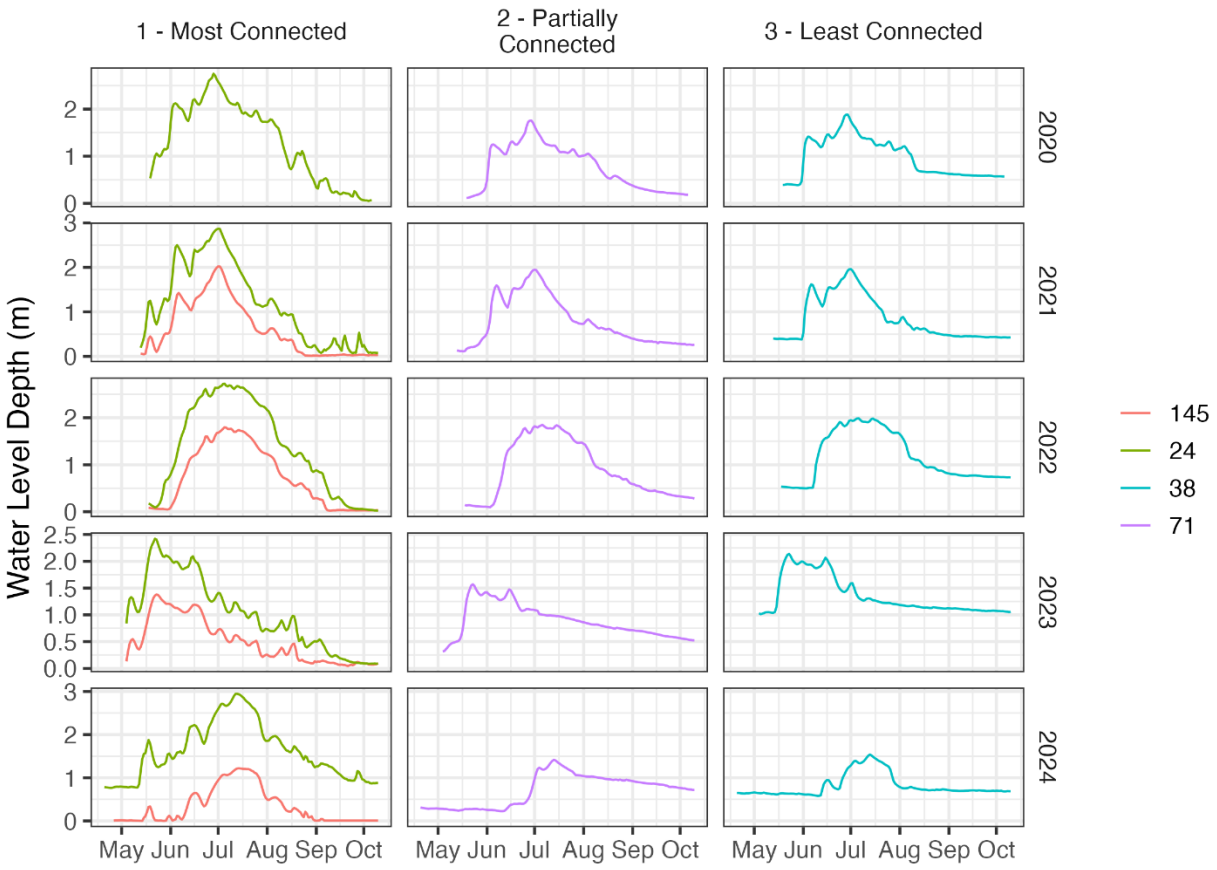

Figure 17: Water levels for the four restoration wetlands (145 (red), 24 (green), 38 (blue), and 71 (purple)) from 2020 (top) to 2024 (bottom).

The four restoration wetlands fall into all three wetland groupings, with Sites 24 and 145 illustrating a strong connection to the Columbia River, where they rise and fall in a similar pattern to the river and lose most of their water by the fall. Both wetlands have large holes in their levees that allow water to drain, creating this connection with the Columbia River. The two wetlands that have been restored show changes in their hydrographs because of the beaver dams. A beaver dam analogue (BDA) was installed in the fall of 2021 in wetland 38. In the years preceding the restoration works the water level drops significantly in the fall; following the construction of the BDA, water levels do not drop as quickly but hold steady at a higher level from 2022 to 2024. These effects are even more evident in wetland 71, where a natural beaver dam was constructed in the spring of 2023. The shape of the hydrograph changes in these years and is even more dissimilar to the flows of the Columbia River, now showing strong retention of water levels

following the freshet pulse. Considering that 2023 and 2024 were low flow years, this illustrates how natural beaver dams and BDAs can influence wetland connectivity and shows the benefit of beaver dams at improving wetland water storage and helping combat the large-scale effects of climate change in the Columbia Wetlands. It is important to recognize that this is particularly important in the southern portion of the study area for the maintenance of wetland diversity across the Columbia Wetland complex.

III. 6CW Conservation Lands (BCO's & Fencing)

In 2024 through to the spring of 2025, there were a number of actions taken to support the continued work of property analysis and valuation within the Columbia Valley. Mapping has been updated and further automated to assess a greater number of propertied in the area of interest than were previously possible when property assessments were manually completed. Up to date mapping related to species at risk, wildlife habitat features, and wildlife habitat areas were updated to reflect the updated analysis. The top five ranked properties in the project area are presented in this report.

In addition to the spatial data analysis works, tenure applications in the project area were assessed and commented on to support the overall Kootenay Connect project goals. A presentation was made in the Kootenay Conservation Program's (KCP) Conservation Action Forum and a video was produced detailing previously completed works proposing scientifically backed access management areas.

Through the CAF a discussion was generated around the updating of land use planning in the Golden Area. An adaptive management cycle in for the Golden Backcountry Access Management Plan could aid in conserving wildlife corridors and align with the goals of Kootenay Connect.

Supporting the dedication of high value crown lands as conservation lands has always been a goal of this project. On the ground, quantitative data is required to support application and justify the designations. A pilot project has been initiated to collect low-cost data in support of land designations.

Kootenay Connect Fairmont Keystone Corridor Project

The goal of this project is to retain the critical connectivity in this wildlife corridor at the north end of Columbia Lake and to improve the health of the grassland and riparian habitats. This project contacted 3 ranch land properties in the Fairmont Columbia Lake Wildlife corridor to install fences and improve the habitat by spraying for noxious weeds It contracted the farmers tor fencing, weed control, grazing management and to complete and maintain the sitework.

Year 1 (2024) project work on the Haynes property accomplished the following:

1. 65 ha of land assessed for health and treatment prescription
2. 65 ha of land fenced
3. 65 ha of land will be grazed strategically for habitat health
4. Over 5 ha of noxious weeds sprayed
5. 2450 m of fence installed

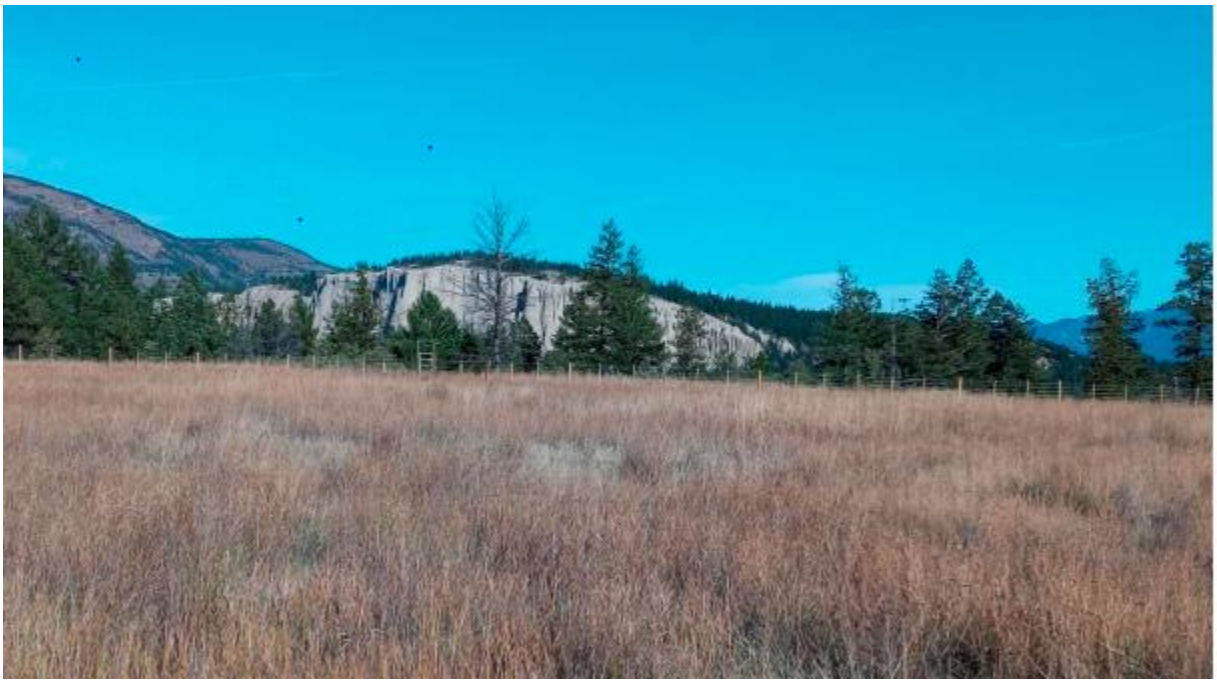

Figure 18: 2450m of fence installed in the Fairmont Columbia Lake Wildlife Corridor

IV. 6CW Cottonwood project: Conservation of Cottonwood Trees in Columbia Wetlands: saving important wildlife trees

This subproject focuses on monitoring and mitigating the impact of beavers on cottonwood/aspen stands throughout the Columbia Wetlands and includes the installation of wire guards on important cottonwood trees as well as assessment/repair of past wire guards on trees. Previously completed wetland mapping has identified critical stands of cottonwoods for targeted surveying.

Building on the work done in Year 5, the work in Year 6 included assessing beaver activity along the Columbia Wetlands via canoe and identifying high quality wildlife trees or cottonwood stands for future wrapping. Mature cottonwoods with existing nest structures or evidence of wildlife use were prioritized, as well as stands with multiple mature trees and younger recruitment trees. All identified stands showed significant evidence of beaver activity.

We installed wire guards on 32 new trees in January 2025. 2 of these trees are located near the Golden airport, 18 are around Parson, and 12 are north of the Radium Hot Springs Mill. Previously installed wire guards were assessed on trees near Radium (21 trees), Brisco (16 trees), Parson (11 trees), and Golden (3 trees) in October 2024 and January 2025. In total, 51 trees with previously installed wire guards were assessed. The wire guards were all in good condition and no beaver damage was seen on these trees, however 4 trees had fallen over due to other causes. The wire guards on these trees were removed and reinstalled on nearby trees.

Table 3: Cottonwood protection sites visited in 2024 or 2025.

Sites	Notes	Date Checked/ Wrapped
Radium	• 21 previously wrapped trees were assessed	October 3rd, 2024
Brisco	• 10/29 previously wrapped trees were assessed • 6/19 remaining unchecked previously wrapped trees were assessed	October 3rd, 2024 January 8th 2025
Parson	• 11 previously wrapped trees were assessed	October 3rd, 2024
Golden	• 3 previously wrapped trees were assessed	January 8th, 2025
Golden Airport	• 2 trees wrapped • trees between 30 and 60 cm • beaver chew in the vicinity	January 10th, 2025
Northside Parson Bridge	• 9 trees wrapped • trees between 25 and 100 cm	January 13th, 2025
Radium Mill North	• 12 trees wrapped • trees between 21 and 69 cm	January 17th, 2025
Northside Parson Bridge	• 9 trees wrapped • trees between 25 and 100 cm	January 20th, 2025

Figure 19: Large cottonwood being wrapped with wire guard (left), and stand of trees protected with wire guards (right).