Elk River Watershed | Qukin ?amak?is Connectivity Restoration Plan: 2021 - 2041

Canadian Wildlife Federation

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Acknowledgements

This plan represents the culmination of a collaborative planning process undertaken in the Elk River watershed over many months of work with a multi-partner planning team of individuals and groups passionate about the conservation and restoration of freshwater ecosystems and the species they support. Plan development was funded by the BC Salmon Restoration and Innovation Fund, the Canada Nature Fund for Aquatic Species at Risk, and the RBC Bluewater Project. We were fortunate to benefit from the feedback, guidance, and wisdom of many groups and individuals who volunteered their time throughout this process — this publication would not have been possible without the engagement of our partners and the planning team see project partners.

We recognize the incredible fish passage and connectivity work that has occurred in the Elk River watershed to date, and we are excited to continue partnering with local groups and organizations to build up existing initiatives and provide a road map to push connectivity restoration forward over the next 20 years and beyond.

The Canadian Wildlife Federation recognizes that the lands and waters that form the basis of this plan are the traditional unceded territory of the Ktunaxa people. We are grateful for the opportunity to work to benefit Westslope Cutthroat Trout (Oncorhynchus clarkii lewisi).

Project Overview

Plan Purpose, Approach, and Scope

The following Watershed Connectivity Restoration Plan (WCRP) represents the culmination of a one-year collaborative planning effort for the Elk River watershed, the overall aim of which is to reduce the threat of aquatic barriers to resident, fluvial, and adfluvial fish and the livelihoods that they support, including the continued sustenance, cultural, and ceremonial needs of the Ktunaxa people both now and into the future. This 30-year plan was developed to identify priority actions that the Elk River WCRP planning team see Planning Team for a list of team members will undertake between 2021-2041 to conserve and restore fish passage in the watershed through strategies aimed at barrier rehabilitation and barrier prevention.

WCRPs are long-term, actionable plans that blend local stakeholder and rightsholder knowledge with innovative GIS analyses to gain a shared understanding of where restorataion efforts will have the greatest benefit for fish. The planning process is inspired by the Conservation Standards (v.4.0), which is a conservation planning framework that allows planning teams to systematically identify, implement, and monitor strategies to apply the most effective solutions to high-priority conservation problems. There is a rich history of fish and fish habitat conservation and restoration work in the Elk River watershed that this WCRP builds upon, including the work undertaken by the Ktunaxa Nation, the Province of British Columbia, and industry proponents, among others. The Canadian Wildlife Federation will continue to engage and coordinate with local partners and existing initiatives, including the Elk Valley Cumulative Effects Management Framework, the Elk Valley Fish and Fish Habitat Committee, and the Elk River Watershed Collaborative Monitoring Program.

The planning team compiled existing barrier location and assessment data, habitat data, and previously identified priorities, and combined this with local knowledge to create a strategic watershed-scale plan to improve connectivity. To expand on this work, the Elk River WCRP planning team applied the WCRP planning framework to define the thematic scope of freshwater connectivity and refine the geographic scope to identify those portions of the watershed where barrier prioritization will be conducted, and subsequent rehabilitation efforts will take place. Additionally, the team selected focal fish species, assessed their current connectivity status in the watershed, defined concrete goals for gains in connectivity, and developed an intermediate list of barriers for rehabilitation to achieve those goals. Field assessments were completed for 31 barriers above Elko Dam, and 21 barriers below Elko Dam on the preliminary barrier list during the summer of 2021, followed by a series of WCRP Update Workshops in

winter 2021. The aim of these workshops was for the team to receive updates on progress made during the field season, review assessment results and identify priority barriers, revise the connectivity status assessment and goals, and update the Operational Plan for 2022. While the current version of this plan is based on the best-available information at the time of publishing, WCRPs are intended to be living plans that are updated regularly as new information becomes available, or if local priorities and contexts change. As such, this document should be interpreted as a current snap-shot in time, and future iterations of this WCRP will build upon the material presented in this plan to continuously improve aquatic barrier rehabilitation for fish in the Elk River watershed. For more information on how WCRPs are developed, see Mazany-Wright, Noseworthy, et al. (2021).

Vision Statement

Healthy, well-connected streams and rivers within the Elk River watershed support thriving populations of Westslope Cutthroat Trout. Watershed users work together to mitigate the negative impacts of aquatic barriers, improving the resiliency of streams and rivers for the benefit and appreciation of all.

Project Scope

Connectivity is a critical component of freshwater ecosystems that encompasses a variety of factors related to ecosystem structure and function, such as the ability of aquatic organisms to disperse and/or migrate, the transportation of energy and matter (e.g., nutrient cycling and sediment flows), and temperature regulation (Seliger and Zeiringer (2018)). Though each of these factors are important when considering the health of a watershed, for the purposes of this WCRP the term "connectivity" is defined as the degree to which aquatic organisms can disperse and/or migrate freely through freshwater systems. Within this context, connectivity is primarily constrained by physical barriers including anthropogenic infrastructure such as dams, weirs, and stream crossings, and natural features such as waterfalls and debris flows. This plan is intended to focus on the direct rehabilitation and prevention of localized, physical barriers instead of the broad land-use patterns that are causing chronic connectivity issues in the watershed. The planning team decided that the primary focus of this WCRP is addressing barriers to longitudinal connectivity (i.e., along the upstream-downstream plane) due to the magnitude of the threat posed by linear development (i.e., road and rail lines) in the watershed. In the Elk River watershed, an additional connectivity consideration is identifying barriers that should not be rehabilitated to protect genetically pure Westslope Cutthroat Trout (Oncorhunchus clarkii lewisi) populations and mitigate the threat of introgression due to aquatic invasive species (AIS).

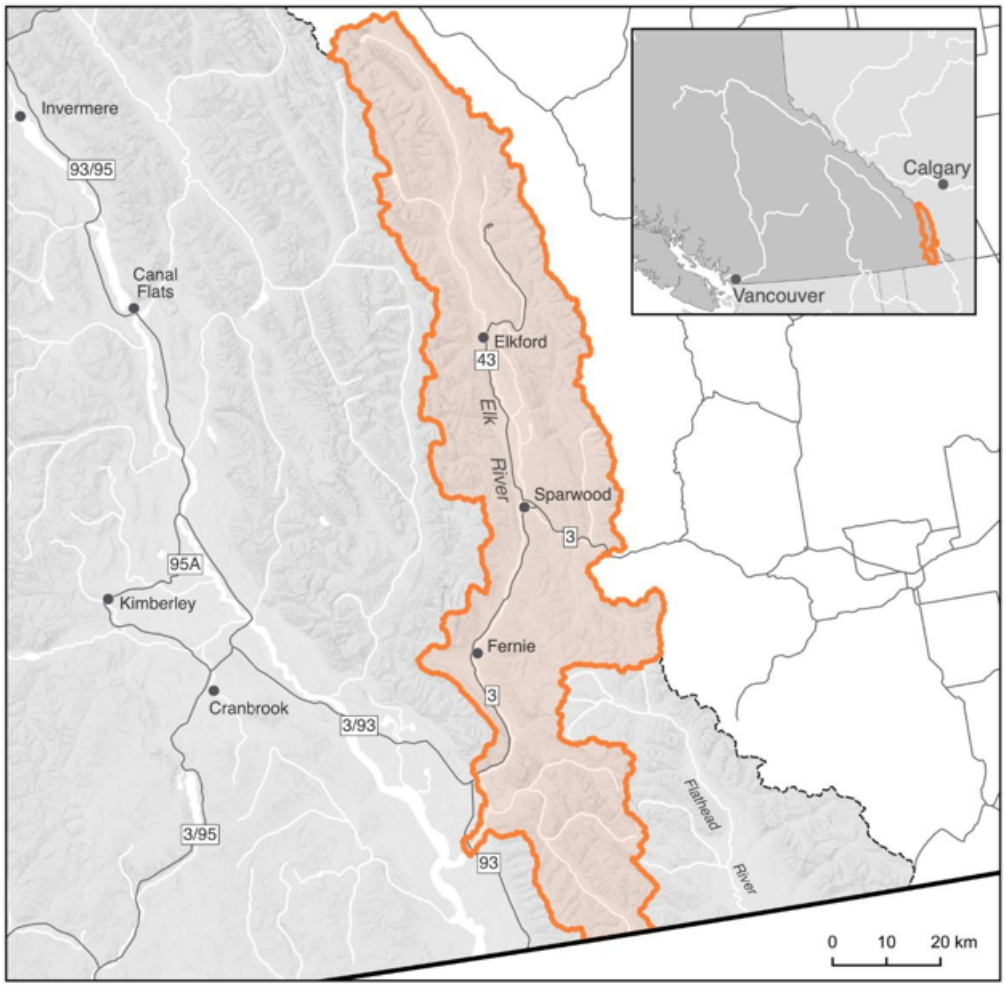

Figure 1: The primary geographic scope — the Elk River watershed.

The primary geographic scope of this WCRP is the Elk River watershed, located in the Kootenays along the southeastern portion of the British Columbia-Alberta border. The scope constitutes the Elk River "watershed group" as defined by the British Columbia Freshwater Atlas (FWA), due to an effort made to standardize spatial scales of the watershed groups. A consistent spatial framework was necessary to undertake a watershed-selection process at the provincial scale to identify target watersheds to improve connectivity for salmonids. The Elk River watershed was identified by the BC Fish Passage Restoration Initiative as one of four target watersheds for WCRP development (Mazany-Wright, Norris, et al. (2021b)). The Elk River watershed has a drainage area of 430,937 ha, spanning from the Rocky Mountains in the northeast, the border with the United States in the south, and the confluence with the Koocanusa Reservoir in the southwest (Figure 1).

Table 1: Focal fish species in the Elk River watershed. The Secwepemctsín and Western common and scientific species names are provided.

Secwepemctsín	Common Name	Scientific Name
Kekèsu	Chinook Salmon	Oncorhynchus tshawytscha
Sxeyqs	Coho Salmon	Oncorhynchus kisutch
Sqlelten7ùwi	Sockeye Salmon	Oncorhynchus nerka

The Elk River watershed comprises part of the traditional territory of the Ktunaxa peoples, and contains culturally and economically important populations of Westslope Cutthroat Trout, which historically supported Indigenous sustenance and trading economies. The geographic scope for this WCRP was further refined by the planning team through the exclusion of the Flathead River system from the defined watershed group. The Flathead River is hydrographically and topographically distinct from the rest of the watershed and does not flow into the Elk River and Columbia River systems, but is considered part of the watershed group in the FWA. The planning team decided that the watershed connectivity planning process should focus on just the Elk River system and the important Westslope Cutthroat Trout populations supported by the streams and rivers there.

Additionally, the planning team decided to divide the remaining watershed into two discrete WCRP units— 1) Upstream of the Elko Dam and 2) Downstream of the Elko Dam. The Elko Dam was constructed in 1924 on the site of a series of waterfalls that were natural barriers to upstream fish passage, and the dam facility remains impassable to all fish species (J. Bisset, Bisset & Associates, pers. comm., Ladell and Baxter (n.d.)). The Elko Dam plays an important role in preventing the upstream dispersal of invasive/hybridized trout populations from the Columbia River thereby acting as an important barrier to introgression (Lamson (2018)). This role, coupled with the waterfalls acting as natural barrier prior to dam construction, provided the justification to remove the Elko Dam from consideration as a barrier to rehabilitate. Each

WCRP unit has Westslope Cutthroat Trout populations with unique life-history forms, and was evaluated independently for connectivity status assessments, goal setting, and barrier prioritization analyses.

Finally, "naturally accessible" waterbodies, which are defined as streams that Westslope Cutthroat Trout should be able to access in the absence of anthropogenic barriers, were modelled to set constraints on the geographic scope (Figure 2). Naturally accessible waterbodies were spatially delineated using Westslope Cutthroat Trout observation and distribution data, as well as data on "exclusionary points", which are waterfalls greater than 5 m in height and gradient barriers where the stream slope exceeds 30% (only in cases where no known populations or observations exist upstream of these points). These maps were explored by the planning team to incorporate additional local knowledge, ensure accuracy, and finalize the constraints on naturally accessible waterbodies. All stream segments not identified as naturally accessible were removed from the scope for further consideration. The resulting constrained geographic scope formed the foundation for all subsequent analyses and planning steps, including mapping and modelling useable habitat types, quantifying the current connectivity status, goal setting, and action planning (Mazany-Wright, Norris, et al. (2021a)).

Focal species

Focal species represent the ecologically and culturally important species for which habitat connectivity is being conserved and/or restored in the watershed. In the Elk River watershed, the planning team selected Westslope Cutthroat Trout as the focal species. The selection of this focal species was driven primarily by the focal species of the primary fund supporting this planning work. The planning team also identified other culturally and ecologically important species within the watershed to consider for inclusion in future iterations of the WCRP, including Burbot (Lota lota), Bull Trout (Salvelinus confluentus), and Whitefish (Prosopium williamsoni).

Westslope Cutthroat Trout | Oncorhynchus clarkii lewisi

Westslope Cutthroat Trout is a cultural and ecological keystone species in the Elk River watershed, playing an important role in structuring aquatic ecosystems and contributing to nutrient recovery for riparian vegetation and forests in cold water streams and lakes, including small, steep streams not accessible to other fish species (Willson and Halupka (1995), COSEWIC (2016)). Westslope Cutthroat Trout are a traditionally important species for the Ktunaxa people and provide substantial economic value for recreational and commercial fisheries. Westslope Cutthroat Trout populations have declined in recent decades due to a combination of threats including, introgressive hybridization with AIS (particularly Rainbow Trout; Oncorhynchus mykiss), habitat degradation, fragmentation, overexploitation, and rising water temperatures due to climate change (COSEWIC (2016), Lamson (2018)). Most relevant to this WCRP,

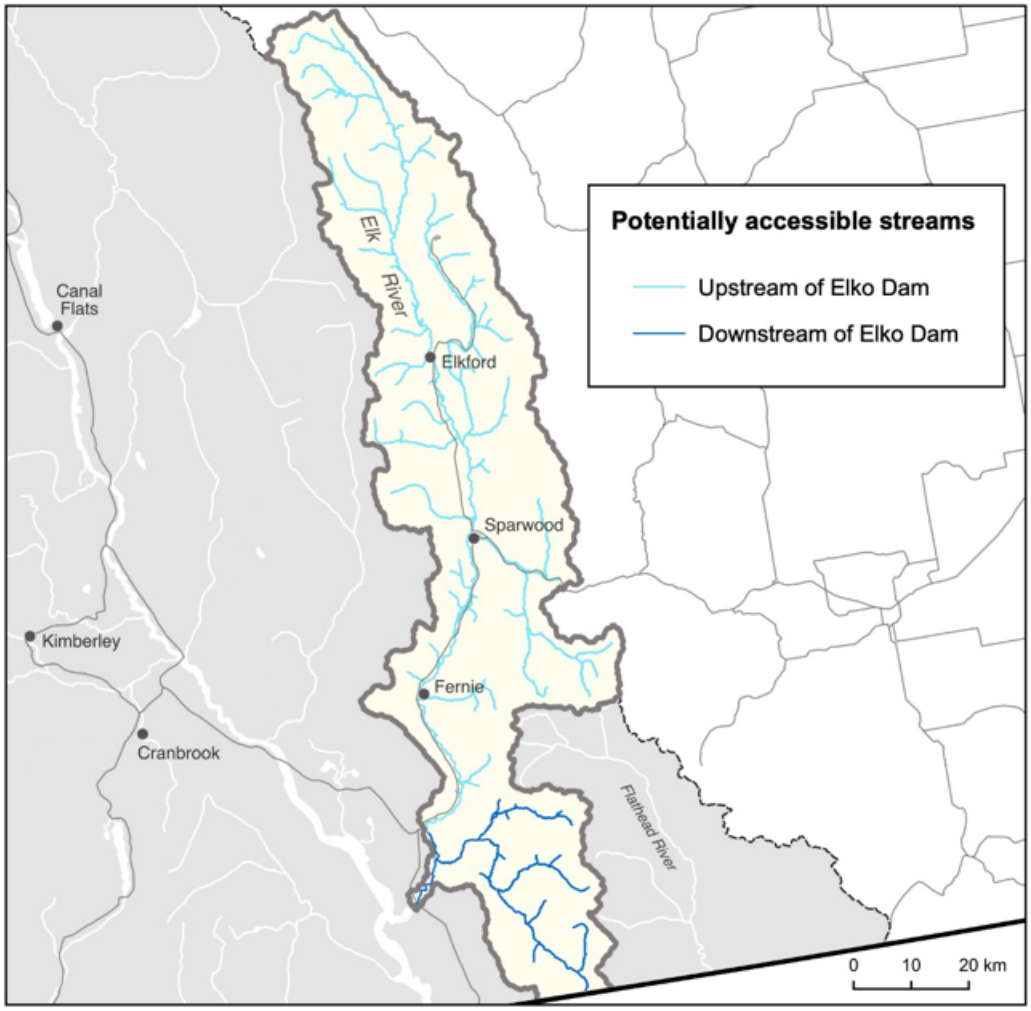

Figure 2: Naturally accessible waterbodies within the Upstream of the Elko Dam (light blue) and Downstream of the Elko Dam (dark blue) units in Elk River watershed. These do not represent useable habitat types, but rather identifies the stream segments within which habitat modelling and barrier mapping and prioritization was undertaken.

road networks have disrupted many parts of the Elk River watershed thereby increasing the density of stream crossings, leading to stream fragmentation and limiting upstream fish passage. Additionally, some entire headwater reaches have been disrupted or have disappeared due to rock drains associated with mining activity in the watershed (COSEWIC (2016)).

Table 2: Westslope Cutthroat Trout Pacific populations Designated Unit assessment. Assessments undertaken by the Committee on the Status of Endangered Wildlife in Canada (2016).

COSEWIC Designated Unit	Status	Trend	Generation length
Pacific populations	Special concern	Declining	4-8 years

Westslope Cutthroat Trout populations and subpopulations found in the Elk River watershed are captured by the "Pacific populations" Designated Unit as defined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), which has a core distribution covering the upper Kootenay River drainage (Table 2). Specifically, the Elk River watershed contains the Elk River and Upper Kootenay population groups, with each population group containing multiple sub-populations with variable life history forms (Table 3). High levels of hybridization exist in most waterbodies connected to the Koocanusa Reservoir (i.e., the Upper Kootenay population group), including the Elk River mainstem downstream of the Elko Dam and much of the Wigwam and Lodgepole systems. Generally, the hybridization levels upstream of Elko Dam are quite low, though there is known hybridization occurring in the Michel Creek subdrainage (COSEWIC (2016); H. Lamson, BC Ministry of Environment pers. comm.). Pure Westslope Cutthroat Trout sub-populations exist in the upper Fording River (upstream of Josephine Falls), Greenhills Creek, Forsyth Creek, Grave Creek, Harmer Creek, Morrissey Creek, Weary Creek, upper Lodgepole Creek, and the upper Elk River (Lamson (2018)).

Table 3: Population group deta
Elko Dam - in the Elk

WCRP Unit	Population Group	Waterbodies
Upstream of the Elko Dam	Elk River	Elk River mainstem and all tributaries above Elko D
Downstream of the Elko Dam	Upper Kootenay	Elk River mainstem below Elko Dam and Wigwam a

Adult Westslope Cutthroat Trout overwinter in deep pools or lakes and then generally move upstream to spawning habitat during high spring flows, with spawning peaking between May and June. Fry emergence occurs between July and August, with individuals migrating to lower

velocity rearing habitats in and around natal streams (COSEWIC (2016), ERA (n.d.)). Westslope Cutthroat Trout exist with three distinct life history forms in the Elk River watershed (Oliver (2009), ERA (n.d.)):

- Stream-resident — individuals spend their entire life history within a restricted distribution of headwater streams, often because movement is restricted by natural barriers.
- Fluvial — individuals migrate between tributaries and larger mainstem rivers to complete various life-history stages (e.g., spawning, overwintering).
- Adfluvial — individuals migrate between tributaries and lakes/reservoirs to complete life-history stages. See Appendix A for maps of modelled Westslope Cutthroat Trout habitat in the Elk River watershed.

Barrier Types

The following table highlights which barrier types pose the greatest threat to Westslope Cutthroat Trout in the watershed. The results of this assessment were used to inform the subsequent planning steps, as well as to identify knowledge gaps where there are little spatial data to inform the assessment for a specific barrier type.

Table 4: Barrier types in the Elk River watershed and barrier rating assessment results. For each barrier type listed, 'Extent' refers to the proportion of Westslope Cutthroat Trout habitat that is being blocked by that barrier type, 'Severity' is the proportion of structures for each barrier type that are known to block passage for focal species based on field assessments, and 'Irreversibility' is the degree to which the effects of a barrier type can be reversed and connectivity restored.

Barrier Types	Extent	Severity	Irreversibility	Overall Threat Rating:
Dams	Medium	Low	High	Low
Road-Stream Crossings	High	Low	Medium	High
Rail-stream Crossings	Low	High	High	Medium
Trail-stream Crossings	Low	Low	Low	Low
Lateral Barriers	Low	Low	High	Low
Sediment Wedges	Low	Low	Medium	Low
Landslides	Low	Low	High	Low

Dams

There are 9 mapped dams on potential habitat in the watershed, blocking698.19 km (39.83% of the total blocked habitat) of modelled spawning and rearing habitat, resulting in a Low extent.

The Elko Dam is excluded from this assessment due to its function in preventing introgression and the spread of AIS upstream, and the historic natural barrier at this site. The extent rating of these structures was confirmed by the planning team — there are a small number of known dams in the watershed, mostly associated with mining activity (e.g., settling/tailing ponds). The Harmer Creek Dam was identified by the planning team as an important dam to rehabilitate to benefit a genetically pure Westslope Cutthroat Trout population in the Grave-Harmer system, and Teck Resources Ltd. is currently undertaking an assessment process to evaluate potential rehabilitation options (W. Franklin, Teck Resources Ltd., pers. comm.). There are no known fishways in the watershed, and the identified dams likely block passage for Westslope Cutthroat Trout. Due to the significant resources required to rehabilitate dams and the Low extent of dams in the watershed, a final pressure rating of Low was assigned.

Road-stream Crossings

Road-stream crossings are the most abundant barrier type in the watershed, with 18 assessed and modelled crossings located on potential habitat. Demographic road crossings (highways, municipal, and paved roads) block 56.38 km of habitat (~40% of the total blocked habitat), with 0% of assessed crossings having been identified as barriers to fish passage. Resource roads potentially block 698.19 km of habitat (~40%), with 0% of assessed crossings have been identified as barriers. Significant land use and linear development throughout the valley bottom, including Highways 3 and 43, have disconnected the Elk River from important habitat in many tributaries. The resource road-stream crossings are primarily associated with mining and forestry activities in the watershed. The collective experience and input from the planning team resulted in a Medium irreversibility rating due to the technical complexity and resources required to rehabilitate road-stream crossings, though it was noted that this differs considerably between resource roads and highway crossings.

Rail-stream crossings

There are relatively few rail-stream crossings in the watershed (65 crossings on potential habitat), potentially blocking only 13.99 km of habitat (~3% of the total habitat blocked). Only 14 rail-stream crossings have been assessed in the watershed, and of these 45% are considered to be barriers. All rail- stream crossings in the watershed are associated with the Canadian Pacific (CP) rail lines running along the Elk River, Fording River, and Michel Creek. With significant financial costs, technical challenges, and stakeholder engagement required with CP to rehabilitate these barriers, the planning team decided on an overall pressure rating of Medium for this barrier type.

Trail-stream crossings

There are very little spatial data available on trail-stream crossings in the watershed, so the planning team was unable to numerically quantify the Extent and Severity of this barrier type. The planning team felt that recreational trail network crossings rarely significantly block passage for Westslope Cutthroat Trout. Given that most crossings will likely be fords or similar structures, the rehabilitation costs associated with these barriers would be quite low. Overall, the planning team felt that the pressure rating for trail-stream crossings was likely Low.

Lateral Barriers

There are numerous types of lateral barriers that potentially occur in the watershed, including dykes, berms, and linear development (i.e., road and rail lines), all of which can restrict the ability of Westslope Cutthroat Trout to move into floodplains, riparian wetlands, and other off-channel habitats. No comprehensive lateral barrier data exist within the watershed, so pressure ratings were based on qualitative local knowledge. Lateral barriers are not thought to be as prevalent as road- or rail-stream crossings and are likely to be passable for at least certain parts of the year where they do exist. Highway 3, Highway 43, and the CP rail line were identified as potential lateral barriers that disconnect the mainstem channels from their historic floodplain and off-channel habitat. Overall, the planning team decided that a Low pressure rating adequately captured the effect that lateral barriers are having on connectivity in the watershed, while recognizing that the lack of data on lateral barriers in the watershed is an important knowledge gap to fill.

Sediment Wedges

Sediment wedges include both mass wasting events and chronic bank erosion that can lead to the deposition of sediment to such an extent as to limit fish passage. The extent and severity of sediment wedges acting as barriers fluctuates seasonally and annually due to natural and human-induced changes to the flow regime, and natural barriers of this type are difficult to include in a spatial prioritization framework due to their transient nature. Both current and historic land-use practices, including mining and forest-harvesting impacts, contribute to the formation of sediment wedges in the watershed; however, the planning team felt that the extent and severity were Low overall.

Landslides

Though a relatively rare occurrence, landslides that result in impediments to fish passage do occur in the watershed and can be technically and financially difficult to rehabilitate when

they occur. Overall, the planning team felt that a Low rating adequately captured the effects of landslides, but felt that it was an important barrier type to identify in this WCRP.

Connectivity Status Assessment and Goals

Connectivity Status Assessment

The planning team devised two Key Ecological Attributes (KEAs) and associated indicators to assess the current connectivity status of the watershed – Accessible habitat above Elko Dam and Accessible habitat below Elko Dam (Table 7). KEAs are the key aspects of Westslope Cutthroat Trout ecology that are being targeted by this WCRP. The connectivity statuses for the Westslope Cutthroat Trout KEAs were used to establish goals to improve habitat connectivity in the watershed and will be the baseline against which progress is tracked over time.

The current connectivity status assessment relies on GIS analyses to map known and modelled barriers to fish passage, identify stream reaches that have potential spawning and rearing habitat, estimate the proportion of habitat that is currently accessible to focal species, and prioritize barriers for field assessment that would provide the greatest gains in connectivity. For the connectivity status assessments and barrier prioritization analysis the amount of spawning and rearing habitat is aggregated without duplication (i.e., a stream segment is only counted once if it is classified as both spawning and rearing habitat; see data methods). To support a flexible prioritization framework to identify priority barriers in the watershed, two assumptions are made: 1) any modelled (i.e., the passability status is unknown) or partial barriers are treated as complete barriers to passage and 2) the habitat modelling is binary, it does not assign any habitat quality values. As such, the current connectivity status will be refined over time as more data on habitat and barriers are collected. For more detail on how the connectivity status assessments were conducted, see data methods.

Table 5: Connectivity status assessment for (a) habitat upstream of Elko Dam and (b) ha downstream of Elko Dam in the Elk River watershed. The two KEAs - Acces habitat upstream of Elko Dam and Accessible habitat downstream of Elko D are evaluated using the Longest Fragment approach (Diaz et al. 2021), whereby length of linear habitat that currently comprises the longest connected section i watershed is divided by the total length of all linear habitat in the watershed.

Target Species	KEA	Indicator	Poor	Fai
Westslope Cutthroat Trout	Accessible habitat upstream of Elko Dam	Longest Fragment (%) Current Status:	<25%	26-5

Comments: Indicator rating definitions are based on the consensus decisions of the planning team. The current status is based on the CWF Barrier Prioritization Model output, which is current as of November 2022.

Goals

Table 6: Goals to improve habitat connectivity for Westslope Cutth
downstream of Elko Dam, in the Elk River watershed over t
(2021-2041). The goals were established through discussion
and represent the resulting desired state of connectivity in
for the Downstream of the Elko Dam unit assume that
dertaken while mitigating the risk of introgressive hybridiz
Strategies & Actions). The goals are subject to change as m
are collected over the course of the plan timeline (e.g., the c
is updated based on barrier field assessments).

Goal #	Goal
1	By 2031, the Longest Fragment (%) for Westslope Cutthroat Trout will increase from 70% to 83% ab
2	By 2041, the Longest Fragment (%) for Westslope Cutthroat Trout will increase to 86% above the E
3	By 2031, the Longest Fragment (%) for Westslope Cutthroat Trout will increase from 98% to 99% be
4	By 2041, the Longest Fragment (%) for Westslope Cutthroat Trout will not decrease from 99% belov

Structure Prioritization

Elk River Watershed Barrier Structure Summary

The primary conservation outcome of the WCRP is the rehabilitation of barriers to connectivity in the Elk River watershed. To achieve the 2041 connectivity goals in this plan (Goals 2 and 4), it is necessary to prioritize and identify a suite of barriers for both the Upstream of Elko Dam and Downstream of Elko Dam units that, if rehabilitated, will provide access to a minimum of 142 km of habitat and 3 km of habitat, respectively (Table 7).

Table 7: Habitat connectivity gain requirements to meet WCRP goals in each WCRP unit of the Elk River watershed. The measures of currently accessible and total habitat values are derived from the Intrinsic Potential habitat model described in the data methods.

WCRP Unit	Currently accessible (km)	Total	Current Connectivity Status	Goal	Gain re
Upstream of Elko Dam	676.38	967.88	70%	86%	156.0
Downstream of Elko Dam	191.34	195.64	98%	99%	2.34

The structure prioritization process comprises three stages:

- Stage 1: preliminary barrier list
- Stage 2: intermediate barrier list
- Stage 3: priority barrier list

The barrier prioritization analysis ranked barriers by the amount of habitat blocked to produce an "intermediate barrier list" comprising more barriers than are needed to achieve the goals. A longer list of barriers is needed due to the inherent assumptions in the connectivity model, habitat model, and gaps in available data. Barriers that have been modelled (i.e., points where streams and road/rail networks intersect) are assumed to be barriers until field verification is undertaken and structures that have been assessed as "potential" barriers (e.g., may be passable at certain flow levels or for certain life history stages) require further investigation before a definitive rehabilitation decision is made. Additionally, the habitat model identifies stream segmentsthat have the potential to support spawning or rearing habitat for focal species but does not attempt to quantify habitat quality or suitability see data methods,

which will require additional field verification once barrier assessments have been completed. As such, the intermediate list of barriers (Table 9) should be considered as a starting point in the prioritization process and represents crossings that are a priority to evaluate further through barrier assessment and habitat confirmations because some structures will likely be passable, others will not be associated with usable habitat, some crossings may not exist, and others may not be feasible to rehabilitate because of logistic considerations. The intermediate barrier list was updated following the barrier assessments and habitat confirmations that were undertaken during the 2021 field season - some barriers were moved forward to the "priority barrier list"(Table 12) and others were eliminated from consideration due to one or more of the considerations discussed above see (Table 8) and (Table 9). The priority barrier list represents structures that were confirmed to be partial or full barriers to fish passage and that block access to confirmed habitat. Barriers on the priority list were reviewed by planning team members and selected for inclusion for proactive rehabilitation. For more details on the barrier prioritization model, please see Mazany-Wright, Norris, et al. (2021a).

Table 8: List of barriers above Elko Dam that were
the intermediate barrier list (field assessm
but were removed from consideration for p
with the planning team.

ID	Stream name	Reason For Removal
112336	Alexander Creek	Improperly mapped on mainstem. Located on trib
1024735443	Abruzzi Creek	Does not exist
62245	Tobermory Creek	Rehabilitated
197527	Crossing Creek	Low quality habitat
1004606284	Fording River	Ford
197826 (1004603334)	Fording River	ford
1100002606	Boivin Creek	Off channel, not a barrier
197818 (1004606007)	Weigert Creek	Ford
197820 (1024735049)	Weigert Creek	Ford
197837 (1004602163)	Morrissey Creek	Ford
197821 (1004606545)	Cummings Creek	Ford
197846 (1004607449)	Tributary to Ewin Creek	Ford
197847 (1004600533)	Chauncey Creek	Ford
197805 (1004601280)	Tributary to Harmer Creek	Ford

ID	Stream name	Reason For Removal
197839 (1004607022)	McCool Creek	Ford
197823(1024706614)	Henretta Creek	Ford
197824 (1004604696)	Henretta Creek	Crossing does not exist
197803 (1004602514)	Harmer Creek	Ford
197838 (1004601704)	Morrissey Creek	Ford
197816 (1004602949)	Weigert Creek	Ford
1004603432	Tributary to Cadorna Creed	Crossing does not exist

Table 9: List of barriers below Elko Dam that were priorit
the intermediate barrier list (field assessments occ
but were removed from consideration for proactive
with the planning team.

ID	Stream name	Reason For Removal	Comments
197789 (1004603791)	Tributary to Lodgepole Creek	Ford	Road Deactivate
197792 (1004605499)	Tributary to Bean Creek	Bridge	
197867 (1004603553)	Bighorn Creek	Ford	
1004605216	Tributary to Wigwam river	No Crossing	Crossing does no
197785 (1004606129)	Tributary to Wigwam river	No channel	No defined chan
197782 (1004602359)	Rabbit Creek	Bridge (Collapsed)	Collapsed bridge
197861 (1004602646)	Tributary to Wigwam river	No crossing	
197794 (1004603480)	Bean Creek	Bridge	
197790 (1004606411)	Tributary to Lodgepole Creek	Ford	
197796 (1004601984)	Tributary to Lodgepole Creek	Short habitat gain	2.3 m falls ~60 m
1004605338	Tributary to Wigwam river	No Crossing, no channel	Dry area with no
197797 (1004606926)	Bighorn Creek	Ford	Crossing remove
197780 (1004601993)	Rabbit Creek	Ford	
197781 (1004601995)	Rabbit Creek	Bridge (Collapsed)	Collapsed bridge

ID	Stream name	Reason For Removal	Comments
1004603793	Lodgepole Creek	Ford	Crossing remove
197795 (1024733953)	Tributary to Lodgepole Creek	Bridge	

ID	Stream name	Barrier type	Assessment Status	Barr
197559	Brûlé Creek	Highway crossing	Habitat confirmation	Barr
61504	Coal Creek	Resource road crossing	Assessed	Barr
1004603413	Henretta Creek	Resource road crossing	Modelled Crossing	Pote
50185	Tributary to Morrisey Creek	Resource road crossing	Habitat confirmation	Barr
197534	Weigert Creek	Highway crossing	Habitat confirmation	Barr
197533	Brûlé Creek	Municipal road crossing	Habitat confirmation	Barr

ID	Stream name	Barrier type	Assessment Status
197783 (1004605937)	Tributary to Wigwam River	Resource road crossing	Barrier Assessment
197787 (1004606370)	Lodgepole Creek	Resource road crossing	Habitat confirmation
197793 (1004606347)	Bean Creek	Resource road crossing	Habitat confirmation
197786 (1004606398)	Lodgepole Creek	Resource road crossing	Habitat confirmation
197844 (1004605514)	Tributary to Bighord Creek	Resource road crossing	Habitat confirmation

ID	Stream name	Barrier type	Assessment Status

There are currently 21 barriers on the priority barrier list, which will be pursued for proactive rehabilitation to achieve the connectivity goals in this plan:

ID	Stream name	Road Name	Barrier C
197827 (1004600762)	Fording River	FRO Coal Haul	Teck Coa
1100001086	Harmer Creek	N/A	Teck Coa
62181	Dry Creek	Rail	CP Rail
197542	Hartley Creek	Dicken Road	BC Minis
62416	Grace Creek	Line Road	CanWel
197825 (1004604677)	Henretta Creek	Unnamed	Teck Coa
62182	Dry Creek	Fording Highway	Teck Coa
62505	Tributary to Lizard Creek	Mount Fernie Parkway	BC Parks
50152	Stove Creek (Tributary to Lizard Creek)	Mount Fernie Parkway	BC Parks
1004602974	Grace Creek	Line Road	CanWel

Work Planning

Annual Progress Report

CWF continues to work with program partners to identify and address priority barriers in the Elk River watershed. CWF worked with BC Parks to replace a barrier culvert on a tributary to Lizard Creek with an clearspan bridge in Mount Fernie Park in 2023 and is developing designs for a second replacement in the park on Stove Creek, with the intent of replacing that crossing with a geotextile reinforced arch culvert in 2025. The BC Ministry of Transportation and Infrastructure is advancing plans for the Hartley Creek crossing, with work currently going through the regulatory approvals process. Teck Coal is actively advancing work to remove the Harmer dam, and a multiplate crossing on the FRO Coal Haul road is anticipated in the near future. CWF is also working with program partners to continue to complete barrier assessments in the watershed during summer/fall 2024 and has begun to investigate ways to improve the Westslope Cutthroat Trout habitat model that is currently being used to assist in identify potential candidate sites for assessment.

Operational Plan

The operational plan represents a preliminary exercise undertaken by the planning team to identify the potential leads, potential participants, and estimated cost for the implementation of each action in the Elk River watershed. Table 8 summarizes individuals, groups, or organizations that the planning team felt could lead or participate in the implementation of the plan and should be interpreted as the first step in on-going planning and engagement to develop more detailed plan for entries into this table. The individuals, groups, and organizations listed under the "Lead(s)" or "Potential Participants" columns are those that provisionally expressed interest in participating in one of those roles or were suggested by the planning team for further engagement (denoted in parentheses), for those that are not members of the planning team. The leads, participants, and estimated costs in the operational plan are not binding nor an official commitment of resources, but rather provide a roadmap for future coordination and engagement to work towards implementation of the WCRP.

Table 13: Operational plan to support the implementation
connectivity for focal species in the Horsefly Riv

Strategy / Actions
Strategy 1: Crossing Rehabilitation
1.1 - Rehabilitate resource road barriers
1.2 - Rehabilitate dams
1.3 - Rehabilitate major infrastructure crossings
1.4 - Barrier mititgation
1.5 - Work with crossing owners to identify and rehabilitate barriers
1.6 - Advocate for increased compliance and enforcement for specific, priority barriers
1.7 - Work with FLNRORD to encourage road decommissioning that returns sites to a more natural condition
1.8 - Integrate with other regional initiatives
1.9 - Raise funds to rehabilitate barriers (ownership dependent)
1.10 - Knowledge Gap: Assess barriers by applying the provincial fish passage framework
1.11 - Knowledge Gap: Identify key barriers for hybridization prevention below Elko Dam
1.12 - Knowledge Gap: Identify and map owners of priority barriers
1.13 - Knowledge Gap: Prioritize barriers for the Upper Fording and Grave-Harmon populations
1.14 - Knowledge Gap: Continue updating the barrier prioritization model
1.15 - Knowledge Gap: Desktop mapping of lateral habitat and barriers; define lateral connectivity goals
1.16 - Knowledge gap: Ground truth lateral habitat and barriers
1.17 - Knowledge gap: Monitor temperature and flows; assess effectiveness of barrier rehabilitation projects
Strategy 2: Barrier Prevention
2.1 - Engage with land managers to share and implement best practices on stream crossings and fish passage
2.2 - Support and engage with First Nations guardians programs where appropriate
2.3 - Engage with ATV clubs/recreation groups to share and implement best practices on stream crossings and
Total:
Fundraising total:
Proponent/government contribution total:

Annual Work Plan

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Version History

v.1.0 – August 2024

Project Partners

Planning Team

The Ktunaxa National Council (KNC) was invited to participate in the planning process, but was unable to at this time. CWF desires to collaborate with KNC on this plan in the future, and the planning team has tried to reflect our understanding of the rights and values of the Ktunaxa people in this WCRP. We are committed to correcting any errors in assumption or interpretation that are identified in this plan.

Table 14: Elk River watershed WCRP planning team members. Planning team members contributed to the development of this plan by participating in a series of workshops and document and data review. The plan was generated based on the input and feedback of the local groups and organizations list in this table.

Name	Organization
Betty Rebellato	Canadian Wildlife Federation
David Hillary	Canadian Wildlife Federation
Justin Duncan	Canadian Wildlife Federation
Nick Mazany-Wright	Canadian Wildlife Federation
Nicolas Lapointe	Canadian Wildlife Federation
Sarah Sra	Canadian Wildlife Federation
Simon Norris	Hillcrest Geographics
Kristin Singer	Department of Fisheries and Oceans Canada
Marlena McCabe	Department of Fisheries and Oceans Canada
Quinn Anderson	Department of Fisheries and Oceans Canada
Chad Hughes	Elk River Alliance
Joshua Noseworthy	Global Conservation Solutions
Camille Des Rosiers-Ste.Marie	Jon Bisset and Associates

Name	Organization
Jon Bisset	Jon Bisset and Associates
John Bransfield	LOTIC Environmental
Mike Robinson	LOTIC Environmental
Herb Tepper	Ministry of Forests, Lands, Natural Resource Operations & Rural Develop
Bill Arling	North Coal
Patty Vadnais	North Coal
Dave Baines	NWP Coal Canada Ltd.
Mindy Sheer	Sheer Ecology
John Huryn	Sparwood & District Fish and Wildlife Association
Lindsay Watson	Teck Resources
Warn Franklin	Teck Resources
Jason Gravelle	Tobacco Plains Indian Band
Myra Juckers	Tobacco Plains Indian Band
Randal McNair	Wildsight BC
Wyatt Petryshen	Wildsight BC

Key Actors

Supplementary Information

Situation Analysis

The following situation model was developed by the planning team to "map" the project context and brainstorm potential actions for implementation. Green text is used to identify actions that were selected for implementation (see 'Strategies & Actions'), and red text is used to identify actions that the project team has decided to exclude from the current iteration of the plan, given that they were either outside of the project scope or were deemed to be ineffective by the planning team.

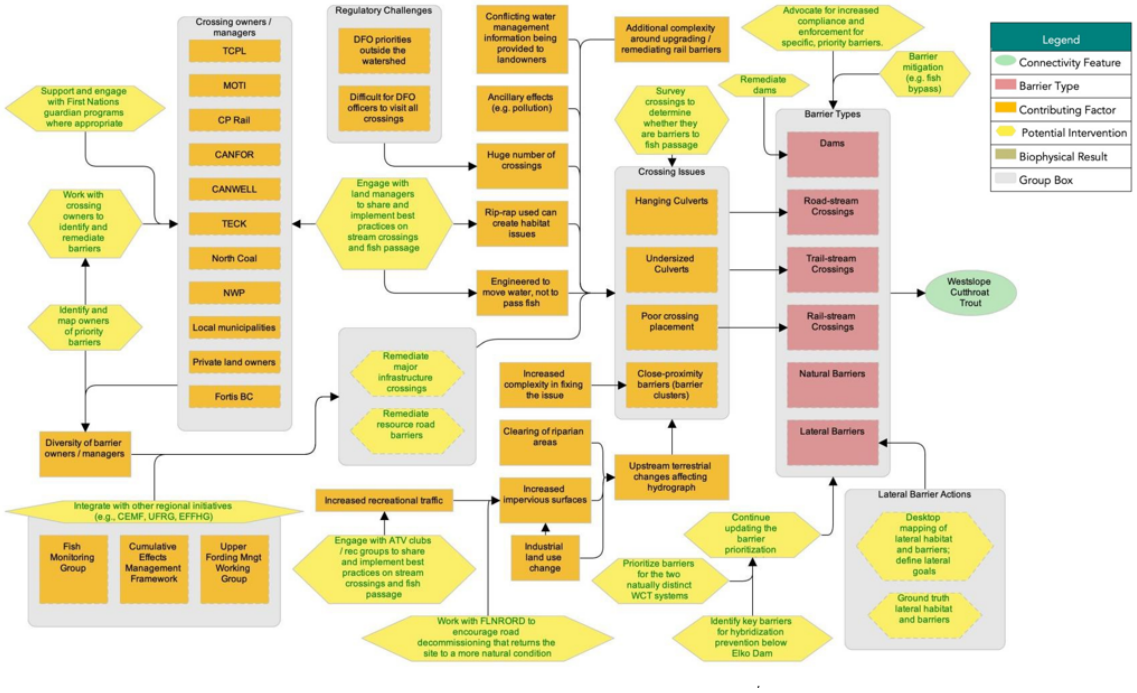

Figure 3: Situation analysis developed by the planning team to identify factors that contribute to fragmentation (orange boxes) and potential strategies/actions to improve connectivity (yellow hexagons) for Westslope Cutthroat Trout in the Elk River watershed.

Strategies & Actions

Effectiveness evaluation of identified conservation strategies and associated actions to improve connectivity for Westslope Cutthroat Trout in the Elk River watershed. The planning team identified two broad strategies to implement through this WCRP, 1) barrier rehabilitation and 2) barrier prevention. Individual actions were qualitatively evaluated based on the anticipated effect each action will have on realizing on-the-ground gains in connectivity. Effectiveness ratings are based on a combination of "Feasibility" and "Impact", Feasibility is defined as the degree to which the project team can implement the action within realistic constraints (financial, time, ethical, etc.) and Impact is the degree to which the action is likely to contribute to achieving one or more of the goals established in this plan.

Strategy 1: Barrier Rehabilitation

ID	Actions
1.1	Rehabilitate resource road barriers
1.2	Rehabilitate dams
1.3	Rehabilitate major infrastructure crossings
1.4	Barrier mititgation
1.5	Work with crossing owners to identify and rehabilitate barriers
1.6	Advocate for increased compliance and enforcement for specific, priority barriers
1.7	Work with FLNRORD to encourage road decommissioning that returns sites to a more natural conditio
1.8	Integrate with other regional initiatives
1.9	Raise funds to rehabilitate barriers (ownership dependent)
1.1	Knowledge Gap: Assess barriers by applying the provincial fish passage framework
1.11	Knowledge Gap: Identify key barriers for hybridization prevention below Elko Dam
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1.13	Knowledge Gap: Prioritize barriers for the Upper Fording and Grave-Harmon populations
1.14	Knowledge Gap: Continue updating the barrier prioritization model
1.15	Knowledge Gap: Desktop mapping of lateral habitat and barriers; define lateral connectivity goals
1.16	Knowledge gap: Ground truth lateral habitat and barriers
1.17	Knowledge gap: Monitor temperature and flows; assess effectiveness of barrier rehabilitation projects

Strategy 2: Barrier Prevention

ID	Actions
2.1	Engage with land managers to share and implement best practices on stream crossings and fish passage
2.2	Support and engage with First Nations guardians programs where appropriate
2.3	Engage with ATV clubs/recreation groups to share and implement best practices on stream crossings and

Theories of Change & Objectives

Theories of Change are explicit assumptions around how the identified actions will achieve gains in connectivity and contribute towards reaching the goals of the plan. To develop Theories of Change, the planning team developed explicit assumptions for each strategy which helped to clarify the rationale used for undertaking actions and provided an opportunity for feedback on invalid assumptions or missing opportunities. The Theories of Change are results oriented and clearly define the expected outcome. The following theory of change models were developed by the WCRP planning team to "map" the causal ("if-then") progression of assumptions of how the actions within a strategy work together to achieve project goals.

Operational Plan

The operational plan represents a preliminary exercise undertaken by the planning team to identify the potential leads, potential participants, and estimated cost for the implementation of each action in the Elk River watershed. Table 8 summarizes individuals, groups, or organizations that the planning team felt could lead or participate in the implementation of the plan and should be interpreted as the first step in on-going planning and engagement to develop more detailed plan for entries into this table. The individuals, groups, and organizations listed under the "Lead(s)" or "Potential Participants" columns are those that provisionally expressed interest in participating in one of those roles or were suggested by the planning team for further engagement (denoted in parentheses), for those that are not members of the planning team. The leads, participants, and estimated costs in the operational plan are not binding nor an official commitment of resources, but rather provide a roadmap for future coordination and engagement to work towards implementation of the WCRP.

Table 17: Operational plan to support the implementation
connectivity for focal species in the Horsefly Ri

Strategy / Actions
Strategy 1: Crossing Rehabilitation
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Total:
Fundraising total:
Proponent/government contribution total:

Funding Sources

Table 18: Confirmed funding sourc

Funding Source	Scope of Work
Fish and Wildlife Compensation Program	Barrier assessments and habitat confirmations (2021-2
Environmental Damages Fund	Engineering designs and rehabilitation implementation
Canada Nature Fund for Aquatic Species at Risk	Conservation planning, barrier assessments, habitat co

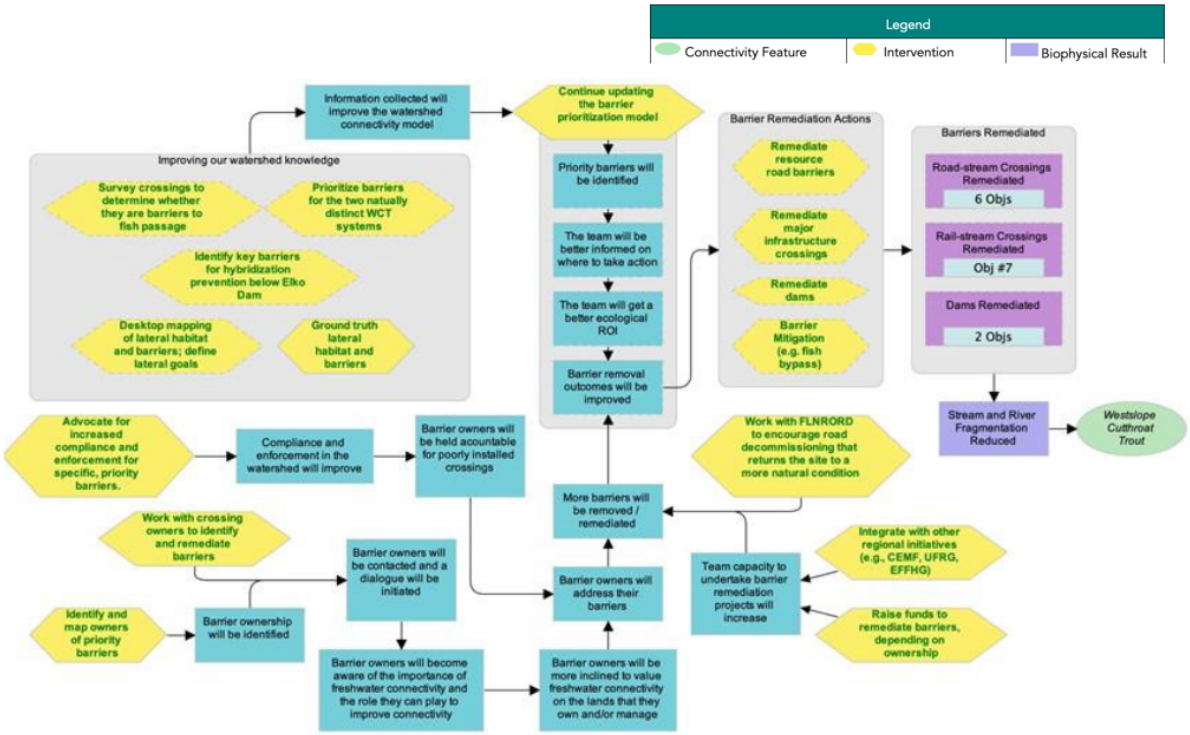

Figure 4: Theory of change developed by the planning team for the actions identified under Strategy 1: Barrier Rehabilitation in the Elk River watershed.

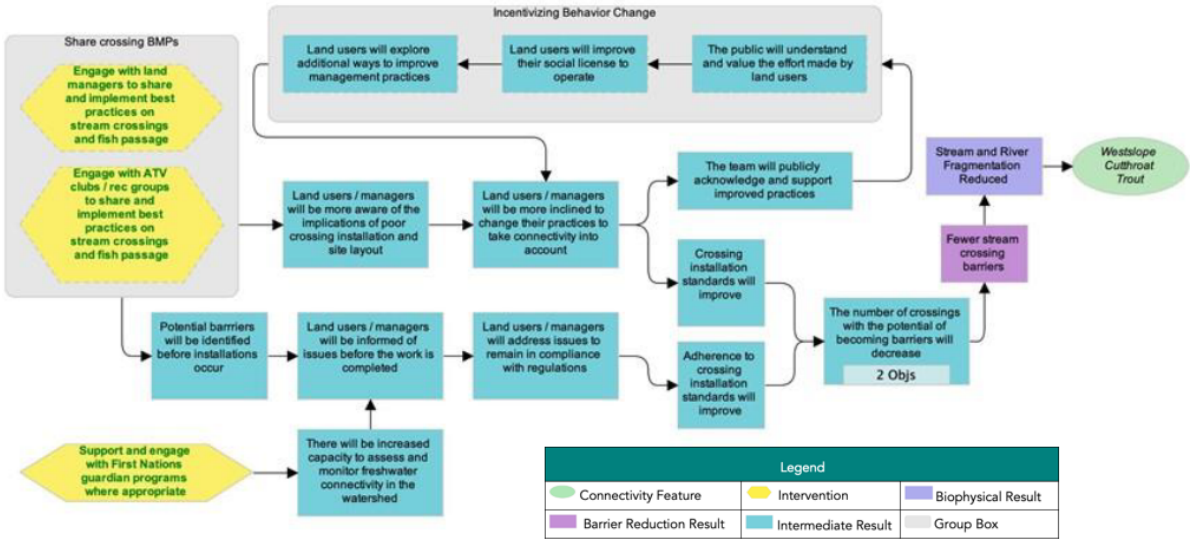

Figure 5: Theory of change developed by the planning team for the actions identified under Strategy 2: Barrier Prevention in the Elk River watershed.

Funding Source	Spending Restrictions and
Land Based Investment Strategy	Assessment and restoratio
Environmental Enhancement Fund	Fish and wildlife passage
Habitat Conservation Trust Foundation Enhancement and Restoration Grants	Projects that focus on fres
Environmental Damages Fund	Direct funds received from
Fish and Wildlife Compensation Program	Funding to conserve and
Habitat Stewardship Program for Aquatic Species at Risk	Program for non-profits, In
Canada Nature Fund for Aquatic Species at Risk	Funding program aimed a
Aboriginal Fund for Species at Risk	Program for Indigenous gr
Colombia Basin Trust Envrionment Grants	Small (<$5K) and large gr
Federal Gas Tax Fund - Community Works Fund	Funding available to local

Funding Source	Spending Restrictions and
Disaster Mitigation and Adaptation Fund	For those projects where f
Community Gaming Grants	Funding for non-profit orga
Sitka Foundation	Funding for registered cha
TULA Foundation	Supports various environm
Vancouver Foundation	Granting agency for comm
BC Conservation Foundation Small Project Fund	Funding available to Non-
Real Estate Foundation of BC General Grants	Funding for First Nations,

Data Download and Methods

Data Download

Coming soon

Connectivity Status Assessment Methods

The connectivity status assessment for Westslope Cutthroat Trout in the Elk River watershed builds on existing connectivity modelling work undertaken by the BC Fish Passage Technical Working Group, resulting in a flexible, customizable open-source spatial model called "bcfishpass". The model spatially locates known and modelled barriers to fish passage, identifies potential spawning and rearing habitat for Westslope Cutthroat Trout, and estimates the amount of habitat that is currently accessible as part of the Longest Fragment for each WCRP unit. The Longest Fragment approach is adapted from Díaz and Habit (2021) and is calculated as the ratio between the length of largest connected set of habitat patches and the total length of all habitat patches in each WCRP unit. In the Elk River watershed, the longest fragment represents the mainstem Elk River and all currently connected tributaries, both upstream and downstream of the Elko Dam. As such, meeting the connectivity goals set in this plan requires prioritizing barriers for rehabilitaton that will reconnect tributaries to the existing longest fragments see barrier prioritzation.

The model uses an adapted version of the Intrinsic Potential (IP) fish habitat modelling framework (see Sheer et al. (2009) for an overview of the IP framework). The habitat model uses two geomorphic characteristics of the stream network — channel gradient and mean annual discharge — to identify potential spawning habitat and rearing habitat for focal species. For the purposes of this plan, rearing habitat is used as an umbrella term to capture the requirements for Westslope Cutthroat Trout rearing, maintenance, and overwintering habitat. The habitat model does not attempt to definitively map each habitat type nor estimate habitat quality, but rather identifies stream segments that have high potential to support spawning or rearing habitat for Westslope Cutthroat Trout based on the geomorphic characteristics of the segment. For more details on the connectivity and habitat model structure and parameters, please see Mazany-Wright, Norris, et al. (2021a). The variables and thresholds used to model potential spawning and rearing habitat are summarized below. The quantity of modelled habitat was aggregated for each habitat type to inform the two KEAs — Accessible Habitat

Upstream of Elko Dam and Accessible Habitat Downstream of Elko Dam — and represents a linear measure of potential habitat. To recognize the rearing value provided by features represented by polygons (e.g., lakes for overwintering) a multiplier of 1.5x the length of the stream segments flowing through the polygons was applied.

Table 20: Param
for spa
waters

Spawning Habitat Channel Gradient (%)	Spawning Habitat Mean annual discharge (m3/s)	Rearing H
0-3 [1] [2]	0.46-322.5 [3][4][5][6][7]	0-5 [5][8]
0-5 [6][10]	0.164-59.15 [3][4][5][10][11]	0-5 [8][12
0-2 [14][15]	0.175-65 [3][4][5][6]	

References: [1] Busch et al. (2011). [2] Cooney and Holzer (2006). [3] Bjornn and Reiser (1991). [4] Neuman and Newcombe (1977). [5] Woll, Albert, and Whited (2017). [6] Roberge et al. (2002). [7] Raleigh and Miller (1986). [8] Porter et al. (2008). [9] Agrawal et al. (2005). [10] Sloat, Reeves, and Christiansen (2017). [11] Mcmahon (1983). [12] Rosenfeld, Porter, and Parkinson (2000). [13] Burnett et al. (2007). [14] Lake (1999). [15] Hoopes (1972).