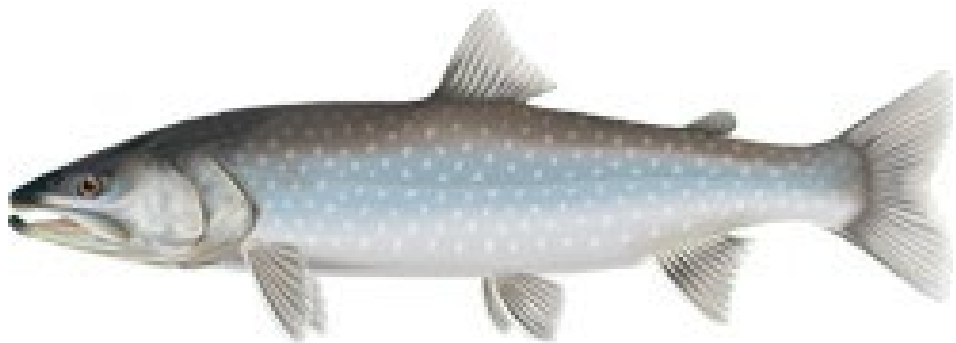


Moon Creek Timber Harvest Plan: Fish and Fish Habitat Risk Overview



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Fintegrate Fisheries & Watershed Consulting Ltd.

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List of Acronyms and Abbreviations

ABMI - Alberta Biodiversity Monitoring Institute
AEPA - Alberta Environment and Protected Areas
AFPT - Alberta Forestry, Parks and Tourism
ARTR - Athabasca Rainbow Trout
AWA - Alberta Wilderness Association
BKTR - Brook Trout
BLTR - Bull Trout
BURB - Burbot
COSEWIC - Committee on the Status of Endangered Wildlife in Canada
DEM - Digital Elevation Model
DFMP - Detailed Forest Management Plan
DFO - Fisheries and Oceans Canada
ECA - equivalent clearcut area
ESH - Ecologically Significant Habitat
FHP - Forest Harvest Plan
Fintegrate - Fintegrate Fisheries & Watershed Consulting Ltd.
FMA - Forest Management Agreement
FMU - Forest Management Unit
fRI - Foothills Research Institute
FWIMT - Fish and Wildlife Internet Mapping Tool
FWMIS - Fisheries and Wildlife Management Information System
GoA - Government of Alberta
HFI - Human Footprint Inventory
LIDAR - airborne light detection and ranging
masl – meters above sea level
MNWH - Mountain Whitefish
OGRs - Operating Ground Rules
RNTR - Rainbow Trout
SARA - *Species at Risk Act*
SPSC - Spoonhead Sculpin
WAM - Wet Area Mapping
West Fraser - West Fraser Mills Ltd.
WWP - Willmore Wilderness Park

Acknowledgements

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West Fraser Mills Ltd. for providing the proposed harvest plan, as the Forest Harvest Plan map submitted to Alberta Forestry, Parks and Tourism and the associated special data.

Foothills Research Institute for providing spatial data for the area, under a data sharing agreement. This included subwatershed boundaries, model-predicted Bull Trout and Athabasca Rainbow Trout probabilities of occurrence, and model-predicted channel types and slopes for all mapped watercourses within the area. Support accessing the necessary data specific to the Moon Creek area was provided by Julie Duval, the GIS Services Manager. Rich McCleary, the researcher who originally completed the modelling, also met with Julie, Alberta Wilderness Association, and Fintegrate to provide background information of the data provided.

Cydne Potter, and independent geospatial analyst, supported completing the analysis of the existing and proposed anthropogenic footprint associated with the Moon Creek harvest plan.

Executive Summary

The 2021 Moon Creek forest harvest plan from West Fraser Mills Ltd. for lands near Grande Cache, Alberta could impact species at risk and the habitat they rely on, including Threatened Mountain Caribou (*Rangifer tarandus*) and Endangered Athabasca Rainbow Trout (*Oncorhynchus mykiss*, ARTR).

ARTR were listed as Endangered under Canada's *Species at Risk Act* (SARA) in 2019. Within the Moon Creek harvest plan area, all streams draining Moon and Fox creeks are listed as containing ARTR critical habitat, which is necessary for the survival and recovery of the species.

Alberta Wilderness Association contracted with Fintegrate Fisheries & Watershed Consulting Ltd. to assess the Moon Creek harvest plan with respect to ARTR and their critical habitat – to highlight issues and locations of concern where the impacts to ARTR could be greatest.

Major findings of this assessment include:

- Harvested area will increase to 14.8% (from 8.6% currently) of the Moon Creek watershed, and to 46.3% (from 35.7% currently) of the Fox Creek watershed;
- The harvest plan proposes a total of 3.7 and 5.5 kilometres of roads within riparian buffer zones for the Moon Creek and Fox Creek watersheds, respectively;
- The total area of predicted riparian area disturbed by roads or cut blocks in the Moon Creek and Fox Creek watersheds will increase by 92.0 and 83.8 hectares, respectively;
- 25 and 60 hectares of cut block area overlapping SARA critical habitat are proposed for the Moon Creek and Fox Creek watersheds, respectively;
- Linear disturbance densities in the Moon Creek and Fox Creek watersheds will increase to 0.55 km/km² and 2.32 km/km², respectively;
- Significant amounts of the proposed harvest area overlap with LIDAR-predicted shallow groundwater areas;
- Proposed cut block area overlap with riparian buffers is almost exclusively on the 30 m SARA Critical Habitat buffer on tributaries;
- Proposed roads can be seen paralleling tributaries within the riparian area, instead of crossing the riparian once, to minimize disturbance;
- and
- Direct instream habitat impacts could occur at road-stream intersections, of which 23 new crossings are proposed in each of the Moon and Fox creek watersheds.

Based on this assessment, there was no indication that **West Fraser's Moon Creek forest harvest plan was designed to meet any specific protections for ARTR under federal legislation**. West Fraser's plan only provides the provincial standard level of protection, and ARTR need enhanced protection to be conserved and recovered.

It is unclear if, or how, West Fraser has ensured that their proposed cut blocks, roads, and watercourse crossings will not cause harmful alteration, disruption, or destruction of critical habitat for ARTR within the Moon Creek and Fox Creek watersheds. **The Moon Creek harvest plan cannot receive a SARA permit because riparian and instream ARTR Critical Habitat will be destroyed, which is prohibited under Section 58(1) of SARA.**

1. Introduction

The Alberta Wilderness Association (AWA) advocates for protection of water, land, and native biodiversity throughout the province. AWA has been engaging with Fisheries and Oceans Canada (DFO) and the Government of Alberta (GoA) on caribou and native trout for many years.

In 2018 AWA learned of proposed timber harvest by West Fraser Mills Ltd. (West Fraser) within the Berland River and Moon and Fox creek watersheds near Grande Cache, Alberta, that could impact several species at risk and the habitat they rely on. The logging proposal is referred to here as the Moon Creek harvest plan. It covers an area of Critical Habitat of two federal *Species at Risk Act* (SARA)-listed species, Threatened Mountain Caribou (*Rangifer tarandus*) and Endangered Athabasca Rainbow Trout (*Oncorhynchus mykiss*, ARTR).

The area is also habitat for Bull Trout (*Salvelinus confluentus*, BLTR), which are federally listed as Special Concern in the Athabasca River drainage. The Special Concern designation does not result in Critical Habitat designation under SARA.

ARTR Critical Habitat, including riparian areas, was legally protected under SARA by DFO on March 11, 2021, when a protection order was issued ([SOR/2021-32](#)).

BLTR, ARTR, and Mountain Caribou populations are also all provincially listed as Threatened under the Alberta *Wildlife Act*.

AWA is currently engaging with Alberta Environment and Protected Areas (AEPA), Alberta Forestry, Parks and Tourism (AFPT), DFO, and West Fraser to understand how current federal and provincial legislation protecting fish and fish habitat applies to the Moon Creek harvest plan.

2. Moon Creek Harvest Plan Status

Under the Alberta Timber Harvest Planning and Operating Ground Rules (OGRs), a Forest Harvest Plan (FHP) is a map and associated report describing a laid-out harvest plan. According to West Fraser, the FHP it submitted in summer 2021 for the Moon Creek harvest plan was approved by Alberta. However, on October 29, 2021, part of the Moon Creek harvest plan was impacted by AEPA establishing a “no harvest zone” to protect Mountain Caribou on the western boundary of Willmore Wilderness Park (WWP). This change in direction from AEPA to West Fraser was relayed to the company in a letter on November 9, 2021. A map dated December 17, 2021, and provided to AWA by West Fraser, shows a revised FHP resubmission where all cut blocks fully or partially within the “no harvest zone” are listed as deferred (**Figure 1**).

Then on February 3, 2022, West Fraser announced in a letter to its stakeholders that it would defer the entire Moon Creek harvest plan until the Alberta Berland sub-regional plan is finalized in 2023. In August 2019, Alberta created caribou sub-regional task forces to advise government on land-use planning at a local scale, including caribou recovery actions, within these areas. The Berland area is one of 11 caribou sub-regions in Alberta where sub-regional plans are being developed.

3. Project Purpose

AWA initially sought a desktop analysis to identify specific stream reaches or locations in the Moon and Fox creek watersheds containing Critical Habitat attributes for ARTR listed in Table 5 of the federal Recovery Strategy (DFO 2020a). However, this would require detailed survey, inventory, and monitoring that are well beyond what is possible with a desktop assessment and the data available. Therefore, the revised purpose of this Project is to more broadly provide additional information to support AWA's interactions with the regulators, including:

- how federal and provincial habitat protections apply to the Moon Creek harvest plan,
- what fish and fish habitat values are in the area, and
- where risks of the proposed timber harvest plan to fish and fish habitat may be greatest.

4. Project Scope

In February 2022 AWA retained Fintegrate Fisheries & Watershed Consulting Ltd. (Fintegrate) to provide a fisheries biologist assessment of the Moon Creek harvest plan. The scope of work outlined included the following tasks, collectively referred to as the Project:

- Assist AWA gathering relevant information regarding the Moon Creek harvest plan
- Summarize fish and fish habitat data for the area
- Identify where instream and riparian habitat could be impacted
- Assess the need for equivalent clearcut area (ECA) analyses
- Report to AWA on the importance of fish habitat in the area and highlight issues and locations of concern where the impacts to fish habitat could be greatest

5. Site Description

Moon and Fox creek originate in the Hoff and Berland mountain ranges. The upper Berland River also flows through these ranges and originates further west in the Persimmon Range. The Berland River originates at an elevation of 2,270 masl in the eastern portion of the WWP. The upper Berland River watershed, including Moon and Fox creek watersheds, extend from alpine and subalpine environments at elevations ranging from 2,100 to 2,800 masl to foothill environments ranging from 1,300 to 1,400 masl at the confluence of these two creeks with the Berland and Little Berland rivers, respectively.

Upland areas in the Moon Creek harvest plan consist of colluvial sedimentary deposits from glaciolacustrine or glaciofluvial deposits. Streams in the area cut through glacial moraines consisting of clay, silt, sand, gravel, cobbles, and boulders. Creek and river valleys are underlain by glaciofluvial and fluvial sedimentary deposits consisting of coarse and fine-grained material. Soils in the area will erode where vegetation is removed by natural processes (e.g., floods and fire) and anthropogenic activities (e.g., roads) and erosion will be greater on steep slopes.

Mean annual precipitation in the Moon Creek harvest plan area ranges from 500 to 900 mm and decreases further to the east with decreasing elevation. Snow melt commences in late May and June, with the timing of peak flows associated with the spring freshet typically ranging from mid-June to mid-July. The closest stream flow monitoring stations near the Moon Creek harvest plan are the Berland River near the mouth with the Athabasca River and the Wildhay River upstream and west of Highway 40 and south of the Rock Lake Road.

Forests in the Moon Creek harvest plan consist primarily of upland pine and non-pine forests (Lodgepole Pine -*Pinus contorta*, White Spruce -*Picea glauca*, Subalpine Fir -*Abies lasiocarpa*).

The Berland watershed is part of the Athabasca River basin. Approximately 67% of the area upstream of the confluence of the Little Berland River, near the Fox Creek confluence, is in WWP. Most of the Moon Creek harvest plan is within the “À La Pêche” subunit of Mountain Caribou range (**Figure 1**). The southern boundary of the range crosses through the plan area, extending northeast from the WWP boundary where the Moon and Fox creek watersheds diverge. A subset of sub-basins for 20 tributaries draining the area of proposed harvest to the Berland River and Moon and Fox creeks and ranging from 1st to 3rd order streams were selected for the fish and fish habitat risk assessment of the Moon Creek plan (**Figure 2**).

The Berland River flows 225.8 km before reaching the Athabasca River. Moon and Fox creek are 5th order streams, while the Berland River is a 6th order stream in the area. Moon Creek flows 56.6 km long before reaching the Berland River, while Fox Creek flows 25.5 km before reaching the Little Berland River, which is 2.4 km upstream from the Berland River.

All tributaries to Moon Creek within the harvest area are 1st or 2nd order streams. Some tributaries to Berland River and Fox Creek within the harvest plan area are larger and include 3rd and 4th order streams.

Based on areal imagery, publicly available photos, and the Alberta 25 m Digital Elevation Model (DEM), it is evident that Moon Creek is a much more hydrologically flashy stream than Fox Creek. The Moon Creek channel is braided, meandering over a broad floodplain, while the Fox Creek channel is more confined.

6. Existing Land Use and Human Footprint

A natural gas pipeline crosses the lower reaches of Moon Creek as well as the Berland River near the Moon Creek confluence (**Figure 3**). There are also natural gas wells along this pipeline, some of which are adjacent to cut blocks within the Moon Creek harvest plan (**Figure 3**). A CN railway also crosses the Berland River and Moon and Fox creeks near the proposed timber harvest plan (**Figure 3**). Highway 40 crosses Fox Creek downstream of the proposed timber harvest plan, as well as a tributary to Fox Creek (**Figure 3**). Culverts at these crossings are known partial barriers to upstream fish movement, and AEPA has prioritized them to be replaced with bridges to improve fish passage (AWA comm. with Ryan Cox, pers. comm.).

Approximately 69.0% and 18.0% of the Moon and Fox creek watersheds are in WWP, respectively. Outside the park, the Moon Creek harvest plan area already has extensive existing linear disturbance (**Figure 3**), based on analysis of Alberta Biodiversity Monitoring Institute (ABMI) Human Footprint Inventory (HFI) data.

At the watershed scale, road and overall linear disturbance densities in the Moon Creek watershed are lower (0.35 km/km²) than in the Fox Creek watershed (1.88 km/km²) because more of the watershed is in the park (**Table 1**). Similarly, there are currently more roads and linear disturbance stream crossings in the Fox Creek watershed (107) than in the Moon Creek watershed (46, **Table 1**).

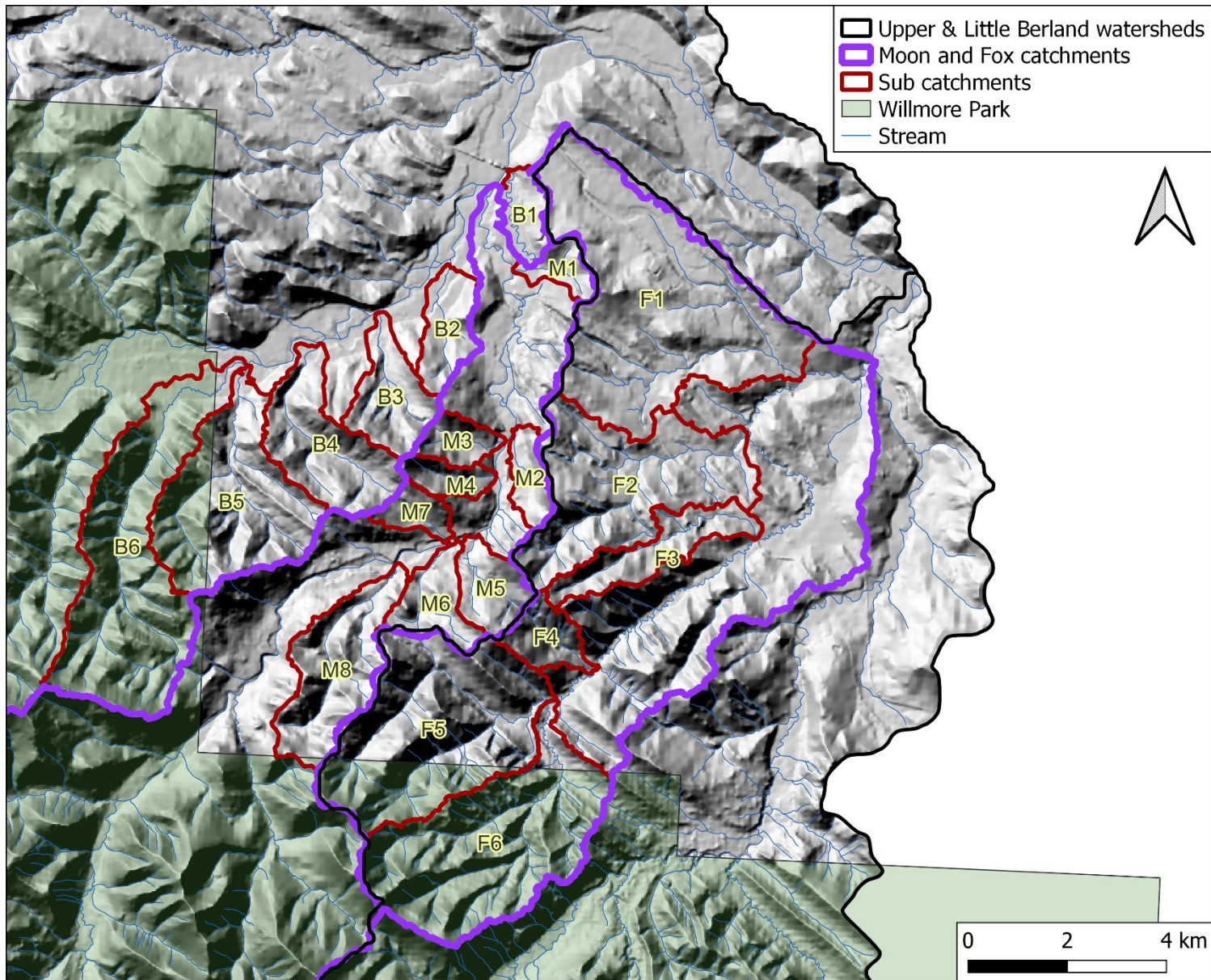


Figure 2. Sub-basins of 20 tributaries draining from the proposed Moon Creek harvest plan area

Table 1. Current and proposed road and linear disturbance densities and number of watercourse crossings in the Moon and Fox creek watersheds as well as 20 subwatersheds within the harvest plan area

Basin/sub-basin	Current road length (km)	Current road density (km/km ²)	Current length of other linear features (km)	Current roads and other linear features density (km/km ²)	Proposed road length associated with Moon Creek harvest plan (km)	Current and proposed road and other linear features density (km/km ²)	Current roads and linear disturbance stream crossings (count)	Additional stream crossings with proposed roads (count)
Moon	12.61	0.11	26.38	0.35	22.68	0.55	46	23
Fox	33.99	0.43	114.77	1.88	34.84	2.32	107	23
B1	0	0	4.08	2.77	0.37	3.03	2	1
B2	0	0	2.00	0.90	4.06	2.74	2	2
B3	0	0	2.27	0.76	3.87	2.06	4	9
B4	1.36	0.27	11.29	2.49	5.53	3.58	7	5
B5	0	0	7.06	0.81	2.62	1.11	6	2
B6	0	0	4.87	0.39	0.00	0.39	5	0
F1	15.71	0.92	48.11	3.74	1.06	3.81	27	1
F2	3.70	0.37	35.22	3.87	10.48	4.91	34	3
F3	0.82	0.27	13.13	4.56	5.22	6.27	10	5
F4	0	0	2.29	1.35	3.43	3.37	8	0
F5	0	0	10.23	0.83	9.70	1.61	9	12
F6	0	0	5.78	0.48	0.38	0.51	4	2
M1	0.26	0.24	2.44	2.47	0.81	3.21	4	0
M2	2.25	1.77	1.94	3.29	1.89	4.78	0	1
M3	0	0	4.91	3.88	3.80	6.89	5	5
M4	0	0	5.31	4.76	0.94	5.60	5	1
M5	0.44	0.21	2.31	1.30	2.99	2.72	3	0
M6	0	0	4.73	2.18	3.65	3.86	5	8
M7	1.45	1.31	1.38	2.56	0.25	2.79	2	0
M8	0	0	3.37	0.63	0.64	0.75	3	1

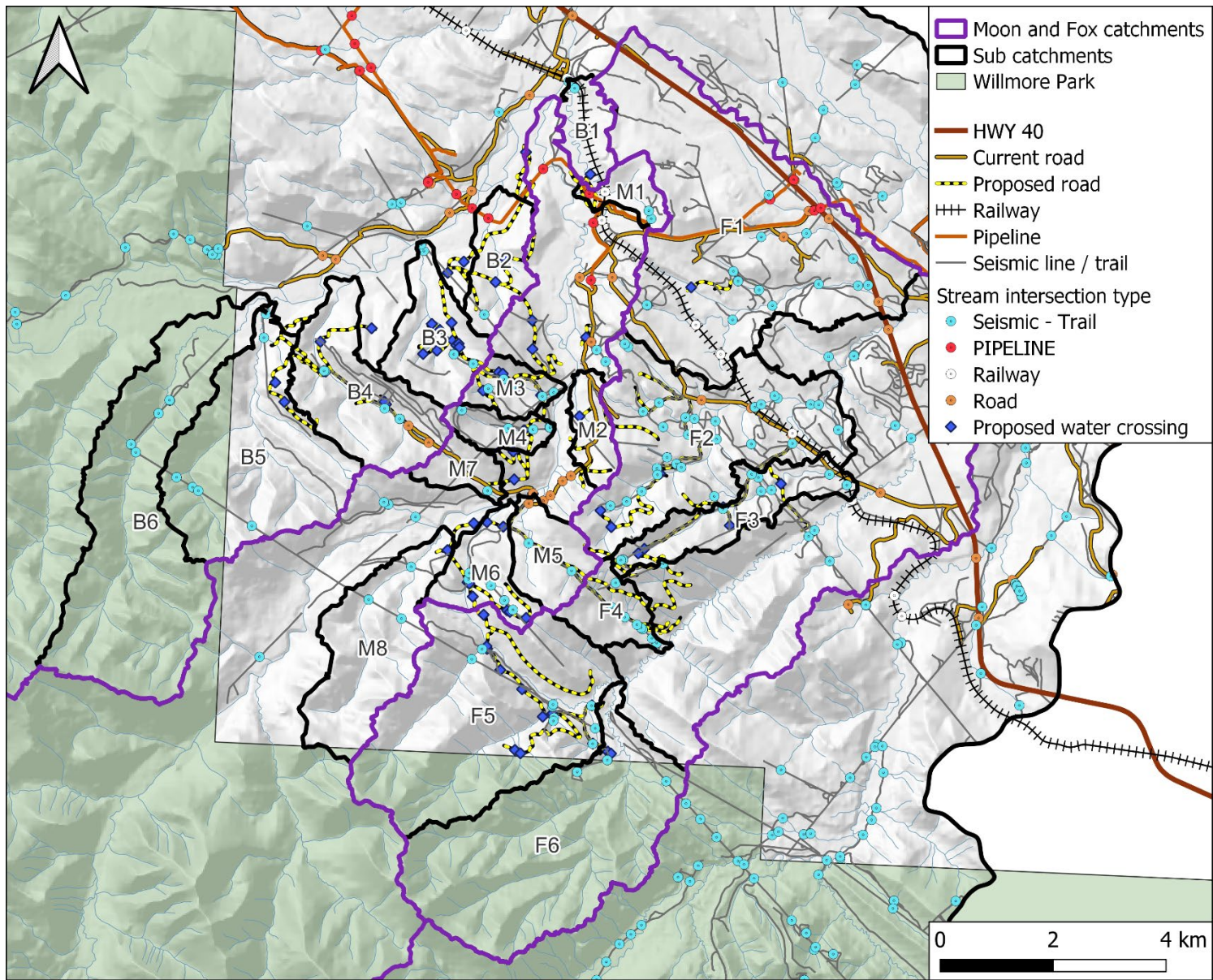


Figure 3. Existing human footprint within the Moon Creek harvest plan area

Of the sub-basins within the harvest plan area, road and linear disturbance densities currently range from 0.39 km/km² (B6, a Berland River tributary) to 4.76 km/km² (M4, a Moon Creek tributary, see **Table 1**). The maximum increases to 6.89 km/km² with the proposed harvest plan roads in a Moon Creek tributary (M3, see **Table 1**).

Within the Moon Creek harvest plan, other than a few existing culverts, most of the proposed crossings are likely fords, including the site of the proposed bridge crossing of Moon Creek (**Figure 4**). Other than the Highway 40 culvert crossings of Fox Creek and its tributary, there are no known anthropogenic fish passage barriers within the proposed timber harvest plan.



Figure 4. Site of the proposed bridge crossing over Moon Creek

Currently, approximately 8.6% and 35.7% of the area of the Moon and Fox creek watersheds, respectively, have been harvested for timber or anthropogenically disturbed (**Table 2, Figure 5**). Like the road and linear disturbance densities, this reflects that more of the Moon Creek watershed is within WWP. The largest percentage of the Moon Creek watershed was harvested in the 1960s, while the largest percentage of the Fox Creek watershed was harvested in the 1960s and 1970s. Some sub-basins draining to the Berland River are currently unharvested. In contrast, other sub-basins are already 66, 70, and 71% harvested (Berland, Fox, and Moon creek tributaries, respectively, **Table 2**).

7. Proposed Timber Harvest

The Moon Creek harvest plan is within the E14 Forest Management Unit (FMU) and allocated to West Fraser under its Hinton Wood Products Forest Management Agreement (FMA8800025). The land base is provincially managed public land. The company is responsible for developing and achieving commitments made in the 2014 Detailed Forest Management Plan (DFMP), which was approved by the GoA in 2017. The DFMP commits to applying a more conservative approach to timber harvest planning in areas close to stream channels where there are special non-timber values. When the DFMP was developed and approved, ARTR and BLTR were not yet listed as Endangered and Special Concern species under SARA, respectively, however both species were listed as Threatened under the Alberta *Wildlife Act*.

Table 2. Current and proposed area of timber harvest as percentages of total basin areas in the Moon and Fox creek watersheds as well as 20 sub-basins within the harvest plan area

Basin/ sub-basin	Basin area (ha)	Area harvested/disturbed by decade (% of basin)						Total current area harvested (% of basin)	Area proposed to be harvested (% of basin)	Total harvested area including area proposed to be harvested (% of basin)
		1950s	1960s	1970s	1980s	1990s	2000s			
Moon	11226.2	0.0	7.0	0.4	0.8	0.0	0.4	8.6	6.5	14.8
Fox	7928.6	0.5	17.9	12.1	1.7	3.5	0.0	35.7	10.8	46.3
B1	147.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.7	85.7
B2	221.0	0.0	3.4	0.0	0.0	0.0	0.0	3.4	75.8	79.0
B3	298.0	0.0	36.7	0.0	0.0	0.0	0.0	36.7	38.4	71.9
B4	506.7	0.0	50.1	0.0	0.0	0.0	16.3	66.4	27.1	85.0
B5	875.0	0.0	16.0	0.0	0.0	0.0	0.0	16.0	6.9	22.9
B6	1247.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F1	1704.2	1.2	31.6	29.5	6.0	1.3	0.0	69.7	10.6	79.8
F2	1005.5	1.7	43.2	19.6	3.5	0.1	0.0	68.1	15.5	83.0
F3	305.7	0.0	43.1	20.0	0.0	0.0	0.0	63.1	18.4	79.7
F4	169.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.7	60.7
F5	1236.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.6	15.6
F6	1213.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
M1	109.1	0.0	7.1	1.3	19.0	0.0	0.0	27.3	59.2	85.1
M2	127.3	0.0	35.9	0.0	3.0	0.0	0.0	38.9	41.2	79.0
M3	126.4	0.0	43.0	0.0	0.0	0.0	0.0	43.0	38.5	79.2
M4	111.5	0.0	56.2	0.0	0.0	0.0	0.0	56.2	43.8	94.8
M5	210.9	0.0	18.1	0.0	0.0	0.0	0.0	18.1	60.0	76.8
M6	217.2	0.0	37.7	0.0	0.0	0.0	0.0	37.7	32.0	68.2
M7	110.1	0.0	54.8	0.0	0.0	0.0	16.2	71.0	26.0	95.6
M8	532.7	0.0	4.3	0.0	0.0	0.0	0.0	4.3	1.5	5.7

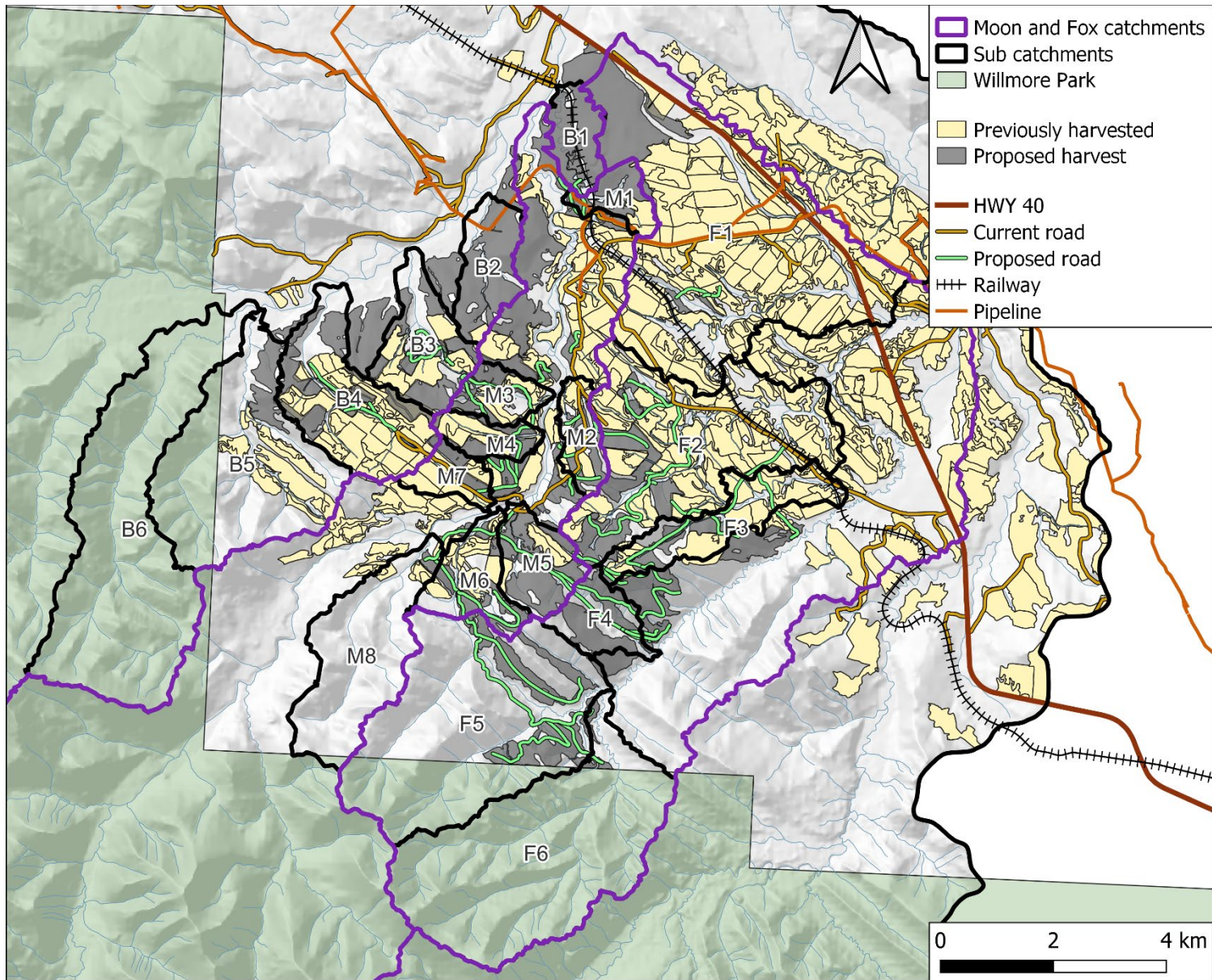


Figure 5. Existing and proposed cut blocks within the Moon Creek harvest plan area

The proposed Moon Creek harvest plan covers two compartments (3 & 16) within the 2014 DFMP and collectively makes up an area of 23.7 km² that overlaps three watersheds.

- Within the Berland River watershed, north of the Moon Creek watershed and south of the Berland River, harvest is proposed in small sub-basins with unnamed tributaries that flow directly into the Berland River. This area makes up 33.3% of the total proposed harvest area, but only 1% of the Upper Berland watershed excluding the Little Berland.
- Within the Moon Creek watershed, the proposed timber harvest makes up 30.7% of the total proposed harvest and 6.5% of the Moon Creek watershed area (**Table 2**).
- Within the Fox Creek watershed, the proposed timber harvest makes up 36.0% of the total proposed harvest and 10.8% of the Fox Creek watershed area (**Table 2**).

Accounting for small amounts of overlap in proposed harvest with areas previously harvested, if the proposed harvest proceeds, the percentage of the overall Moon and Fox creek watershed areas that will have been harvested will increase from 8.6 to 14.8% and 35.7 to 46.3%, respectively (**Table 2**). The average percentage of the area of 20 tributary sub-basins draining to the Berland River and Fox and Moon creeks that will be harvested will increase from 20% to 57%, 33% to 53%, and 37% to 70%, respectively (**Table 2**).

8. Fisheries Resources

Only five fish species are recorded in the GoA Fisheries and Wildlife Management Information System (FWMIS) in the Berland River upstream of and including Moon and Fox creeks. These are ARTR, BLTR, Mountain Whitefish (*Prosopium williamsoni*, MNWH), Burbot (*Lota lota*, BURB), and Spoonhead Sculpin (*Cottus ricei*, SPSC) (FWIMT 2023).

8.1 Athabasca Rainbow Trout

ARTR is a small salmonid, native to small streams and rivers of the upper Athabasca watershed, in the Upper Foothills Natural Sub-region in west-central Alberta. It requires clear, cold flowing water to survive and primarily occupies small headwater watersheds. ARTR populations exhibit both stream-resident and river-migrant life history strategies and are predominantly found in 2nd to 5th order streams and small rivers (**Figure 6**).

ARTR spawn from late-May to early-June, like the non-native Rainbow Trout (*Oncorhynchus mykiss*, RNTR) that were introduced to the Athabasca watershed. Typically, spawning occurs on the descending limb of the snow-melt hydrograph (Sterling 1980). Hybridization is a risk factor facing ARTR, although populations in the headwaters of the Berland River have retained a high level of genetic purity. Most ARTR spawn and rear in 2nd to 4th order streams (Sterling 1980). Some 1st order streams can also support ARTR when and where flows and channel gradient create suitable habitat. Egg incubation occurs rapidly with fry emerging during the summer. The small size of ARTR relative to larger migratory fluvial BLTR, which also occur in the Berland watershed, necessitates finer gravel on smaller streams for spawning. This could include tributaries within the Moon Creek harvest plan.

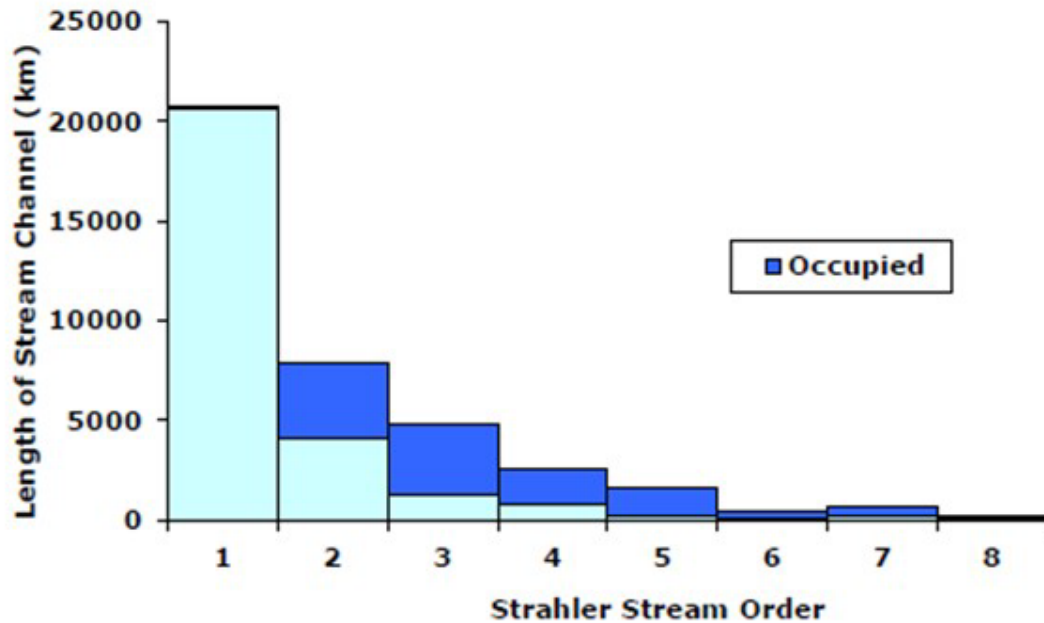


Figure 6. Relative proportions of stream orders occupied by ARTR (from AARTRT 2014)

ARTR males can mature at age 3 while females can mature at age 4. Males and females can commonly live to 8 years old. Relative to migratory BLTR, which are longer lived and can access alternative spawning habitat when local habitat degradation prevents spawning in one stream, ARTR are shorter lived and do not migrate as far, making the species more susceptible to localized habitat impacts resulting from land use.

The overall population of ARTR is small, the area occupied is small, there are declines in the number of mature individuals, and habitat loss and degradation are ongoing (DFO 2020a). Overall risk factors facing ARTR populations include hybridization with non-native RNTR, competition and displacement by Brook Trout (BKTR), and changes in water quantity and quality as well as habitat degradation related to industrial development and climate change. BKTR are absent from the Berland River watershed near Moon Creek (FWMIS 2023), and the risk of hybridization with non-native Rainbow Trout in the area is also low (AWA comm. with Ryan Cox). Therefore, in the Berland watershed, habitat is the main factor limiting the ARTR population. Although densities are lower than what historical densities indicate the available habitat should be able to support, habitat requirements and limitations as well as the level of habitat degradation that has already occurred remain unclear (COSEWIC 2014).

Of the 15 Hydrologic Unit Code level 8 (HUC8) watersheds within ARTR range, the Berland and Wildhay HUC8s have the most genetically pure sampling sites and the least historical stocking of non-native RNTR (AEP 2015). These factors support the Berland watershed being one of AEP's top priority watersheds to remediate habitat fragmentation caused by culverts (AWA comm. with Ryan Cox, pers. comm.).

Electrofishing at an index site at the mouth of Moon Creek near the Berland River has showed a decline in terms of number of ARTR caught over 6 years of sampling (1986, 1997, 1998, 2001, 2008, and 2017, **Figure 7**).

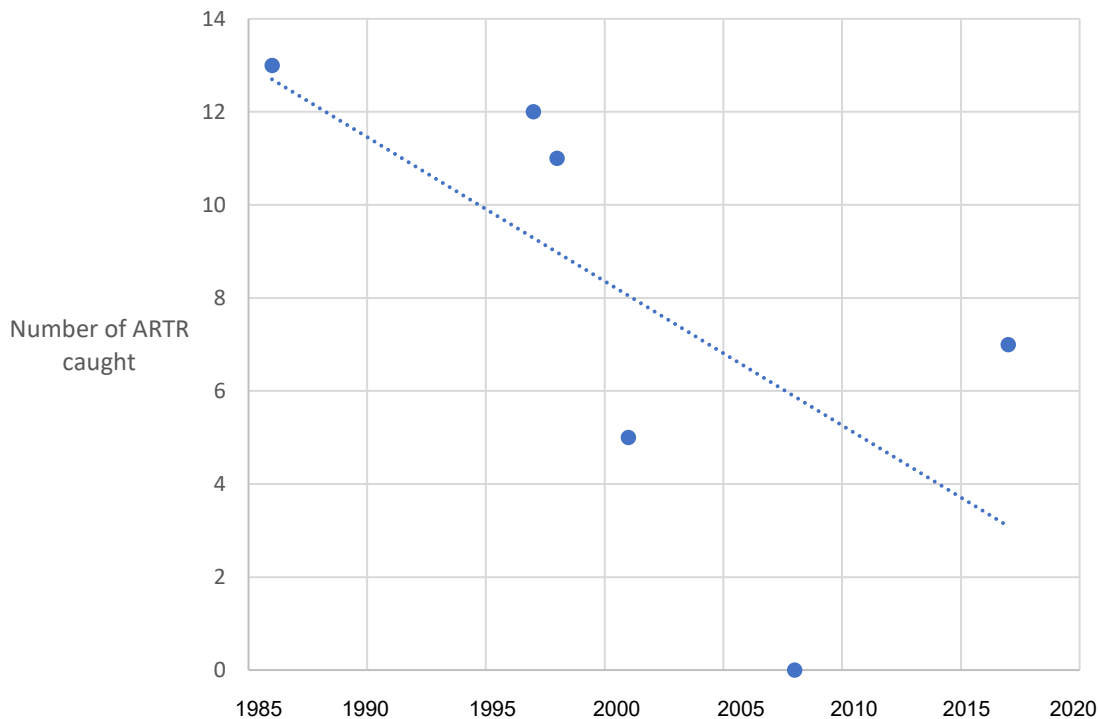


Figure 7. Trend in ARTR electrofishing catch (300 m Moon Creek index site near Berland River)

8.2 Bull Trout

BLTR also require clear, cold flowing water to survive and have resident, fluvial, and adfluvial life histories, although only the fluvial life history has been confirmed in the Berland watershed. BLTR spawn during low flow periods in the fall, starting in late August or early September and continuing until mid-October. Egg incubation occurs more slowly over the winter than for ARTR and fry emerge early the following spring. Clean gravel that is free of sediment is also important for BLTR spawning. Stream-resident forms require smaller substrate size, while larger fluvial and adfluvial Bull Trout can spawn in larger substrate, however, only fluvial BLTR have been documented in the Berland River watershed (AEP 2020).

BLTR face similar risk factors as ARTR populations in terms of hybridization and displacement and changes in water quantity and quality and habitat degradation related to industrial development and climate change. BLTR are much more migratory than ARTR and the Berland River BLTR population supports a migratory population, so trends in BLTR catch at the same index site at the mouth of Moon Creek near the Berland River may not be as representative of the broader population. The Alberta Bull Trout Conservation Management Plan (2012-2017) lists Berland watershed BLTR population as showing short-term trends of decline (ASRD 2012).

9. Predicted Fish Distribution

Research conducted in the headwaters of the Athabasca River developed models to predict BLTR and ARTR occurrence in small Rocky Mountain foothill streams, that were intended to be used for planning forestry activities (McCleary and Hassan 2008). Data from large-scale fish inventories in subwatersheds throughout the region were used to develop and validate the models. Watershed characteristics (e.g., basin area upstream of each reach, basin slope, reach elevation, and reach slope) were evaluated as predictor variables, and the most parsimonious

models explaining species occurrence were selected to estimate the probability of BLTR and ARTR occurrence for all stream reaches throughout the region.

Moon Creek was one of the watersheds where fish inventory work was conducted, and BLTR and ARTR model results were produced (McCleary and Hassan 2008). These results were made available to AWA through a data sharing agreement with the Foothills Research Institute (fRI). The results show that the probability of BLTR and ARTR occurring in tributaries decreases with distance upstream from the mainstem streams (**Figure 8**). The modelling assumed the mainstem reaches of the Berland River, Moon Creek, and Fox Creek (5th and 6th order streams) have 100% probability of these two species occurring. Within the harvest plan area, the lower reaches of some tributaries have probabilities of BLTR and ARTR occurring that are >50% or in the range of 25-50%. These tributaries may be most likely impacted by the harvest plan. Although the FMA DFMP commits to using fRI fish habitat modelling (**Figure 8**) in forest harvest planning, it is not clear if and how West Fraser has specifically incorporated this information into the Moon Creek harvest plan lay out.

Most of the stream reaches within the harvest plan are 1st order streams and have low (i.e., <10%) probability of BLTR and ARTR occurring (**Figure 9**). Other than the mainstem streams, 2nd and 3rd order tributaries have the highest number of stream reaches where the models predicted the probability of BLTR and ARTR occurring as ≥50% (**Figure 9**). In these tributaries, seasonal BLTR and ARTR occupancy is more likely, especially closer to the mainstems where gradients are lower and flows higher and more stable.

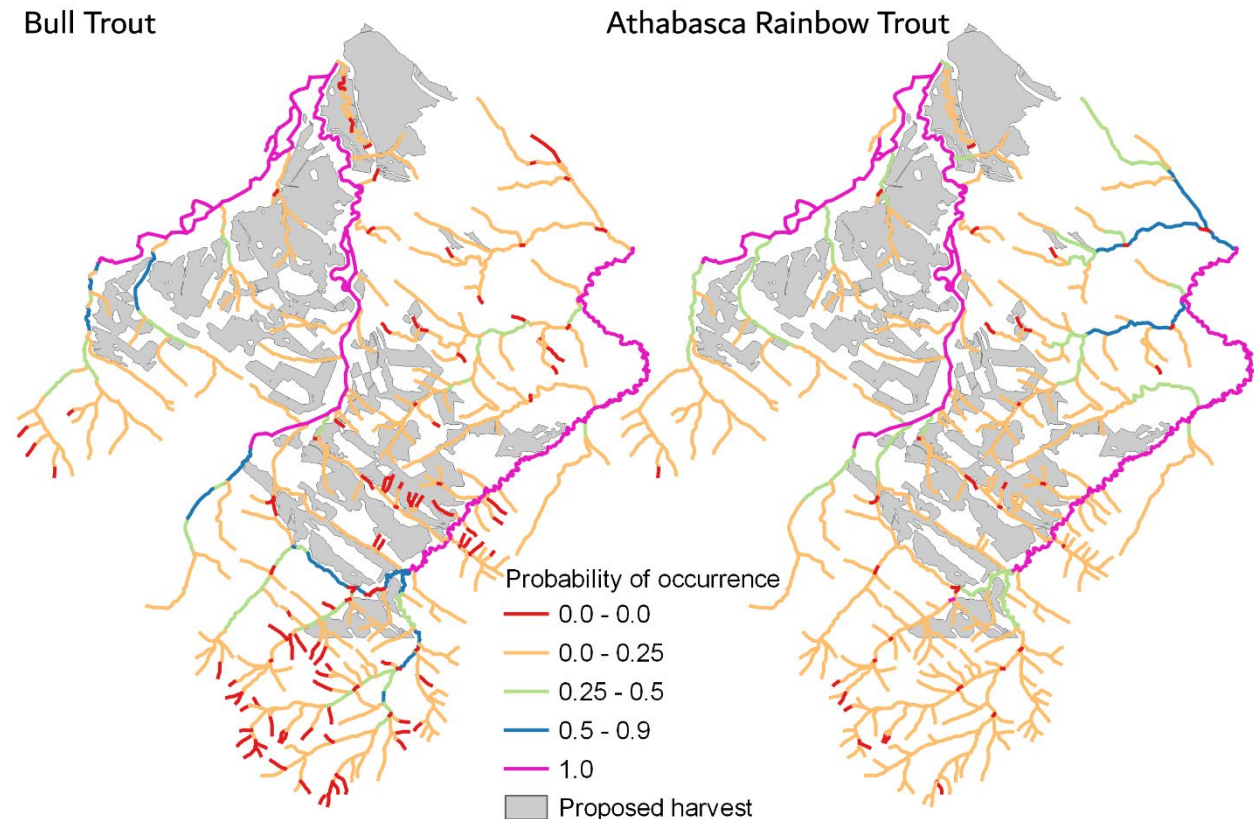


Figure 8. Modelled probabilities of native trout occurrence within Moon Creek harvest plan area; from McCleary and Hassan (2008); only reaches adjacent to the proposed harvest are mapped

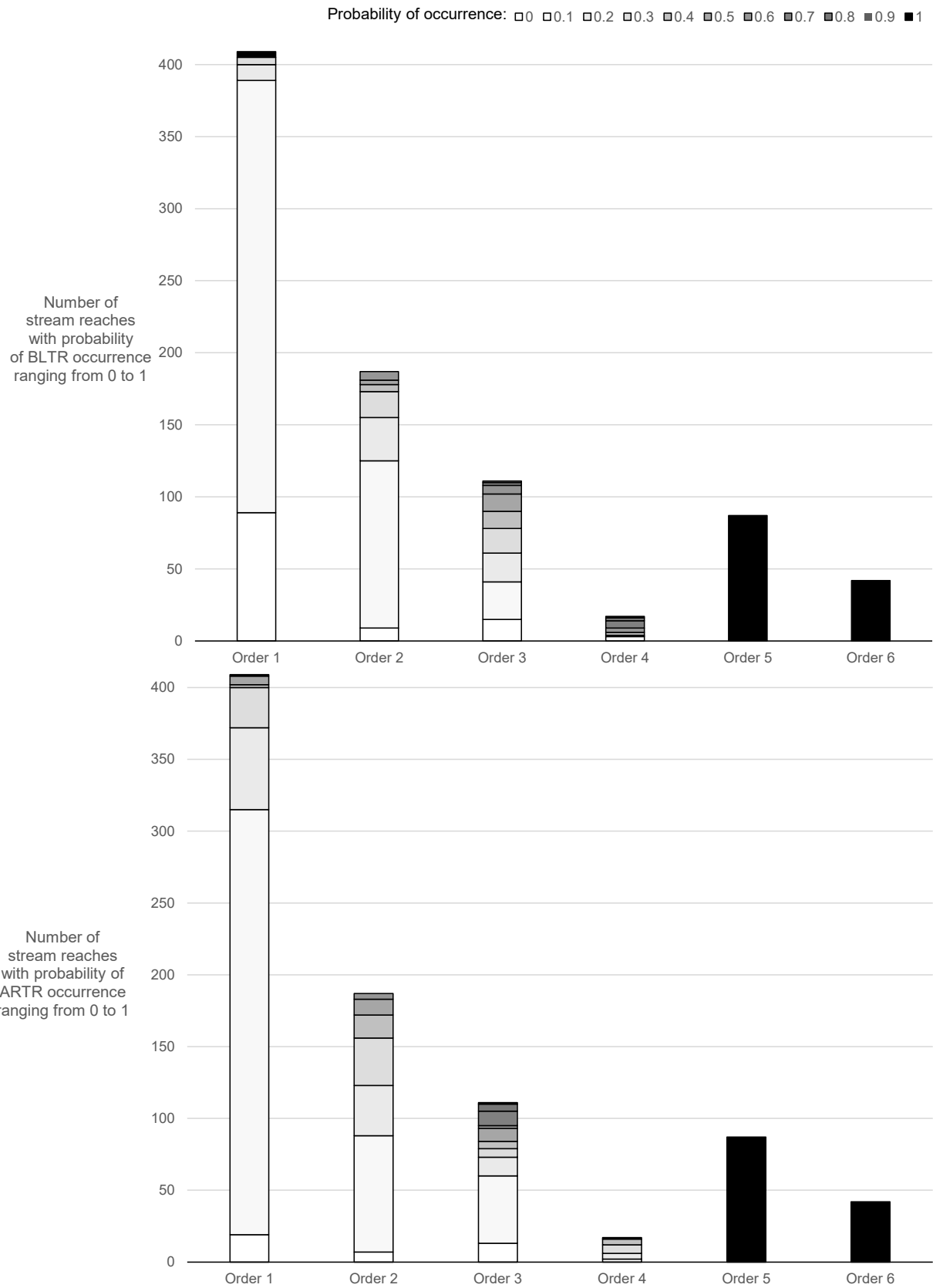


Figure 9. Number of Order 1-6 reaches with probability of BLTR & ARTR occurrence from 0-1

10. Known fish distribution

BLTR and ARTR occur in the mainstem Berland River, Moon Creek, and Fox Creek throughout the harvest plan area (FWMIS 2023). In the Berland River and Moon Creek both species extend upstream of the WWP boundary. On Fox Creek, available records show ARTR have been caught as far upstream as just above the CN Railway crossing (FWMIS 2023), approximately 1 km downstream from the furthest downstream extent of the proposed timber harvest within this watershed. The Fox Creek channel gradient (McCleary and Hassan 2008) and size (FWMIS 2023) suggest there are no habitat features that would limit ARTR from occurring in Fox Creek upstream to the WWP boundary, where proposed cut blocks are laid out at the confluence of the tributaries that come together and form Fox Creek.

One example of tributary occupancy just beyond the extent of the mapped Moon Creek harvest plan area includes a 4th order tributary to the Little Berland River (Broad Creek), where ARTR were captured in a reach where the gradient was 3.5%. On another 2nd order tributary to Moon Creek upstream of the proposed harvest plan area, BLTR were captured above a reach where the gradient was 4.4%.

Electrofishing has occurred on three tributaries in the Moon Creek harvest plan (**Figure 10**, one site on a Berland River tributary, two on a Moon Creek tributary, one on a Fox Creek tributary).

Only the two sites on the 2nd order Moon Creek tributary resulted in fish capture. One of these sites was 300 m long and immediately upstream from the confluence with Moon Creek, the other was 150 m long and over 2 km upstream from Moon Creek. In 1997, 1 MNWH, 4 ARTR, and 11 BLTR were captured at the lower site. In 1998, 3 BLTR and 1 ARTR were also captured at this site. The lower site is approximately 200 m downstream from the boundary of the nearest proposed cut block and 400 m downstream from a proposed culvert crossing on an ephemeral draw (not a mapped stream) that drains into the tributary upstream of where the fish were caught.

The upper Moon Creek 2nd order tributary site is over 1.5 km upstream from the proposed cut block near the lower site. One BLTR was electrofished at this site in 1997 and two BLTR in 1998. While this suggests fish can occur a considerable distance upstream from the mainstem streams within the Moon Creek harvest plan, results from this one tributary may or may not be representative of other tributaries that have not been sampled within the area. The three sites on other tributaries did not result in fish capture, suggesting fish distribution is somewhat limited.

11. SARA Designation of Critical Habitat

Critical habitat is defined in SARA as "...the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species." [subsection 2(1)]. Also, SARA defines habitat for aquatic species as "... spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced." [subsection 2(1)]

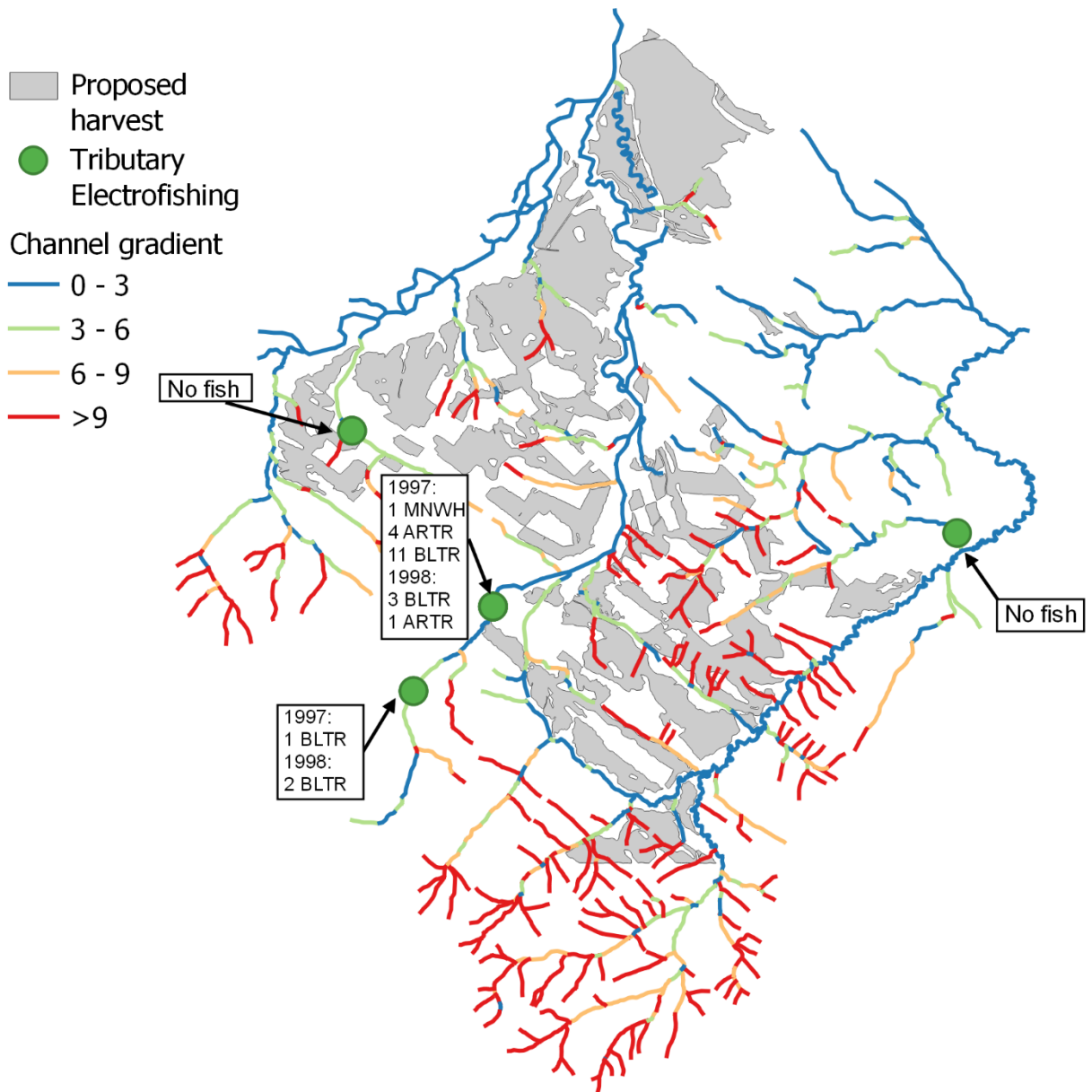


Figure 10. Electrofishing sites and catch on tributaries within Moon Creek harvest plan; stream network not mapped beyond furthest upstream tributaries flowing adjacent to proposed harvest

Critical Habitat under SARA is only listed for Threatened or Endangered species, and therefore for ARTR, and not BLTR, in the Athabasca River drainage. In 2020, Fisheries and Oceans Canada (DFO) prepared a “Recovery Strategy for the Rainbow Trout (*Oncorhynchus mykiss*) in Canada (Athabasca River populations)”, which specifically defined ARTR Critical Habitat for designation under SARA (DFO 2020a).

In designating reaches of stream as Critical Habitat, the ARTR Recovery Strategy largely deferred to the Provincial recovery plan (AARTRT 2014) definition of the reaches as Ecologically Significant Habitat (ESH). Alberta defined ESH in terms of the genetic integrity of ARTR populations using a stringent limitation on hybridization with non-native RNTR. Only streams where ARTR were determined to have an average admixture coefficient of ≥ 0.99 were identified

as ESH, although some additional areas where the coefficient was ≥ 0.95 were also included if there was a potential to recover a genetically pure population of ARTR in these areas.

Overall, instream ARTR Critical Habitat is made up of reaches of stream occupied by pure-strain populations (e.g., the mainstems of Moon and Fox creeks), reaches with the potential for ARTR to be re-introduced and recovered, as well as areas upstream that provide direct and indirect habitat and areas downstream that have habitat features for spawning or overwintering.

Within the Moon Creek harvest plan area, all streams draining Moon and Fox creeks are ARTR Critical Habitat, while tributaries to the Berland River are not Critical Habitat (**Figure 11**).

12. SARA Riparian Critical Habitat

As is the case for all other SARA-listed native trout in Alberta, the ARTR Recovery Strategy included riparian areas in the definition of Critical Habitat, recognizing that these areas define and maintain channel configuration, instream habitat structure, and aquatic health necessary to support the survival and recovery of ARTR. Large woody debris is specifically included in the ARTR Recovery Strategy as a Critical Habitat feature linked to riparian areas. Other riparian features that are not specifically listed within the Critical Habitat definition section of the Recovery Strategy, but are referenced elsewhere in the document, include areas of groundwater input through groundwater recharge, hyporheic flow, and beaver ponds.

The ARTR Recovery Strategy (DFO 2020a) describes the approach to defining riparian Critical Habitat as a “reasonable and precautionary approach”. It defines it as extending 30 m from the high-water mark as well as groundwater recharge areas up to 100 m from the stream. However, groundwater recharge areas are not defined, and since groundwater recharge occurs everywhere throughout a watershed, this protection measure may be difficult to implement.

Some of the proposed roads and cut blocks overlap with mapped ARTR Critical Habitat and no buffer on the habitat is apparent (**Figure 11**).

If all Critical Habitat streams were classified as “transitional”, according to Table 3 of the 2018 Hinton Wood Products OGRs, they would at least require a 10 m buffer. However, there are areas where the proposed cut blocks do not appear to have any buffer around mapped ARTR Critical Habitat (**Figure 11**).

The West Fraser FHP (**Figure 1**) has used the “intermittent” stream classification category for all tributaries within the proposed harvest plan area, and the OGRs specify a buffer of undisturbed brush and lesser vegetation on these streams, but the width of this buffer is not specified.

Even if the less protective “ephemeral” stream classification category was applied to mapped ARTR Critical Habitat, the OGRs still specify no disturbance of hydrophytic vegetation, but there is no such protection shown on the FHP map (**Figure 1**).

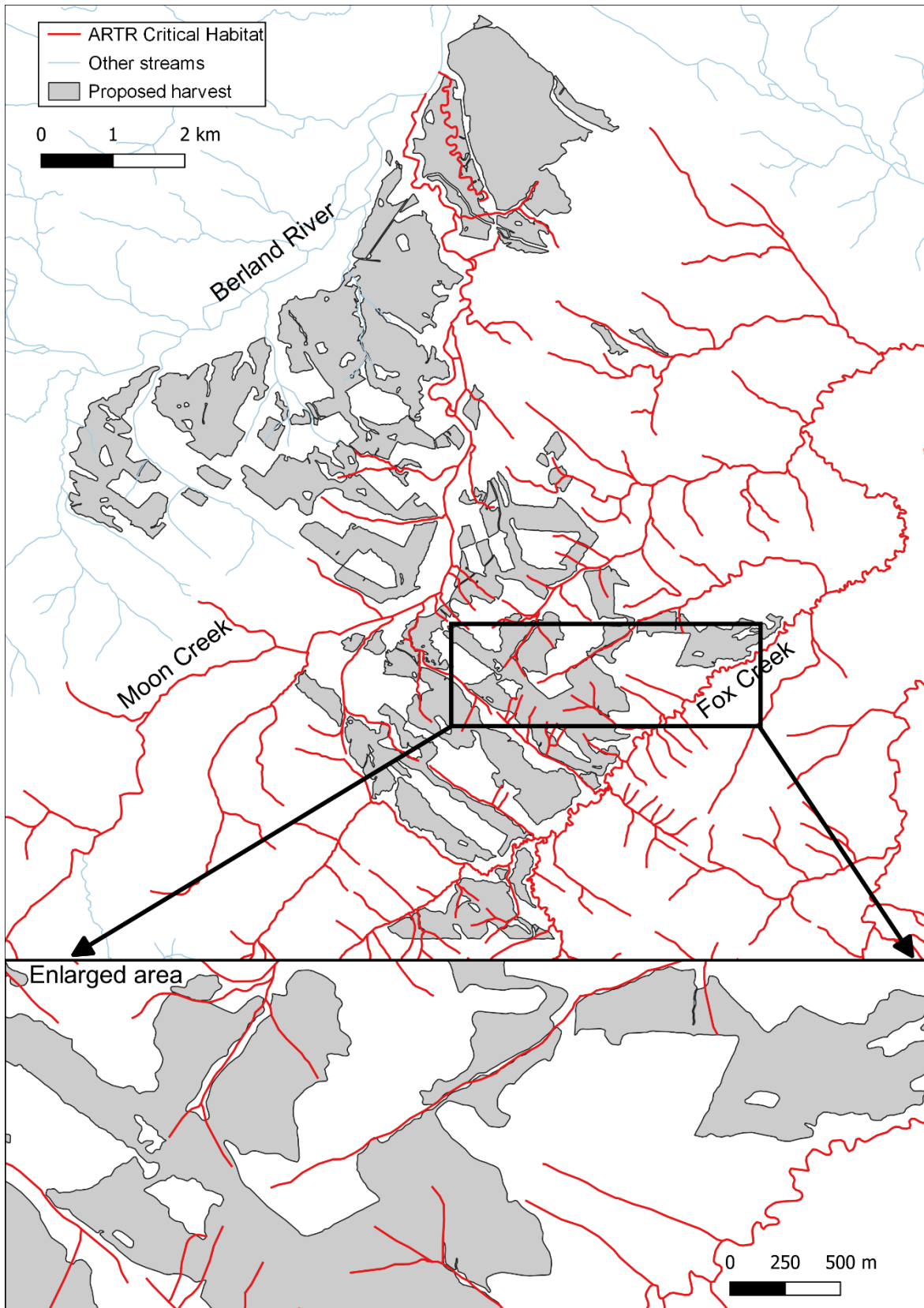


Figure 11. ARTR Critical Habitat with enlarged area illustrating overlap with proposed cut blocks

13. Harvest Overlap with Predicted Riparian Areas

Using the GoA Wet Area Mapping (WAM) layers, which provide depth to groundwater estimates based on airborne light detection and ranging (LIDAR) data, a risk assessment of the overlap of the harvest plan with wet areas was completed (**Figure 12**). Groundwater areas most vulnerable to mechanized timber harvest were considered as the shallowest depth profiles (i.e., <0.25 m), and wet areas where groundwater was predicted to be >0.25 m deep were not considered.

Significant amounts of the proposed harvest area overlap shallow groundwater, with sub-basins with the greatest overlap of cut blocks and roads being B1, B2, M1, F3, and F4 (**Figure 12**). Additional areas of overlap also exist along the mainstem streams. Wet areas may not freeze in the winter and rutting could disturb groundwater, impacting stream flows. Almost all cut blocks overlap at least some areas mapped with the WAM layer. West Fraser may or may not have completed field surveys during melt, heavy precipitation, and run off to demonstrate that these areas are not groundwater recharge areas. Otherwise, these areas may have appeared dry during lay-out and could still be important for sustaining flows and appropriate temperatures for ARTR.

When reviewing locations of overlap with LIDAR-predicted wet areas, keep in mind that Table 2 of the 2018 Hinton Wood Products OGRs requires hydrophytic vegetation within 500 m upstream of Class B waterbodies to be left undisturbed. The interpretation of this rule is that it applies for a distance of 500 m along the length of tributaries to Class B streams rather than a buffer of 500 m on either side of the streams. It is assumed to only apply to areas overlapping where a stream is mapped and not any adjacent riparian areas. Therefore, the SARA-defined ARTR riparian Critical Habitat protecting groundwater recharge areas up to 100 m from the high-water mark adds a higher level of protection, if it is implemented and enforced.

14. Protection beyond 30 m from streams

The 30 m SARA-defined ARTR riparian Critical Habitat buffer width is narrower than any of the four options proposed in a review that an Alberta technical science committee prepared for DFO (AEP 2018a). Although it was labeled as a WSCT review, broadly applicable literature was reviewed not specific to WSCT. Habitat requirements for WSCT and ARTR are similar, so the review's findings are relevant to ARTR. The four options considered in the review in 2018 were:

- Option 1 – 100 m fixed width proposed by DFO
- Option 2 – fixed widths defined under current policy (i.e., OGRs)
- Option 3 – 100 m bounding box
- Option 4 – blended 30 m fixed width plus additional bounding box protection of 100 m

DFO Science, DFO Species at Risk, and Parks Canada Agency's recommendations to Alberta in November 2017 were that 100 m was an appropriate precautionary distance to use given the literature Alberta had reviewed indicating nutrients and fine sediment could be transported through treed riparian buffers up to, and in some cases, beyond this distance (Cooper *et al.* 1987, Lowrance *et al.*, 1988, Castelle *et al.* 1994, Mayer *et al.* 2006, Clinton 2011, Sweeny and Newbold 2014). In contrast, the ARTR Recovery Strategy (DFO 2020a) does not reference literature indicating the broad range of functions that riparian Critical Habitat provides will be protected by a 30 m buffer.

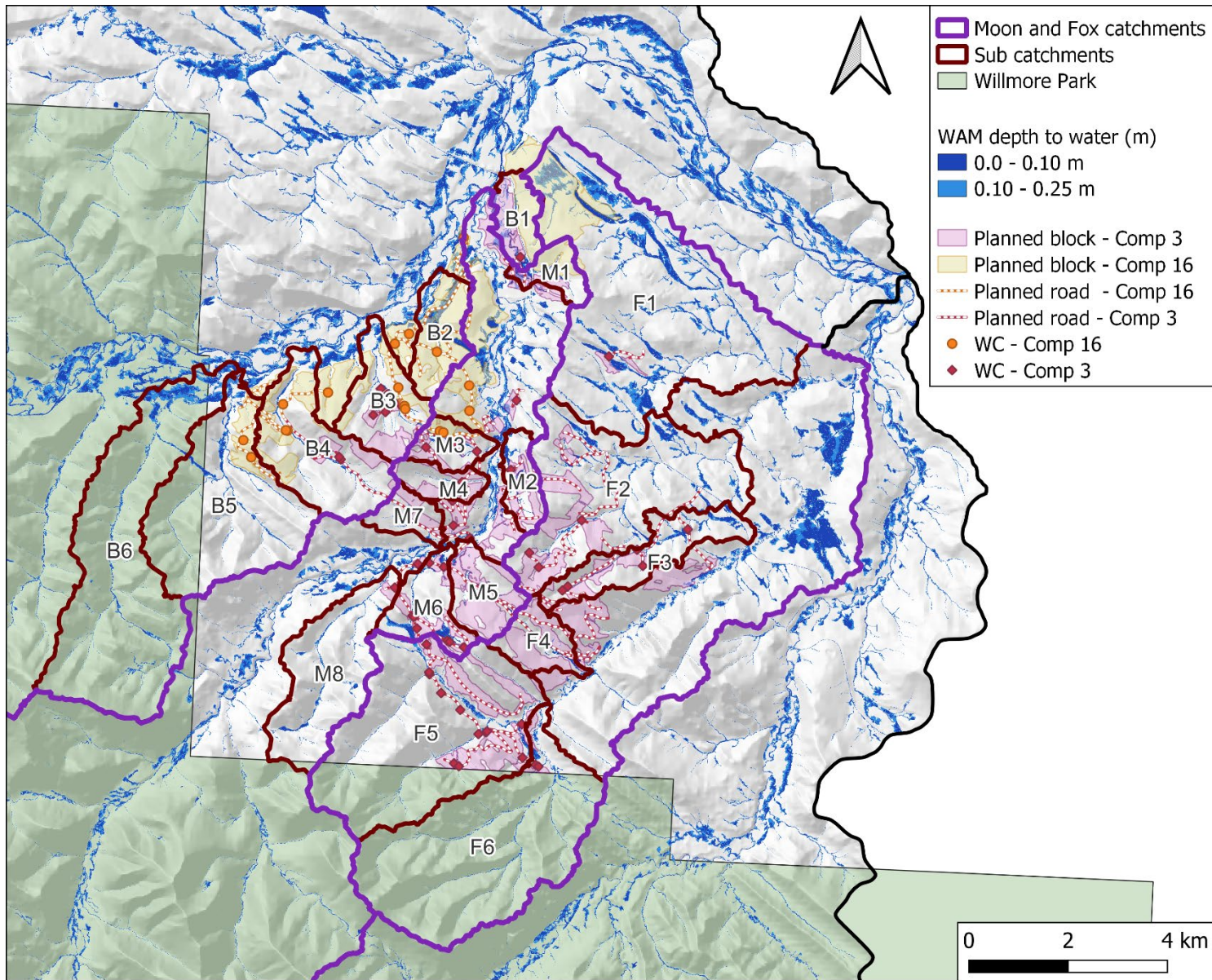


Figure 12. Proposed cut blocks and roads showing overlap with WAM-predicted shallow groundwater (<0.25 m deep)

Other literature not considered by Alberta's technical science committee in 2018, such as Swift and Norton (1993), shows only a 50% reduction in the suspended sediment load across buffer widths of 60-70 m on vegetated mineral soils. This research also shows attenuation efficiency is reduced where slopes exceed 7%, which likely occur throughout the riparian buffers within the Moon Creek harvest plan.

A recent modelling exercise examining sediment and nutrient loading to streams at the watershed scale using an integrated Riparian Ecosystem Management Model and Soil and Water Assessment Tool found in the sensitivity analysis that the reducing effects on loadings of riparian buffers did not plateau until the riparian buffer width reached 200 m (Zhang et al. 2017).

Furthermore, riparian groundwater inputs are known to play a key role in contributing to native trout habitat (Larsen and Woelfle-Erskine 2018, Dugdale et al. 2013, Borwick et al. 2006, Boulton and Hancock 2006, Power et al. 1999, Biro 1998).

Although the ARTR Recovery Strategy states that Critical Habitat tends to be confined to 2nd to 4th order streams, it acknowledges that larger 1st order channels can directly or indirectly support Critical Habitat (DFO 2020a). This is assumed to be why all reaches of stream upstream of the Alberta Recovery Plan ESH reaches, up to and including 1st order streams, are mapped by DFO as ARTR Critical Habitat within the Moon and Fox creek watersheds (**Figure 11**).

The Recovery Strategy also states that streams greater than 4th order lack spawning substrate small enough for ARTR to use but can be important overwintering habitat (DFO 2020a). Given that the Berland River is a 6th order stream, and Moon and Fox creeks are 5th order, this suggests that smaller tributaries within the harvest plan area may be used for spawning. Although these streams may only provide suitable fluvial spawning habitat in short reaches near the mainstem streams, these short reaches of stream could be impacted by hydrologic changes resulting from timber harvest in the broader sub-basin of each tributary.

15. Harvest Overlap with Predicted Riparian Areas

In addition to proposed harvest overlapping LIDAR-predicted WAM areas, the amount of proposed cut blocks and roads within the lotic riparian area, as defined using a DEM-predicted layer available from the GoA was also reviewed (**Table 3**). Widespread overlap of roads and cut blocks with the predicted riparian areas is apparent throughout the Moon Creek harvest plan (**Figure 13**). Roads can be seen paralleling tributaries within the riparian area, instead of crossing the area once, to minimize disturbance (e.g., B4, M7, M5, M3, and F4 subwatersheds). An area near the confluence of Moon Creek with the Berland River has the most overlap in terms of cut blocks. This includes subwatersheds B1 and M1 as well as B2 and adjacent areas along the Berland River and Moon Creek. There is also considerable overlap of roads and cut blocks with the riparian area layer in subwatersheds M2 and M5 and small first order tributaries draining directly to Moon Creek. In the headwaters of Fox Creek in subwatershed F5, there is also considerable overlap. Other areas of overlap within the Fox Creek drainage also exist (e.g., sub-basins F1 and F2).

Currently, there are 2.1 and 3.9 km of roads within the predicted riparian areas in the Moon and Fox creek watersheds, respectively (**Table 3**). This will increase by 4.1 and 5.5 km in Moon and Fox creek watersheds, respectively, if the proposed harvest plan proceeds (**Table 3, Figure 13**).

Table 3. Current and proposed road length and disturbed area within predicted riparian areas

Tributary basin	Current road length (km)	Additional road length planned (km)	Current disturbed area (ha)	Additional disturbed area (ha)
Moon Creek	2.1	4.1	157.9	92.0
Fox Creek	3.9	5.5	333.0	83.8
B1	0.0	0.4	0.0	48.7
B2	0.0	0.6	0.0	30.3
B3	0.0	0.9	9.0	5.6
B4	1.0	2.2	37.1	6.9
B5	0.0	0.1	15.5	4.0
B6	0.0	0.0	0.0	0.0
F1	1.8	0.1	140.2	11.0
F2	0.9	1.7	129.7	19.7
F3	0.4	1.0	36.0	8.6
F4	0.0	1.5	0.0	12.7
F5	0.0	1.0	0.0	20.5
F6	0.0	0.0	0.0	1.3
M1	0.0	0.8	3.7	15.8
M2	0.0	0.2	7.7	4.5
M3	0.0	0.8	9.8	3.7
M4	0.0	0.1	9.2	0.5
M5	0.3	1.1	1.8	15.5
M6	0.0	0.3	12.4	7.2
M7	0.6	0.6	13.0	1.3
M8	0.0	0.0	0.3	0.0

In the 20 sub-basins the length of road within predicted riparian areas currently ranges from 0 km in many sub-basins to 1.8 km in the F1 Fox Creek sub-basin (**Table 3**). This will increase by as little as 0.008 km in the Fox Creek F6 sub-basin, and as much as 2.2 km in the B4 Berland River sub-basin (**Table 3, Figure 13**).

Currently, 157.9 and 333.0 ha of predicted riparian area is disturbed by roads or cut blocks in the Moon and Fox creek watersheds, respectively (**Table 3**). This will increase by 92.0 and 83.8 ha, respectively, if the proposed harvest plan proceeds (**Table 3, Figure 13**). Within the 20 sub-basins, the average increase in area disturbed by roads or cut blocks that are part of the proposed harvest plan is 10.9 ha per sub-basin (**Table 3**).

Some parts of the Moon Creek harvest plan have more roads, cut blocks, or both overlapping the predicted riparian area than others. The DEM-derived lotic riparian area layer is not a regulatory tool. However, the precautionary approach is apparently being applied in the design of the Moon Creek harvest plan to avoid impacts to ARTR riparian Critical Habitat.

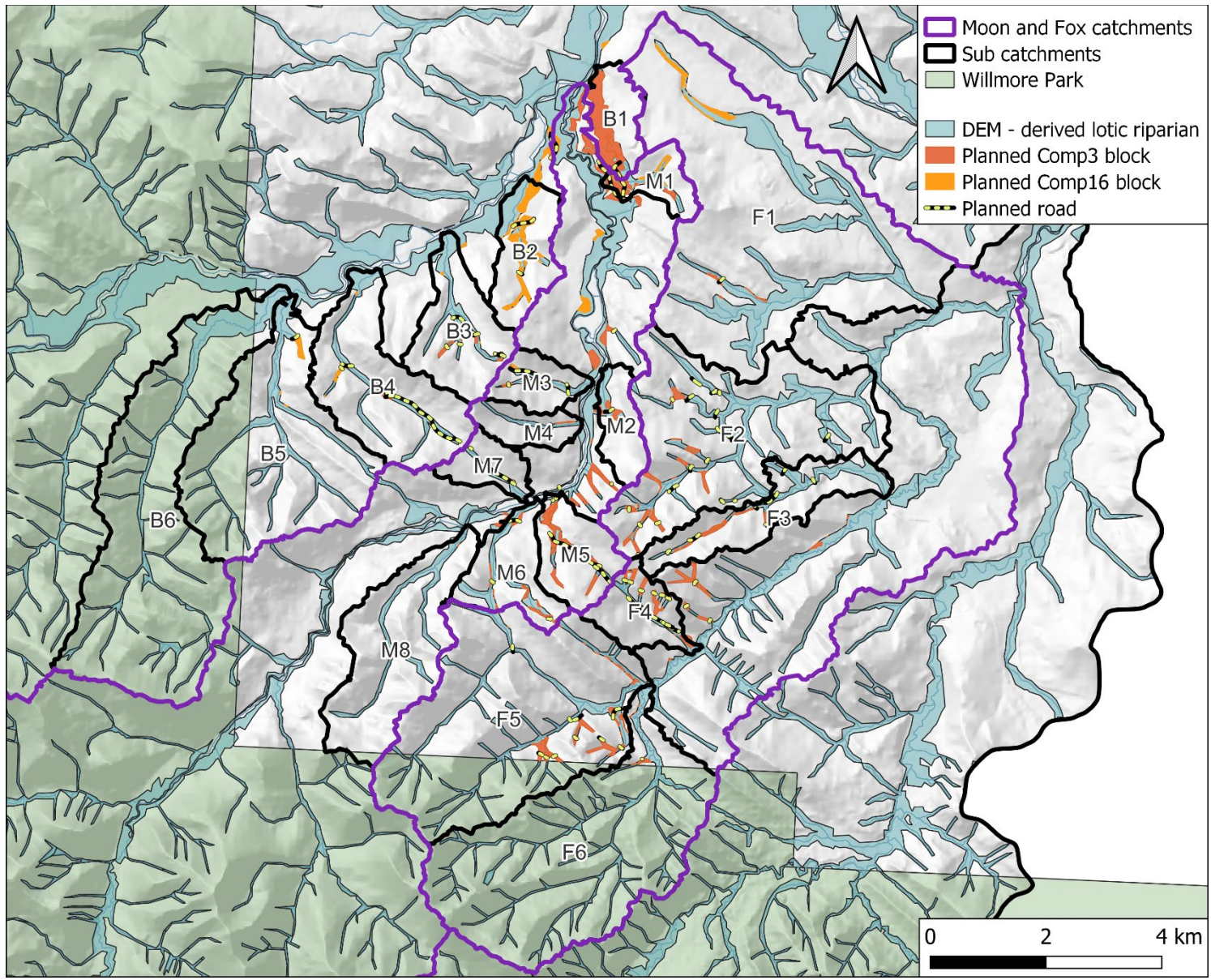


Figure 13. Proposed cut blocks and roads within riparian areas derived from a DEM

The OGRs state that “the primary strategy for maintenance and protection of the aquatic environment and fish habitat values is to maintain treed buffers along watercourses and water bodies and adopt rigorous watercourse crossing and erosion control measures.”

Both FMA-specific and provincial standard OGRs exist. Given that AFPT directed West Fraser to develop the Moon Creek harvest plan in June 2018 and West Fraser confirmed in their February 3, 2022, letter to stakeholders that they started developing the harvest plan in 2018, the FMA-specific 2018 Hinton Wood Products OGRs are the most applicable version of the OGRs that apply to the Moon Creek harvest plan.

According to these OGRs, riparian protection areas are required to be based on the watercourse classifications outlined in Table 2 and the Standards and Guidelines for Operating beside Watercourses in Table 3 (AAF 2018). Section 6.3 of these OGRs says that “where uncertainty exists on the classification of the watercourse, the watercourse protection area shall be that required by the higher class of watercourse”.

Most native trout streams in Alberta are classified as Class A or B under the *Water Act* Code of Practice. The 2018 OGRs define Class B streams as “key broadly distributed habitat areas important to the continued viability of a population of locally or regionally important fish species.”

The waterbody classifications in Table 2 of the Hinton Wood Products 2018 OGRs includes Class B Waterbodies and describes the mapping designation as “Solid (Variable Colour) lines overlain by small circles on Watercourse Crossing Codes of Practice (*Water Act*)”. These can be found in the maps in Schedule 5 of the *Water Act* (**Figure 14**), and form part of the *Water Act* Code of Practice according to Section 8(1).

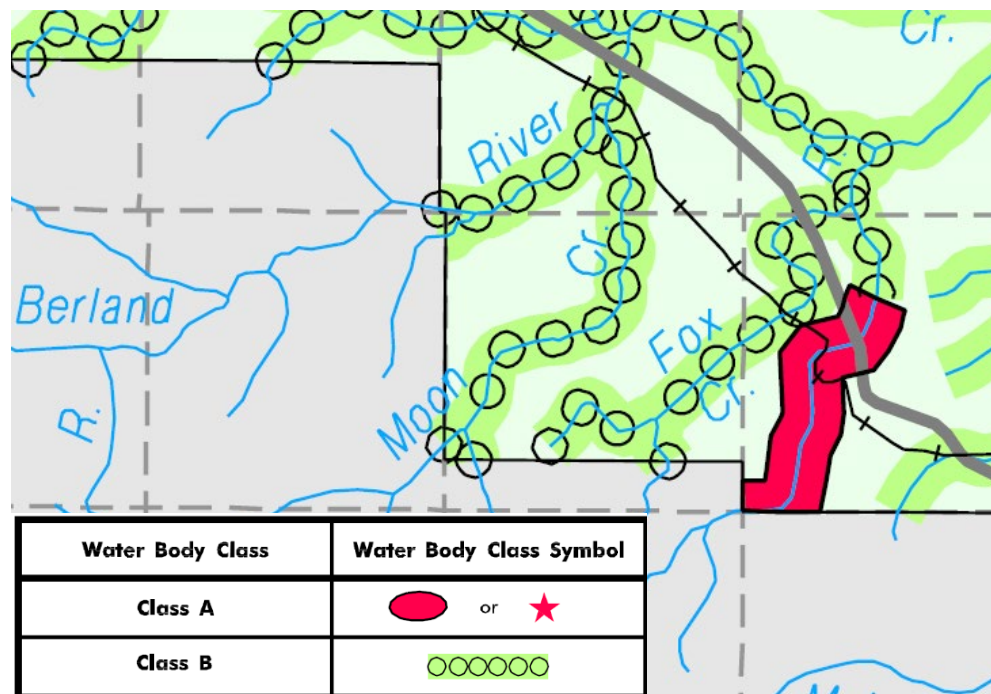


Figure 14. Water Act Code of Practice map for the Edson Management Area (November 2006).

The Standards and Guidelines for Operating beside Waterbodies (Table 3 of the Hinton Wood Products 2018 OGRs) specify that “Roads, Decking and Bared Areas” are “not permitted within 60 m of high water mark. Any existing roads may be maintained at present classification standards.”

The *Water Act* Codes of Practice (CoP) defines a water body as having a stream with discernible banks and a bed lacking terrestrial vegetation (Section 1(2)). The CoP also states that the portion of the unmapped water bodies (i.e., not shown on the Schedule 5 map, **Figure 14**) entering mapped water bodies within 2 km upstream from the mouth have the same watercourse classification as the mapped water bodies (Section 8(4)(b)(i)). Here it specifies that this applies even if the unmapped water body is dry or frozen.

The Berland River, Moon Creek, and Fox Creek are all mapped Class B water bodies under the *Water Act* CoP. However, West Fraser has classified all the tributaries to these streams within the Moon Creek harvest plan as “intermittent” streams (**Figure 1**) even though under the *Water Act* CoP and the 2018 Hinton Wood Products OGRs, they are Class B streams for 2 km upstream from the mainstem. The OGRs state the intermittent stream classification is applied where there is “distinct channel development”, the “channel usually has no terrestrial vegetation”, and there is “usually some bank development.” However, if these characteristics are present, this would mean tributaries to Berland River, Moon Creek, and Fox Creek within the harvest plan meet the *Water Act* definition of Class B water bodies for 2 km upstream from the mouth, and the 60 m buffer excluding new and upgraded roads along these streams applies.

16. Harvest Plan Overlap with Buffers

The Moon Creek harvest plan was assessed with respect to the above interpretation of the OGRs and *Water Act* CoP as well as the SARA Critical Habitat riparian buffer. Based on all these regulations, different buffers apply in different locations (**Table 4**).

Table 4. Existing buffer requirements that apply to the Moon Creek harvest plan

Legislation	Stream type	Footprint type	Buffer
OGRs	Mainstems	Roads	100 m
OGRs	Mainstems	Cut blocks	60 m
<i>Water Act</i> CoP	Class B tributaries for a distance of 2 km upstream from the mainstems	Roads	60 m
SARA	Tributaries (Moon & Fox creeks only)	Cut blocks and roads along stream reaches >2 km upstream from the mainstems	30 m

Note: Table assumes all mainstems, including Fox Creek, meet the OGR definition of large permanent streams; see details below.

A desktop assessment of the proposed roads within the Moon Creek harvest plan was conducted by placing a 100 m buffer on the mainstem Berland River and Moon and Fox creeks, a 60 m buffer to all tributaries to these mainstems for a distance of 2 km upstream from the mouth, and a 30 m buffer beyond the 2 km, but only on tributaries to Moon and Fox creeks, which are ARTR SARA Critical Habitat (**Table 5, Figure 15**).

Table 5. Length and area of roads within 100, 60, and 30 m buffers applied to the mainstem streams, all tributaries within 2 km of the mainstem, and all reaches beyond 2 km, respectively

Tributary/sub-basin	Current km	Current ha	Planned km	Planned ha
Moon Creek	1.74	1.34	3.72	7.73
Fox Creek	3.25	3.36	5.54	10.95
B1	0.00	0.00	0.00	0.00
B2	0.00	0.00	0.52	1.03
B3	0.00	0.00	0.51	1.02
B4	0.00	0.00	0.13	0.25
B5	0.00	0.00	0.26	0.50
B6	0.00	0.00	0.00	0.00
F1	0.84	1.25	0.06	0.12
F2	0.66	0.59	1.15	2.34
F3	0.17	0.10	0.86	1.76
F4	0.00	0.00	2.12	3.99
F5	0.00	0.00	0.91	1.84
F6	0.00	0.00	0.00	0.01
M1	0.00	0.00	0.28	0.56
M2	0.00	0.00	0.13	0.27
M3	0.00	0.00	1.38	2.83
M4	0.00	0.00	0.15	0.32
M5	0.30	0.23	1.57	3.13
M6	0.00	0.00	0.43	0.82
M7	0.65	0.39	0.70	1.39
M8	0.00	0.00	0.00	0.00

A total of 3.7 and 5.5 km of proposed road exists within the riparian buffers in the Moon and Fox creek watersheds as part of the proposed harvest plan (**Table 5**). These are significant increases above the length of road currently within buffers in these watersheds (**Table 5**). The proposed area to be disturbed by roads is estimated as 7.7 and 11.0 ha (**Table 5**).

The assessment showed roads did not always cross streams perpendicularly to minimize the length of road within riparian areas (**Figure 15**). In particular, Moon Creek sub-basins M3, M5, and M7 had lengths of road 1.38, 1.57, and 0.70 km within the riparian buffer, and Fox Creek sub-basin F4 had 2.12 km of road within the riparian buffer (**Table 5**). Other sub-basins also had high lengths of road within the riparian buffer simply because of the large number of road crossings associated with the proposed harvest plan (**Table 5, Figure 15**).

An equivalent assessment was conducted of proposed cut block area within a 60 m OGRs buffer on the mainstems of Moon and Fox creeks and a 30 m SARA Critical Habitat buffer on all tributaries to these mainstems (**Table 6, Figure 16**). Cut block area overlap with riparian buffers is almost exclusively on the 30 m SARA Critical Habitat buffer on tributaries. Other than a few small areas along the mainstem of Fox Creek and just one small area along the mainstem of Moon Creek, proposed cut blocks do not overlap with mainstem riparian buffers.

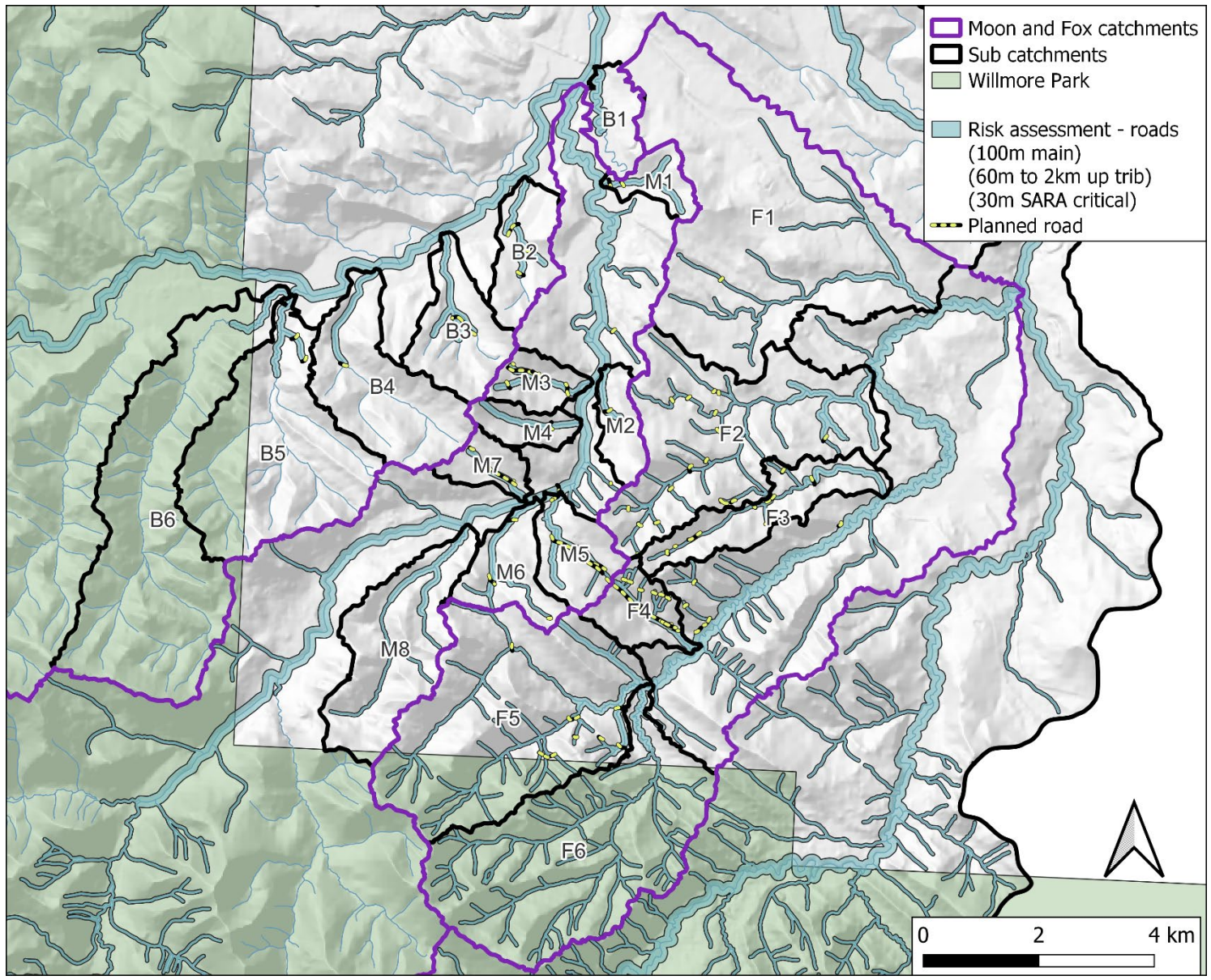


Figure 15. Proposed roads within buffers required by the OGRs, *Water Act CoP*, and SARA

Table 6. Assessment of cut block area within a 60 m buffer applied to mainstem streams and a 30 m buffer applied only to tributaries mapped as ARTR SARA Critical Habitat

Tributary/sub-basin	Current block area (ha)	Planned block area (ha)
Moon Creek	69.1	25.1
Fox Creek	153.1	60.3
B1	0.0	0.0
B2	0.0	0.0
B3	0.0	0.0
B4	0.0	0.0
B5	0.0	0.0
B6	0.0	0.0
F1	33.4	0.1
F2	76.5	16.1
F3	16.2	6.3
F4	0.0	10.8
F5	0.0	15.0
F6	0.0	1.2
M1	0.0	2.0
M2	3.5	0.6
M3	6.9	1.1
M4	9.2	0.0
M5	0.7	10.0
M6	7.7	1.9
M7	6.9	0.0
M8	0.1	0.1

A total of 69 and 153 ha of cut block area already exists in the riparian buffers in the Moon and Fox creek watersheds, respectively (**Table 6**). An additional 25 and 60 ha of cut block area is proposed in the buffers of these watersheds, respectively, as part of the harvest plan (**Table 6**).

The sub-basin with the largest amount of proposed cut block area within the riparian buffers in the Moon Creek watershed is M5 (10 ha, **Table 6, Figure 16**). In the Fox Creek watershed, sub-basins F2, F3, F4, and F5 have the largest amount of proposed cut block area within the riparian buffers (16, 6, and 11 ha, **Table 6, Figure 16**).

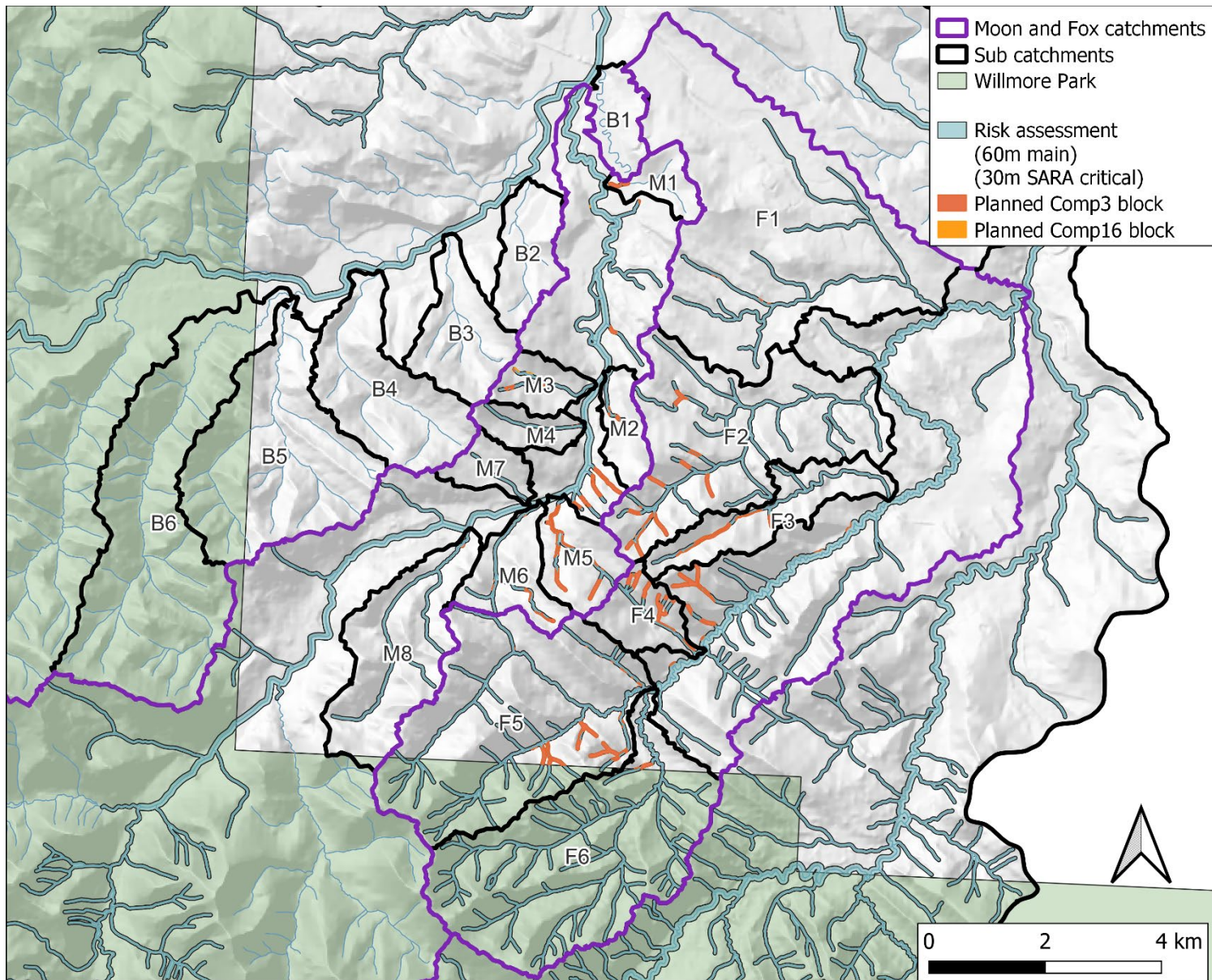


Figure 16. Proposed cut block areas within a 60 m mainstem and a 30 m tributary buffer.

17. *Water Act* Code of Practice Restricted Activity Period

The *Water Act* CoP Restricted Activity Period (RAP) for Berland River, Moon Creek, and Fox Creek and their tributaries is the period during which fish are considered most sensitive to habitat disturbance. Stream crossing construction should be avoided during this period. Additional precautionary conditions apply if the RAP cannot be avoided.

For the Moon Creek harvest plan, the RAP is from September 1 to July 15. The FHP map (**Figure 1**) indicates most of the roads it plans to construct are for summer use. The window of least risk in the RAP is identified as July 16 to August 31, and given the sensitivity of ARTR and BLTR in the area, construction should only occur during this window.

Beyond standard sedimentation and erosion control measures, reducing the duration these roads are in place and in use before they are decommissioned is the most effective way to reduce the risk they pose to ARTR and BLTR.

18. Stream classification and *Water Act* CoP and OGRs

The Berland River and Moon and Fox creek are perennial, fluvial streams that meet the definition of water bodies under the Alberta *Water Act* and have defined bed and banks and unvegetated channels. The gradient of these streams remains low throughout the Moon Creek harvest plan area (i.e., <2% slope), and there are no known barriers to upstream fish passage limiting fish habitat on these streams within the area.

The OGR stream classification assigned to Moon Creek by West Fraser appears to be a large permanent stream. The average channel width (included unwetted and unvegetated areas) from 181 measurements of Moon Creek in FWIMS within the harvest plan area is 25.9 m. This is well above the 5 m width threshold for a large permanent stream in the OGRs. The Berland River within the harvest plan area is larger than Moon Creek, so it is assumed West Fraser classified this stream as a large permanent as well. Proposed cut blocks have been kept ≥ 60 m from these streams, reflecting large permanent stream OGR classification.

There are no channel width measurements for Fox Creek in FWIMS within the harvest plan area. Downstream of the harvest plan between Highway 40 and the confluence with the Little Berland River, the average channel width (included unwetted and unvegetated areas) from 18 records in FWIMS within the harvest plan area is 7.4 m. This is above the 5 m width threshold for a large permanent stream in the OGRs, but it is a considerable distance downstream from the harvest plan. West Fraser has deemed the average channel width of Fox Creek within the harvest plan to be <5 m and classified the stream as a small permanent. This allows timber harvest to occur as close as 30 m from Fox Creek. In a few locations portions of some of the proposed cut blocks along the mainstem of Fox Creek are within a 60 m buffer (**Figure 16**). These would need to be pulled back to further than 60 m if Fox Creek was classified as a large permanent stream.

Channel width measurements of Fox Creek are needed from West Fraser, following OGR procedures, to demonstrate the creek meets the definition of a small permanent stream. Aerial imagery suggests the creek may be near the 5 m channel width threshold in the harvest area,

and the OGRs state in Section 2.17.5 that “where uncertainty exists on the classification of the watercourse, the watercourse protection area shall be that required by the higher class of watercourse”. If Fox Creek was treated as a large permanent stream, a 60 m buffer on timber harvest instead of a 30 m buffer would apply, but this will have minimal impact on the current cut block layout (**Figure 16**).

As shown in the FHP (**Figure 1**), West Fraser has classified all tributaries to the Berland River and Moon and Fox creeks (within the Moon Creek harvest plan) as intermittent streams from the confluence with the mainstems all the way to the headwaters of each tributary. The Hinton Wood Products OGRs described intermittent streams as having channel widths <0.4 m and only “some bank development”. They do not require a treed buffer to be retained and using this classification may be how West Fraser has rationalized laying out cut blocks over top of some tributaries, despite the fact they are mapped as ARTR Critical Habitat with a 30 m buffer.

West Fraser’s classification of all tributaries as intermittent streams is inconsistent with electrofishing records on three tributaries within the harvest plan, where channel width measurements were taken. One site is on a Berland River tributary, two sites are on a Moon Creek tributary, and one site is on a Fox Creek tributary. Average channel widths ranged from 1.1 m to 1.9 m, putting these streams well above the 0.7 m threshold for small permanent streams. The OGRs state that if the banks and channel are well defined, the small permanent classification applies. Streams can still dry up or freeze to the bottom and still be considered small permanent. Some of the tributaries clearly transition to small permanent streams closer to the mainstems, and this may need to be accounted for in the Moon Creek harvest plan.

With all tributaries in the harvest plan mapped as ARTR Critical Habitat, whether a defined channel is present or not, these drainages still act as groundwater recharge areas supporting fish habitat lower down in the watershed.

Lower stream gradients are more likely occupied by fish, and most tributaries have slopes <3% near the mainstems and slopes <6% extending upstream to the cut block areas (**Figure 10**).

Tributaries in the Moon Creek harvest plan are Class B for 2 km from the mainstems since they are unmapped on the CoP map (**Figure 14**). Class B streams under the 2018 OGRs require a 60 m buffer excluding new or upgraded roads, instead of the small permanent 30 m buffer.

19. Wetlands

No cut blocks or roads within the Moon Creek harvest plan overlap any wetland areas mapped in the Alberta Merged Wetland Inventory. Local wetlands consist primarily of fens, with a few limited areas connected to the fens also classified as swamps. There is a limited distribution of these features restricted to the lower reaches of Moon Creek near the pipeline crossing and for approximately 3 km upstream from that point. Fens also occur in the Fox Creek watershed east and west of the CN railway and along the creek downstream of the railway.

20. Federal *Fisheries and Species at Risk Act* requirements

As stated in the OGRs, forestry authorizations issued by Alberta do not imply authorization under federal legislation and requirements, notably the federal *Fisheries Act*. West Fraser must seek advice and approval from DFO regarding the requirements of this legislation. AWA has learned from West Fraser that some communication between the company and DFO has occurred regarding the Moon Creek harvest plan.

Although ARTR are Endangered under SARA, the Moon Creek harvest plan has not been designed to meet any specific protections for ARTR under federal legislation. Provincial standards may not be precautionary enough, and there may be important riparian habitat and groundwater recharge areas supporting ARTR that are not protected by these standards. This is evident with cut blocks and roads overlapping mapped Critical Habitat tributaries and predicted shallow groundwater areas (**Figure 11 & Figure 12**).

21. Summary Discussion

The tasks identified for this Project were to:

- Summarize fish and fish habitat data for the area
- Identify where instream and riparian habitat could be impacted
- Assess the need for ECA analyses
- Report to AWA on the importance of fish habitat in the area and highlight issues and locations of concern where the impacts to fish habitat could be greatest

Fish and fish habitat data for the area are limited and are summarized above. The two native trout of concern, ARTR and BLTR, are distributed in the mainstem Berland River as well as Moon and Fox creeks through up the Moon Creek harvest plan area and further upstream into WWP. The FWMIS database lists only four fish sampling sites on tributaries to these mainstem streams within the harvest plan area, and fish were only observed and captured at two sites, which are on a single tributary to Moon Creek at the upstream limits of the proposed harvest. Both ARTR and BLTR were captured in this tributary near Moon Creek, while only BLTR were captured at the site 2 km from the mainstem. Electrofishing at all the fish sampling sites and associated channel width measurements indicate that the tributaries sampled within the harvest plan have defined channels and at times have flows that can support ARTR and BLTR.

ARTR and BLTR are adapted to select areas where the resources they require are available, so habitat where these species occur would not be occupied unless the habitat is essential to the survival and recovery of these species. Therefore, occurrence of these species within the harvest plan area indicates that these streams are significant for their conservation and recovery. Whether tributaries flowing through the harvest plan are occupied or not, they provide flow directly to habitat that these species rely on, and therefore meet the definition of fish habitat under the Fisheries Act and the definition of Critical Habitat under SARA.

Protection of ARTR Critical Habitat must be interpreted within the context of the federal Fisheries Act, which defines fish habitat in subsection 2(1) as “water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas”. The Fish and Fish Habitat Protection Policy Statement interprets harmful alteration, disruption, or destruction

(HADD), as stated in the Fisheries Act subsection 35(1), as any temporary or permanent change to fish habitat that directly or indirectly impairs the capacity of fish habitat to support one or more life processes of fish. Therefore, habitat occupancy is not a requirement for fish to depend directly or indirectly on areas that are Critical Habitat.

This report focused on identifying where instream and riparian habitat could be impacted by the proposed Moon Creek harvest plan. Currently, there appears to be no enhanced or precautionary measures being taken for ARTR or BLTR, despite fRI-predicted probabilities of these species occurring in the tributaries of sub-basins draining the area (**Figure 8**) and a commitment in the FMA DFMP to use this model-derived information.

Direct instream habitat impacts could occur at road-stream intersections, of which 23 new crossings are proposed in each of the Moon and Fox creek watersheds, respectively (**Table 1**). An additional 22 new crossings are also proposed in Berland River watershed. Indirect instream habitat impacts could occur through changes to the hydrologic regime resulting from altered runoff and groundwater inputs associated with loss of forest cover and ground disturbance.

Overlap of roads and cut blocks within riparian areas has been summarized in terms of length (km) and area (ha) throughout this report. Sensitive riparian areas were delineated by shallow groundwater (the WAM layer), predicted riparian area (DEM-derived), and by regulatory buffers of varying widths. In all cases, the proposed Moon Creek harvest plan includes roads and cut blocks overlapping these areas.

Impacts on instream habitat could result from an altered hydrologic regime. Fintegrate's assessment has found that the percentage of the Moon Creek watershed area that is harvested is currently 8.6% and will increase to 14.8% with the proposed plan. A forest hydrologist would need to be consulted regarding what extent this increase could alter the hydrology of Moon Creek. The percentage of the Fox Creek watershed currently harvested is 35.7% and this will increase to 46.3% under the proposed plan. This is much greater than in the Moon Creek watershed. Sub-basins of tributaries within the proposed harvest plan that may be occupied by BLTR and ARTR could have up to 60-85% of the land base harvested after the proposed plan proceeds. However, some amount of hydrologic recovery has occurred in the area, since the majority of clear-cut areas were harvested 40-60 years ago. Important considerations are how likely it is that fish are using habitat within these tributaries for spawning or rearing and what the hydrologic recovery rate of the forest is in the area following clear-cut logging. Sub-basin analysis will be most appropriate where fish are most likely to occupy the tributary, even if only near the mouth, and ECA may be high (e.g., B2, B3, B4, M3, M5, F1, F2).

For the harvest plan to proceed, it will be impossible to avoid at least some direct loss of instream and riparian Critical Habitat where stream crossings are constructed. Some smaller stream crossings are proposed using culverts and log fills, and the multi-span bridge crossing of Moon Creek will involve piers within the stream channel. Both will result in direct loss of instream habitat. All crossings will result in loss of riparian Critical Habitat.

The affected riparian and instream Critical Habitat areas provide and convey necessary flows, including from groundwater sources, provide substrate for benthic invertebrate food production, produce, collect and transport allochthonous invertebrate food, provide substrate for spawning

and egg incubation, and provide habitat space for fish rearing, food production and feeding, and overwintering.

As outlined in the Bull Trout Recovery Strategy (DFO 2020b), even “activities occurring outside of an area identified as Critical Habitat can destroy Critical Habitat” and “activities including installation, maintenance, repair or replacement of any anthropogenic structures, located within, or adjacent to, Critical Habitat, must be reviewed by DFO or PCA to determine whether a SARA permit, Fisheries Act and/or other authorizations or permits are required and can be issued.”

The Moon Creek harvest plan cannot receive a SARA permit because riparian and instream ARTR Critical Habitat will be destroyed, which is prohibited under Section 58(1) of SARA. According to SARA Section 73, for activities to be approved that will affect a species listed under SARA, a SARA permit is required. Section 73 of SARA only provides for the issuance of permits to affect any part of the Critical Habitat of a listed species if the activity is scientific research relating to the conservation of the species, the activity benefits the species or is required to enhance its chance of survival, or affecting the species is incidental to the carrying out of the activity. None of these exceptions would appear to apply to clearing riparian Critical Habitat and destroying instream habitat for timber harvest road crossing construction.

Despite the limited exceptions allowing for a SARA permit to destroy Critical Habitat, there is an example where a permit was issued, and these exceptions were not met. A recent Fisheries Act Authorization (19-HPAC-00036, DFO 2019) for another SARA-listed fish species, Nooksack Dace (*Rhinichthys cataractae* spp.), required quantifying the amount of riparian Critical Habitat vegetation to be permanently lost at a pipeline crossing of Stoney Creek and an offset of this loss at a ratio of 5:1 with native riparian revegetation planting elsewhere in a degraded area. The Authorization required weekly irrigation of the plantings for 3 years afterwards and 5 years of monitoring the growth and function of the riparian offsetting measures.

21.1 Changes to the OGRs

In reviewing different versions of the OGRs, Fintegrate notes that the treed riparian buffer widths, which the OGRs state are “the primary strategy for maintenance and protection of the aquatic environment and fish habitat values” have recently changed.

- A 100 m buffer on Class A streams excluding both timber harvest and new or upgraded roads was in place in the Hinton Wood Products 2018 OGRs
- A 60 m buffer on Class B streams excluding new or upgraded roads was also in place in the Hinton Wood Products 2018 OGRs
- The 2022 OGRs removed these requirements and do not refer to Class A or B streams.

As stated above, given that AFPT directed West Fraser to develop the Moon Creek harvest plan in June 2018 and West Fraser confirmed in their February 3, 2022, letter to stakeholders that they started developing the harvest plan in 2018, the FMA-specific 2018 Hinton Wood Products OGRs are the most applicable version of the OGRs that apply to the Moon Creek harvest plan.

21.2 Linear disturbance density

The Moon Creek harvest plan involves 80.9 km of inter-block roads. As reviewed above (**Table 1**), at the watershed scale, overall linear disturbance densities in the Moon and Fox creek

watersheds are currently 0.35 km/km² and 1.88 km/km², respectively, and these will increase to 0.55 km/km² and 2.32 km/km², respectively, if the harvest plan proceeds.

It is worthwhile considering this in the context of regulatory limits and targets set out in the Livingstone-Porcupine Hills Land Footprint Management Plan (LFMP), which have set restricted motorize access disturbance limits to protect WSCT and BLTR in the Oldman River watershed (AEP 2018b). A watershed scale limit of 0.6 km/km² to open motorized access has been set, as well as a near-stream motorized access disturbance limit within 100 m of streams on erodible soils of 0.04 km/km².

There is no access management plan in place in the Moon Creek area, but not all linear disturbance in the area is necessarily being used for motorized access. However, the Livingstone-Porcupine Hills LFMP regulatory limits, which were set to protect native trout elsewhere in the province, would still likely be exceeded if applied to the Moon Creek area even if only applied to disturbance used for motorized access. This is because the limits are low and densities in the Moon Creek area are high. Some sub-basins currently have densities as high as 4.76 km/km² (M4, a Moon Creek tributary), and this maximum increases to 6.89 km/km² with the proposed harvest plan roads (M3, in a Moon Creek tributary). Therefore, both the watershed-wide and near-stream limits in the Livingstone-Porcupine Hills LFMP would likely be exceeded.

21.3 Water Act CoP Class A protection

WSCT and ARTR have similar habitat requirements, and as reviewed above, DFO initially proposed to establish the WSCT Critical Habitat riparian buffer as 100 m. DFO then reduced the width to 30 m based on input from GoA, setting the stage for a 30 m buffer for BLTR and ARTR.

The 2018 Hinton Wood Products OGRs require a 100 m buffer on Class A streams, although this protection was removed in the 2022 OGRs. Given that ARTR are Endangered, given that genetically pure core populations occupy a limited area, and given that the species depends entirely on these areas, designation of pure ARTR streams as Class A under the Water Act would provide substantially more habitat protection for this species.

Inconsistent levels of protection of native trout habitat exist in the immediate Moon Creek harvest plan area. The Little Berland River, just south of Fox Creek, is a Class A stream because BLTR spawn there, and under the same OGRs being applied to the Moon Creek harvest plan, this stream would be required to have a 100 m buffer on the mainstem and tributaries for 2 km upstream from the mainstem. This higher level of protection has been in place on the Little Berland River for 17 years. The inconsistency is that even though BLTR do not have SARA Critical Habitat designated for the area and the species is only listed as Special Concern in the Athabasca drainage, under the OGRs on the adjacent Little Berland River, the level of protection is greater for BLTR than Endangered ARTR.

West Fraser's plan only provides the provincial standard level of protection, and ARTR need enhanced protection to be conserved and recovered. This could be implemented by giving the same level of protection for the streams within the Moon Creek harvest plan as is applied to the Little Berland River and its tributaries.

Coordinated federal-provincial review of projects like the Moon Creek harvest plan is needed, especially as land use activities intensify and native trout populations continue to decline. If DFO and GoA treated ARTR streams as Class A, it would trigger the joint federal-provincial protocol that exists for the review of development applications for activities or works proposed in Class A watercourses (see the Working Agreement: Class A Watercourses, ASRD 2007).

21.4 Effects of a 100 m Buffer on the Proposed Harvest Plan

For discussion purposes, an assessment was conducted of how much of the Moon Creek harvest plan would be affected if a 100 m Class A buffer was applied to the mainstems and tributaries for 2 km upstream, as well as the existing 30 m buffer on all tributaries mapped as ARTR Critical Habitat in the Moon and Fox creek watersheds only (**Figure 17**). The assessment shows that compared to the assessments under the 2018 OGRs (**Figure 15 & Figure 16**) the amount of road within the buffers increases less than the amount of cut block within the buffers. However, note that the earlier assessments (**Figure 15 & Figure 16**) did not apply any buffer to the Berland River tributaries, because they are not designated as ARTR Critical Habitat.

21.5 Alignment with Recommended ARTR Recovery Actions

The Alberta ARTR Recovery Plan (AARTRT 2014) recommends reducing impacts from stream crossings. The proposed Moon Creek harvest plan includes 23 additional crossings in Moon and Fox creek watersheds, as well as 22 in the Berland River watershed. There are already 46 crossings in the Moon Creek watershed and 107 in the Fox Creek watershed.

The Alberta ARTR Recovery Plan (AARTRT 2014) recommends complete delineation of all essential habitat to ensure it is conserved and protected. This has not yet occurred, and therefore precautionary management principles are recommended. As stated in Section 6.3 of these OGRs, “where uncertainty exists on the classification of the watercourse, the watercourse protection area shall be that required by the higher class of watercourse”.

The Alberta ARTR Recovery Plan (AARTRT 2014) also recommends increasing industrial inspections.

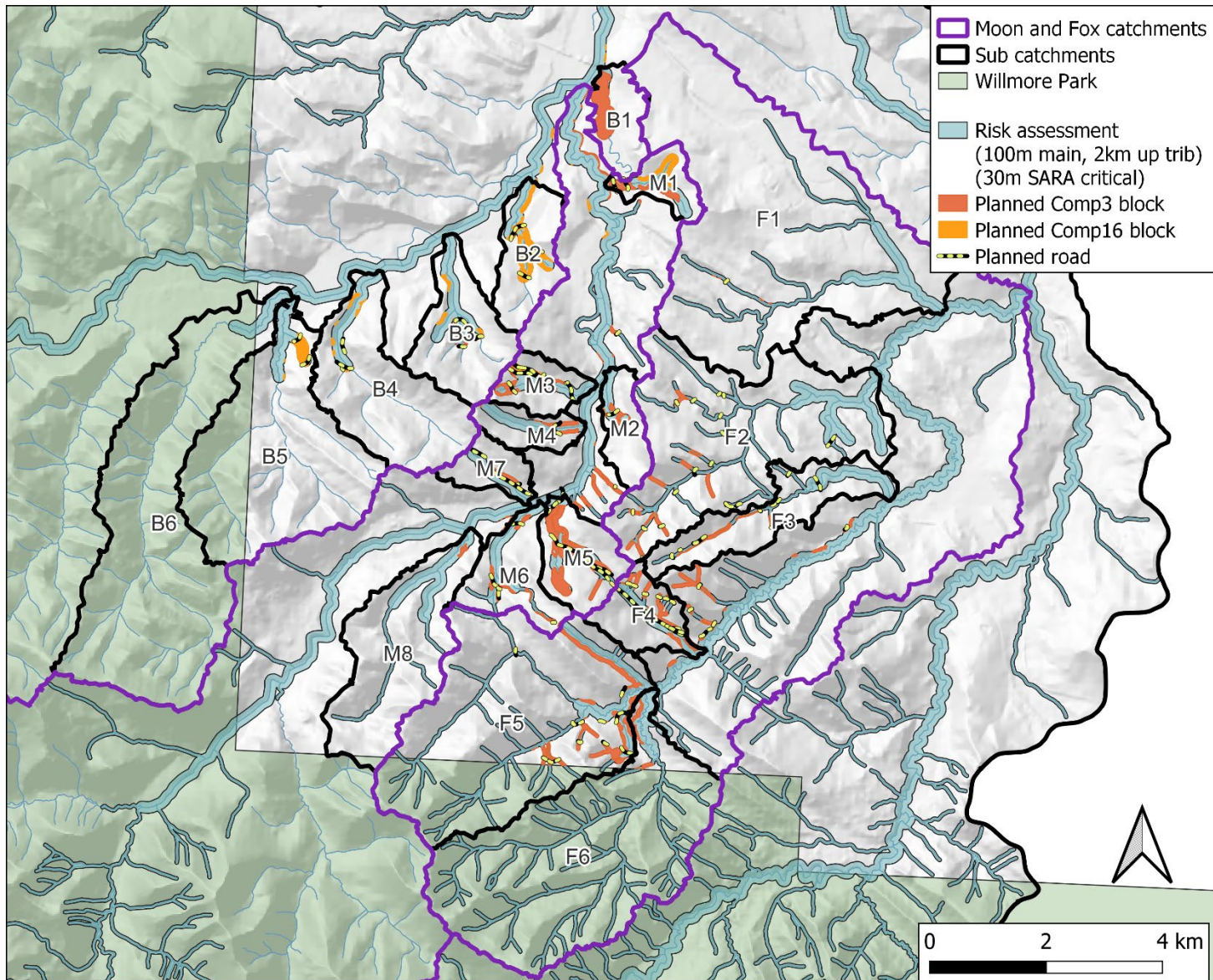


Figure 17. Proposed roads and cut block areas within a 100 m buffer on mainstem streams and tributary reaches within 2 km of the mainstem and a 30 m tributary buffer on Critical Habitat beyond, which is only designated in the Moon and Fox creek watersheds.

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