



Forest
Practices
Board

Special Report: Conserving Fish Habitats under the Forest and Range Practices Act

PART 1: A Review of the
BC Government Approach

July 2018

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EXECUTIVE SUMMARY

BC has a diversity of fish and fish habitats that are foundational to the environmental, economic, and social well-being of the province.

British Columbia has a diversity of fish and fish habitats that are foundational to the environmental, economic, and social well-being of the province. The conservation of fish habitats is complex, involving multiple levels of government, including First Nations, and managed through many types of regulation. Fish habitats are subject to stresses from multiple land uses, including forestry and range activities under the *Forest and Range Practices Act* (FRPA).

This special report examines what the BC Government is doing to conserve fish habitats that overlap areas of forestry activity under FRPA.

Investigators reviewed provincial legislation, policies and programs, with a focus on forest practices and the FRPA framework, and interviewed people working to conserve fish habitats within and outside of government.

The investigation asked three questions:

1. Are FRPA's planning and practice requirements adequate to conserve fish habitats across the forested landbase?
2. Is government implementing FRPA tools to conserve fish habitats in areas requiring special management?
3. Is government monitoring the effectiveness of FRPA in conserving fish habitats?

For question 1, past Board work and government monitoring have shown that the general practice requirements in FRPA are adequate for the protection of fish habitats across the forested landbase. However, there are three key aspects of forest management that could be strengthened, particularly for watersheds not designated as requiring special management:

- cumulative effects at the watershed scale, particularly where there are no watershed-specific legal objectives;
- riparian management adjacent to small streams; and
- minimizing inputs of sediment from roads, stream crossings and other forestry developments.

For question 2, the Board found that government has been slow to implement the tools under FRPA to address high value and sensitive fish habitats requiring special management. In March 2018, government designated a number of fisheries sensitive watersheds, bringing the total number up to 61 from 36, which is encouraging. However, site level designations have been very limited. At the time of publication there were

22 wildlife habitat areas designated for bull trout and 1 for stickleback, no temperature sensitive streams and no fisheries sensitive features designated in the province. These designations need to be expedited to provide watershed level objectives in watersheds with significant fish values and sensitivity to development and site-specific management for critical and important habitats that are not otherwise protected under the regulations.

Finally, for question 3, the Board found that, while government is doing site level monitoring for riparian areas and water quality, it does very limited monitoring of the effectiveness of FRPA at the watershed level and only for fisheries sensitive watersheds at high risk.

Fish habitats are subject to stresses from multiple land uses, including forestry and range activities.

INTRODUCTION

Careful management of activities in and around fish habitats is fundamental to the health of fish populations in British Columbia. These habitats support fish populations that are integral to the ecological, economic, social, and cultural fabric of the province. Fish and fish habitats are included in the eleven values to be managed and protected under the *Forest and Range Practices Act (FRPA)*.¹



Fish-bearing streams occur throughout the province and any forestry activities have the potential to negatively impact fish habitats. Based on past work and feedback from around the province, the Forest Practices

Board (the Board) decided to look at whether forest practices are meeting government's objectives for fish and fish habitats.

This special report is the first of two reports by the Board looking at the management of fish habitats in BC. This report evaluates the BC government's approach to the management of fish habitats through its legislation, policies, and monitoring. The second report will look at planning and practices by forest tenure holders to conserve fish habitats on the ground.

This report is based on interviews with representatives of the provincial and federal governments, forest licensees, non-government organizations, fish and stream scientists, and First Nations. In addition, the Board reviewed reports on fish habitat management in BC and adjacent jurisdictions.

This report focuses on forestry activities under FRPA. Range activities were excluded from the project scope in order to keep the project manageable. The report does not comment on the management of fish populations (e.g., through stock enhancement or commercial, recreational or sustenance harvesting).

¹ A list of the acronyms used throughout this report is in Appendix 1.

BACKGROUND

What makes good fish habitat?

Fish habitat is conserved by managing for the basic needs of fish throughout their lifecycle. Key components of good quality fish habitat include the following:

- Water that is free of pollutants and excessive turbidity, and where temperatures are within ranges tolerable for fish at each of their life stages.
- Stream flows within ranges that support fish and maintain channel stability, structure and function.
- Riparian vegetation adjacent to streams to stabilize streambanks, provide cover, moderate stream temperatures and provide continual inputs of nutrients and woody debris.
- Connected and accessible stream habitats to allow for fish migration up or downstream during changing stream conditions or critical life phases.

Maintaining the quality of these habitat components requires consideration of aquatic and terrestrial inputs at the site and landscape levels, not only where fish dwell but also in upstream areas that flow into fish-bearing stream reaches.

The regulatory framework to conserve fish habitats in BC

The conservation of fish habitats in British Columbia is governed by a complex set of jurisdictions, involving federal, provincial, municipal, and First Nations governments.

Canada's federal government has primary responsibility for the management of tidal fisheries and commercial anadromous² salmon species (chinook, coho, chum, pink and sockeye salmon) in freshwater systems.

British Columbia's government is responsible for the management of land based activities and for freshwater uses. BC manages freshwater (non-tidal) fisheries other than anadromous salmon stocks.

² *Anadromous fish* are those species, such as salmon, that are hatched in freshwater systems, such as rivers and lakes, migrate to the ocean to mature, then back to freshwater to spawn.

Conservation of fish habitats in BC is governed by a complex set of jurisdictions, involving federal, provincial, municipal, and First Nations governments.

Municipalities have the authority to create by-laws to prevent damage to water quality and quantity, and to the flow of watercourses.

Some First Nations governments have their own programs for managing and monitoring fish habitat and collaborate with provincial and federal governments.

Federal legislation

The federal *Fisheries Act* defines fish habitat as, “spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes.” According to Fisheries and Oceans Canada, this definition encompasses water in lakes, streams and oceans as well as “the quality of that water and the total surroundings in which plants and other life forms interact to make fish life possible.”ⁱ This interpretation could encompass riparian areas as well as broader upstream areas that channel water and materials into fish-bearing waters.

Under section 35 of the federal *Fisheries Act*, it is an offence to carry out an activity that causes “serious harm” to a commercial, recreational or Aboriginal fishery or to fish that support such a fishery. Section 1(2) of the Act defines serious harm as the “death of fish or any permanent alteration to, or destruction of, fish habitat. The federal government introduced a number of amendments to the House of Commons in February 2018 to strengthen the protection of fish habitats under the *Fisheries Act*.ⁱⁱ

Provincial legislation and regulations

Canada has delegated to BC the authority to manage freshwater (non-tidal) fisheries, other than salmonids. BC has constitutional authority over land-based activities, such as forestry, range use, oil and gas development, and agriculture, all of which have the potential to impact fish habitats.

BC has a number of governance tools (legislation, regulations and guidelines) that complement the federal *Fisheries Act* for the activities and sectors under provincial jurisdiction (see text box on page 5). The provincial and federal governments coordinate fish habitat management through joint ministerial

BC Legislation Relevant to Fish Habitats

- Industry-specific legislation: *FRPA, Private Managed Forest Land Act, Oil and Gas Activities Act*
- Legislation that specifically addresses fish and fish habitat: *Riparian Areas Protection Act, Wildlife Act, Water Sustainability Act*
- General legislation: *Environmental Assessment Act, Environmental Management Act, Integrated Pest Management Act.*

councils, such as the Canadian Council of Fisheries and Aquaculture Ministers, and federal/ provincial task groups.

Roles in fish habitat management are divided, with the Ministry of Environment and Climate Change (MECC) responsible for policy-making on fish habitat management and the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRO) responsible for land development activities that affect fish and fish habitats and managing freshwater fishing. Much of the planning and decision-making related to fish and fish habitats rests with FLNRO regions and regional approaches vary depending on regional issues, priorities and resourcing.

Regulation of forestry activities – the Forest and Range Practices Act

In BC, forestry licensees must have authorization from the provincial government before they can harvest trees or build roads on Crown land.³ Under FRPA, licensees must submit a forest stewardship plan (FSP) or woodlot licence plan to government for approval, describing their forest developments over a five-year period, before they can apply for permits and authorizations to commence on-the-ground forestry activities. FSPs describe, using results, strategies and measures, how licensees will address government’s objectives and practice requirements to conserve non-timber resource values, including water and fish.⁴

FRPA is a “results-based” regime, meaning that forest licensees have flexibility to plan and implement forest practices using the knowledge of qualified professionals. However, those practices must be consistent with objectives set by government for forest values and meet practice requirements in the regulations. Licensees are held accountable through FLNRO’s compliance and enforcement program and the Board’s independent oversight. Government tracks the effectiveness of FRPA and its regulations through effectiveness monitoring under the Forest and Range Evaluation Program (FREP).

³ Forestry activities on private managed forest lands are regulated by the *Private Managed Forest Land Act* and its regulations. *Managed forest* is a BC Assessment property classification to encourage private landowners to manage their lands for long-term forest production.

⁴ Section 149 of FRPA enables the Lieutenant Governor in Council to make regulations prescribing objectives for the following 11 resource values: soils; visual quality; timber; forage and associated plant communities; water; fish, wildlife; biodiversity; recreation resources; resource features; and cultural heritage resources.

Although the conservation of fish habitat is an objective in FRPA, neither the Act nor its regulations define “fish habitat.” Other provincial laws, such as the *Water Sustainability Regulation* (under the *Water Sustainability Act*) and *Environmental Protection and Management Regulation* (under the *Oil and Gas Activities Act*), adopt the federal *Fisheries Act* definition of fish habitat as “areas on which fish depend directly and indirectly for their life processes.” Since the federal definition of “fish habitat” reflects a common understanding of the term in BC legislation, the Board also adopts this definition for the purposes of this report.

FRPA regulations relevant to fish habitats

Government has established objectives and practice requirements to manage for water, riparian areas, and fish habitats in the *Forest Planning and Practices Regulation* (FPPR) and the *Woodlot Licence Planning and Practices Regulation* (WLPPR). FRPA regulations protecting fish habitats apply across the landbase, wherever these habitats occur. Objectives to conserve fish habitats are limited in FRPA regulations to the extent that they do not “unduly reduce the supply of timber from British Columbia’s forests.”

At the *landscape level*, the FPPR objective for fish habitat is expressed generally in section 8 as “the objective...within riparian areas is...to conserve, at the landscape level...fish habitat.”⁵

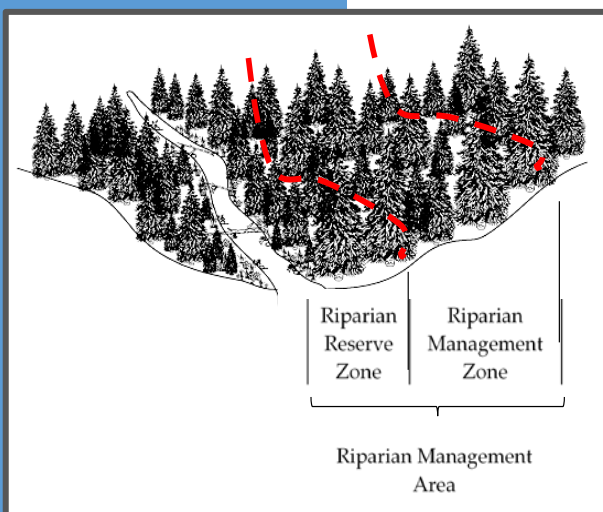


FIGURE 1. FRPA riparian management.

At the *site level*, both the FPPR and WLPPR contain a number of practice requirements relevant to fish habitats. These are summarized as follows:

- Conduct forestry activities at a time and in a manner that is unlikely to harm fish or destroy, damage or harmfully alter fish habitat.⁶
- Manage vegetation within the riparian areas of streams, wetlands, and lakes. Streams are classified and buffered according to the size and fish-bearing status of the watercourse (Figure 1). S1 – S4 are fish-bearing streams of varying widths. S5 and S6 are non-fish-bearing.

⁵ The WLPPR does not contain landscape level objectives and requirements because woodlots are small tenures that comprise only a portion of landscapes.

⁶ As guidance, FLNRO sets regional timing windows as periods when work may be carried out with lowest risk to fish and wildlife species and their habitats:

<http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights/working-around-water/regional-terms-conditions-timing-windows>

- Maintain adequate stream shade for temperature sensitive streams to prevent water temperatures from increasing to the extent that they have a material adverse impact on fish.
- Avoid destabilization of alluvial or colluvial fans in coastal regions (FPPR only).
- Protect the stream channel and bank at stream crossings.
- Maintain fish passage through stream crossing structures such as bridges and culverts.

General practice requirements that may also protect fish habitat include requirements to prevent landslides, gully processes, maintaining natural surface drainage, revegetation, road construction, maintenance and deactivation, general wildlife measures, and resource features and wildlife habitat features.

Government Actions Regulation and other tools to designate areas of special management for fish habitats

The *Government Actions Regulation* (GAR) enables government to designate sites or areas of special management for fish habitats not otherwise provided under basic FRPA requirements. GAR designations are established by government in consultation with First Nations, forest licensees and other stakeholders.

At the watershed scale, the GAR designation specific to fish habitat is the fisheries sensitive watershed (FSW).

At the site level, GAR designations include temperature sensitive streams, wildlife habitat areas for species at risk and regionally important wildlife, and wildlife habitat features, which may include “fisheries sensitive features.”⁷

Areas can also be designated for the purposes of FRPA under the *Land Act*. The *Water Sustainability Act* enables government to establish objectives to sustain water quantity, water quality and aquatic ecosystems that apply across resource sectors, including forestry.

Government has established objectives and practice requirements to manage for water, riparian area, and fish habitats.

⁷ *Wildlife habitat features* are site-specific habitat elements, such as mineral licks or nests of bird species listed under section 11 of GAR that require special management not otherwise provided under FRPA. The FRPA definition of wildlife includes “fish from or in the non-tidal waters of BC” and their eggs and juvenile stages.

Forest Practices and Climate Change Adaptation

Climate change is affecting temperatures and precipitation levels throughout BC with increased incidence of unseasonal and extreme weather events, which can increase the risk of substantial impacts to fish and fish habitats. Forest harvesting has the potential to reduce the resiliency of streams and fish habitats. For example:

- Increases in stream temperatures may be worsened by removing riparian vegetation adjacent to non fish-bearing and small streams.
- Increased and unseasonal extreme rain events in harvested areas can increase peak flows to a size and force that alters stream channels and scours streambeds, damaging fish habitats.
- Increased storm intensities could increase the risk of slope instability associated with forest harvesting and roads. This could result in increased deposition of soil material into streams.
- Existing stream crossing structures (culverts and bridges) may not be large enough to accommodate projected increases in size and frequency of peak flow events and stream widening.
- Longer and warmer growing seasons may result in second growth trees growing quickly to crown closure and out-competing understory shrub and ground cover vegetation for light, water and nutrients. Fewer understory shrubs in riparian areas could reduce stream bank strength and result in lower stream resilience to heavy water flows.



Photo: CBC News

The BC Government is developing policies, tools and information to assist with climate change adaptation in the natural resource sector. FLNRO approved a *Forest Stewardship Action Plan for Climate Change Adaptation* in 2012. Each FLNRO region is implementing their own climate change action plans, with actions specific to the pressing issues in each region. As an example, the Climate Action Plan for Thompson Okanagan Region includes actions to establish thresholds for low stream flows, mitigate advances in the timing of freshets, reduce risk of increased stream and lake temperatures, and restore fish habitats lost through increased storm and flood intensity and frequency.

Engineers and Geoscientists BC and the Association of BC Forest Professionals are preparing joint watershed guidelines that require members who are responsible for watershed management or watershed assessments to take into account and plan for climate change. These professional associations expect their members to stay informed on climate change and incorporate consideration of climate change into their practice.

EVALUATION OF GOVERNMENT'S APPROACH

To evaluate government's approach to conserving fish habitats, the Board considered three questions. To answer these questions, investigators interviewed fish experts, habitat managers and forest professionals and reviewed the legislation, policies and current literature on fish habitat management.

Question 1. Are FRPA's planning and practice requirements adequate to conserve fish habitats across the forested landbase?

FRPA regulations contain planning and practice requirements that are assumed, overall, to achieve government's objectives to conserve fish habitats. Investigators evaluated whether basic FRPA requirements are adequate across the forested landbase wherever forestry and fish habitats overlap (i.e., outside of areas designated for special management).

Question 2. Is government implementing FRPA tools to conserve fish habitats in areas requiring special management?

Investigators examined the extent to which government is implementing tools to provide site- and watershed-specific management of fish habitats, where basic planning and practice requirements under FRPA are insufficient. Fish-related designations under the GAR include FSWs, temperature sensitive streams, wildlife habitat areas, and wildlife habitat features.

Question 3. Is government monitoring the effectiveness of FRPA in conserving fish habitats?

A key aspect of the FRPA framework is monitoring and continuous improvement. Investigators reviewed government's processes to monitor the effectiveness of FRPA management to conserve fish habitats.

Question 1. Are FRPA's planning and practice requirements adequate to conserve fish habitats across the forested landbase?

Most fish habitats in BC occur outside of areas designated for special management, such as FSWs and wildlife habitat areas. For most of the landbase, fish habitats are assumed to be adequately conserved through the basic planning and practice requirements in FRPA.

Monitoring and studies have shown that practice requirements to protect fish habitats, which were introduced under the Forest Practices Code (the Code) in the 1990s and continued under FRPA have resulted overall in significantly better outcomes for fish habitats compared to previous non-legislated practices.^{iii, iv} A 1998 Board study to compare stream condition before and after the introduction of the Code revealed significant improvements in the functioning condition of streams with the greatest improvements to larger streams due to retention of streamside vegetation, falling and yarding trees away from streams, and reducing windthrow risk in riparian areas.^v Monitoring under FREP from 2005 to 2011 found similar results to the 1998 Board report and also identified positive effects from reduced inputs of fine sediments to streams throughout the life cycle of roads.^{vi}

While management for fish habitats is significantly better than it was prior to the Code and FRPA, impacts to fish habitats continue to be observed through monitoring and assessments and there have been no substantive updates to FRPA requirements to improve conservation of fish habitats.

This review has identified three areas of concern with the adequacy of the general provisions under FRPA to conserve fish habitats:

1. risk of cumulative effects in watersheds with no protective designations;
2. forest practices next to small streams; and
3. inputs of sediment into streams.

While management for fish habitats is significantly better than it was...impacts to fish habitats continue to be observed...

1. Risk of cumulative effects of development in watersheds with no protective designations

FPPR Section 8: Objectives set by government for water, fish, wildlife and biodiversity within riparian areas

Without unduly reducing the supply of timber from British Columbia's forests, to conserve, at the landscape level, the water quality, fish habitat, wildlife habitat and biodiversity associated with those riparian areas.

Aside from a general requirement to protect fish and fish habitats in FRPA regulations (section 57), the only objective is to protect fish habitats at the watershed scale is by managing fish habitats “associated with riparian areas” (refer to text box on the left). The wording of this objective suggests that meeting the practice requirements for riparian areas (sections 47 – 52 of FPPR; sections 30 – 40 of WLPPR) will conserve fish habitats “at the landscape level.” Currently, almost all FSPs refer to default riparian practices requirements to meet the section 8 objective.

FRPA does not require licensees to address other cumulative effects of forestry activities such as effects on hydrology, fish passage, sedimentation, stream channels and fish habitat structure. Without objectives to manage the amount and rate of development at the watershed level, licensees do not have guidance from government on acceptable rates of change in watershed condition. There is also no requirement in FRPA to undertake watershed level assessments and, without assessments, licensees do not have a blueprint to guide efforts work to minimize the risks of development on fish habitat values (see text box on page 13).⁸

These issues are particularly important in watersheds with multiple, overlapping licences where there is no single party responsible to manage for watershed-level impacts. In timber supply areas with multiple, volume-based tenures, there is potential for a high density of cutblocks, roads and road crossings to result in cumulative damage to fish habitats, particularly in areas vulnerable to sedimentation and erosion. In interviews, some government staff expressed concerns about the rate at which some watersheds were being harvested in the absence of objectives and worry that limiting rate of harvest in designated FSWs might increase harvesting pressure on undesignated watersheds where licensees are not legally required to consider watershed level effects.

⁸ The Forest Practices Board 2014 report *Community Watersheds: From Objectives to Results on the Ground* revealed that methods and assumptions used in watershed assessment may vary considerably and the recommendations from those assessments may or may not result in changes in practices on the ground. The Joint Practices Board of the ABCFP and EGBC is preparing professional practice guidelines for watershed assessment.

Coordinated planning of forestry activities in watersheds does happen in some areas of BC, for example, by timber supply area steering committees or at all-licensee meetings. However, this practice is not universal and there is an opportunity to strengthen collaborative watershed level planning. A challenge is that licensees are only legally responsible for their own activities within their forest development units and there is no requirement to ensure, overall, that watersheds are appropriately assessed and managed.

Potential for Cumulative Effects of Roads and Stream Crossings

The number of stream crossings (bridges and culverts) in a watershed can, cumulatively, affect the amount of sediment transported to the main reaches downstream of the crossings.

As an example, FREP sampling at 59 crossings in the Memekay River watershed on Vancouver Island in 2012 showed that an average of 0.55 m³ of fine sediments were released into streams at each sampled crossing. This level of sediment input at a crossing is generally considered a low risk to stream functioning condition. However, multiplying this average by the number of crossings sampled (59 x 0.55 m³) reveals a total of 32.5 m³/year or 78 metric tonnes of sediment potentially introduced to streams from those crossings alone.

There are around 250 stream crossings of the Memekay River, including many deactivated and abandoned roads that may or may not release sediment into streams on an ongoing basis. Overall, the amount of sediments released from crossings combined with natural levels of suspended sediments, could pose a risk to egg-to-fry survival (one of the most vulnerable life phases of the fish life cycle).^{viii}

Forestry activities are not the only developments on the landbase that have the potential for cumulative effects on fish habitats. Permanent settlement areas, agriculture and major transportation corridors commonly occur in valley bottoms that are also important habitat for fish. For example, a monitoring and assessment report for the Wet'suwet'en Hereditary Territory, released in 2017, estimated that 43 percent of 1141 watersheds assessed in the Skeena Basin had high potential risks to fish habitats due to the effects of multiple land use activities, with logging being a dominant impact in the three watersheds most at risk.^{vii}

Government has completed a preliminary set of procedures to assess the cumulative effects of multiple developments across resource sectors and incorporate outputs in decision-making as part of its cumulative effects framework (Appendix 2).⁹ However, BC does not have legislation to address the cumulative effects of all activities within a watershed (see text box on page 14).

⁹ Fish habitats are assessed as part of cumulative effects framework procedures for aquatic ecosystems.

Applying Cumulative Effects Assessments to Conservation of Fish Habitats in the Thompson / Okanagan Region

The following is an example of efforts in one FLRNO region to address cumulative watershed level effects. Cumulative risk assessments have been undertaken in the Thompson/Okanagan Region to assess watershed level risks to fish habitats from all developments, including forestry (Figure 2). In 2016, the chief forester applied the outcomes of these assessments in her allowable annual cut (AAC) determination for the Kamloops Timber Supply Area, which reduced the AAC from 4.0 million cubic metres to 2.3 million cubic metres. While the reduced AAC was mainly to restore the harvest to levels that were in place prior to uplifts for mountain pine beetle salvage, the chief forester also noted in her rationale that the reduced AAC would help support hydrologic recovery to mitigate cumulative effects to fish habitats. She requested that district staff “develop and provide clear expectations to licensees for the development of watershed assessments to guide both the amount and spatial location of harvest and road development and management activities.”^{ix}

District managers in the Thompson Okanagan Natural Resource Region have distributed letters of expectation to licensees replacing their forest stewardship plans (FSPs), noting that they “expect that forest professionals recognize the importance of managing cumulative watershed effects to maintain water quality, quantity, timing of flows, stream channel dynamics, aquatic ecosystem integrity, fish and fish habitat that exist in all watersheds.”^x

There is no legal requirement for licensees to follow the guidance of the chief forester and expectations of district managers to address cumulative watershed effects. It remains to be seen if licensees will choose to apply this guidance in preparing FSPs.

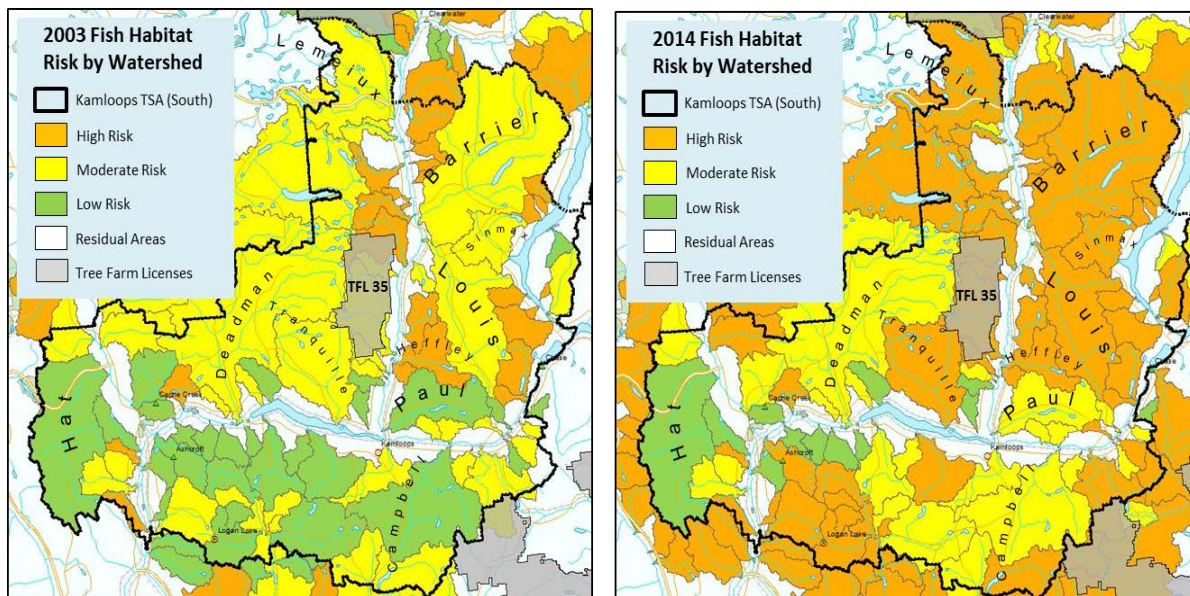


FIGURE 2. Comparison of risk to fish habitats by watershed in 2003 and 2014, in the south portion of the Kamloops TSA, showing the risk to fish habitats before and after salvage harvesting for mountain pine beetle. The 2014 risk assessment was considered in the most recent timber supply review for the Kamloops TSA. (Source: Thompson-Okanagan Natural Resource Region)

2. Forest practices next to small streams

FRPA and its regulations do not prescribe the retention of trees along S4 (small fish-bearing) and S6 (small, non-fish-bearing) streams. Instead, licensees have the discretion to apply anywhere from 0 to 100 percent tree retention within the riparian management areas for S4 and S6 stream classes.

Collectively, small streams¹⁰ account for a large proportion of watersheds, comprising, on average, 70 to 80 percent of the total drainage area.^{xi} They play a vital ecological role in supplying water, organic matter, and nutrients to downstream aquatic ecosystems and associated fish habitats. They may also support rich and diverse biological communities in the upland environment.



Monitoring and research in BC, as well as in adjacent jurisdictions, have demonstrated impacts to the functioning condition of small streams when riparian vegetation is removed.^{xii, xiii, xiv} For example, of over 2000 streams assessed between 2005 and 2014 using the FREP riparian protocol, one-third were assessed as not properly functioning. Of that third, four out of five were small, non-fish bearing streams (S6) and the smallest fish-bearing streams (S4).^{xv}

The Assistant Deputy Minister's Resource Stewardship Report for 2016/17 recommended a general increase in retention on small streams in all

Natural Resource regions, emphasizing "wider perennial streams that make significant contributions of water, sediment, debris and nutrients to downstream fish habitats and watershed function."^{xvi} FREP monitoring has shown that many licensees do provide riparian retention and/or machine-free zones adjacent to S4 and S6 streams, despite this not being a legal requirement.

The provincial Small Streams Project Team is a joint government-licensee working group formed to assess data from FREP and other sources on small streams management and work with practitioners on ways to improve practices adjacent to small streams. The team plans to work together with the broader stakeholder community to identify recommendations for small streams management. They are also developing a tool to assess the cumulative effects of riparian management for small streams at the watershed scale.

¹⁰ For the purpose of this report, *small streams* are defined as streams with an average width of 3.0 metres or less.

3. Inputs of sediment into streams

The FPPR and WLPPR contain a number of requirements for licensees that are directly or indirectly related to preventing inputs of sediments into streams, lakes and wetlands, including requirements to:

- limit soil disturbance related to cutblocks and access structures such as roads (sections 35, 36, 40 and 50);
- prevent landslides or gully processes (sections 37 and 38); and
- maintain natural surface drainage patterns during and after road construction (section 39).

Eroding banks in harvest areas and roads are among the most significant sources of increased sedimentation in streams, including both fine and coarse sediments adjacent to, or upstream of, fish habitats. Increased amounts of fine sediment in streams above natural levels can be detrimental to fish and fish habitats, covering spawning and feeding beds, smothering incubating eggs and clogging fish gills. Increased amounts of coarse sediments (gravels, cobbles, boulders) above natural levels are equally damaging, leading to channel widening and bank erosion, channel infilling, diversions, and dewatering.



Improvements in road construction and maintenance have generally reduced the number of mass wasting events and inputs of sediment into streams, first under the Code^{xvii} and, subsequently, under FRPA.^{xviii} However, there are still ongoing effects from sediment on fish habitats and opportunities exist to improve practices to minimize risk of sediment inputs.^{xix} Surface erosion from older, unused roads can also be a chronic source of sediments that impact stream and aquatic biota at crossings and below road rights-of-way. As an example, a 2017 Board investigation into sedimentation at McClure Creek found several legacy issues including non-status roads, access trails and an old skid trail crossing the creek multiple times.^{xx}

Road-related sediment is not limited to forest development activities. Roads associated with mining, utilities (powerlines), agriculture, and settlement contribute to cumulative inputs of sediment into streams. Small streams are particularly vulnerable to sediment inputs, since it only takes a small volume of sediment to impact a small stream at any given point. Inputs of sediment at multiple road crossings can be additive and, cumulatively, can affect water quality and fish survival. Planning to minimize road and stream crossing densities can also help to reduce sediment inputs.

Findings: Opportunities exist to strengthen FRPA requirements to conserve fish habitats

FRPA contains a number of general practice requirements that are intended to conserve fish and fish habitats across the forested landbase. These include retention of riparian habitat buffers, provision of fish passage at stream crossings, and road construction, maintenance and deactivation practices to maintain natural drainage and avoid inputs of sediment into streams.

There are three key aspects of forest management that could be strengthened, particularly for watersheds not designated as requiring special management:

1. cumulative effects at the watershed scale, particularly where there are no watershed-specific legal objectives;
2. riparian management adjacent to small streams; and
3. minimizing inputs of sediment from roads, stream crossings and other forestry developments.

Question 2. Is government implementing FRPA tools to conserve fish habitats in areas requiring special management?

Under the GAR, there are four main tools to designate areas for special management to address specific sensitivities and habitat requirements for fish: FSWs, temperature sensitive streams, wildlife habitat areas, and wildlife habitat features. These designations enable protections that are not otherwise provided under FRPA.

1. Setting watershed level objectives in fisheries sensitive watersheds

The FSW is the designation in the GAR to set legal planning objectives to conserve fish habitats at the watershed level. Within FSWs, licensees are required to conserve the natural hydrological and stream channel morphological conditions in the watershed and prevent cumulative hydrological effects that would have a material adverse effect on fish.¹¹

¹¹ The one other GAR designation that addresses cumulative hydrological effect at the watershed level is the community watershed. The FRPA objective for community watersheds is to prevent material adverse effects on drinking water going into a licensed waterworks. As such, it is only applicable to the portion of a watershed that feeds into a water intake and is not directly applicable to the conservation of fish habitats.

Examples of cumulative effects at the watershed level include the hydrologic effects of total area logged, density and location of roads and stream crossings, and cumulative inputs of sediment into streams.

To qualify as a FSW, watersheds must meet two tests: they must have significant fisheries values and significant watershed sensitivity (e.g., to increased peak flows, surface erosion, and mass wasting). GAR designations must also meet the test of not unduly reducing the supply of timber from BC's forests.^{xxi}

In June 2018, there were 61 watersheds designated as FSWs under the GAR. The number of FSWs has changed considerably over the last 18+ years (Figure 3). Over one hundred FSWs were originally designated under the Code and 44 of these were grandfathered into FRPA under section 8(1) of the FPPR. All of these expired in 2005 and FLNRO regions were tasked with identifying priority watersheds based on fish habitat values and watershed sensitivity. By 2013, there were 36 approved FSWs and an additional 25 were added in March of 2018. There are several other FSW proposals awaiting approval and an unknown number being assessed. Government has not estimated the overall proportion of BC watersheds that could potentially meet the criteria to become FSWs, since watersheds vary so much in size, characteristics and sensitivities, and fish populations.

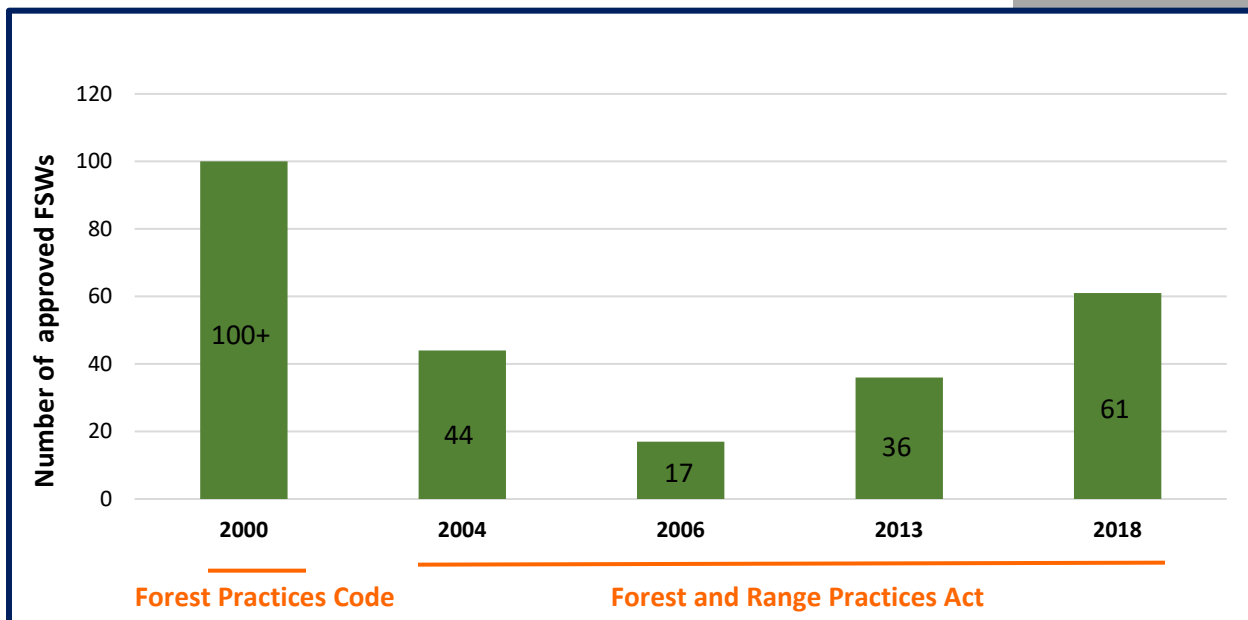


FIGURE 3. Change in the number of designated fisheries sensitive watersheds since 2000.

FSW designations are approved in only 9 of BC's 23 natural resource districts (Figure 4). This is due, in part, to priorities in each district and region, since designations for fish habitat must compete with other possible GAR designations (e.g., for wildlife or species at risk), for staff time and limits on impacts to timber supply. In interviews, government staff expressed frustration at the slow progress in designating FSWs. In some regions, a considerable amount of assessment work has been completed and priority watersheds have been identified but approvals are not forthcoming (see text box on page 20).

Watershed-level zoning and objectives for fish habitats have been more comprehensively established in some areas as an outcome of land use planning processes under other provincial legislation, such as the *Land Act*. In the last 10 years, a number of watershed-level designations for fish and watersheds have occurred through government-to-government strategic land use agreements with First Nations in northwestern BC. Examples include the Great Bear Rainforest Agreement (Important Fisheries Watersheds), Haida Gwaii Land Use Agreement (Sensitive Watersheds) and the Cranberry and Nass South Sustainable Resource Management Plans (Equivalent Clearcut Area Threshold Watersheds). Some of these planning areas also have requirements for enhanced riparian protection. Parks, protected areas and conservancies also contribute to the conservation of fish habitats.

Government has stated its intention to re-initiate land use planning, which could provide an opportunity to introduce legal watershed-level objectives over broader areas than is being achieved through FSW designations.¹² This could include water sustainability plans or objectives to sustain water quantity, water quality and aquatic ecosystems under the *Water Sustainability Act*.

¹² Several older strategic land use plans, such as land and resource management plans, have objectives to protect values at the watershed level but most of these are not legally established and therefore are not required to be included in FSPs.

FSW Designation Process in the Horsefly River

The Horsefly River is an example of how challenging it can be to designate FSWs. The Horsefly is a river system with some of the highest fish values in BC. Its high fish values and sensitivities to development were recognized as a priority for conservation as far back as 1996, in the Cariboo-Chilcotin Land Use Plan. Subsequent assessments support this ranking. It has also been subject to extensive forest development, particularly in sub-basins within the larger watershed that were subject to salvage logging post-mountain pine beetle attack.

Government began the process of designating the Horsefly as a FSW in 2000. While the designation had broad support from First Nations and non-forestry stakeholders, forest licensees' concerns about impacts to timber supply led to a difficult and protracted process and it was not until June 2018 that the order was finalized and signed off. In the interim, forestry activities continued without strategic objectives to manage rate of development, potentially increasing the risk to fish habitats (Figure 4).

Forest licensees have two years from the date of sign-off in 2018 to incorporate the FSW designation into their FSPs and it may take up to four years more before forestry activities are fully consistent with the FSW order.

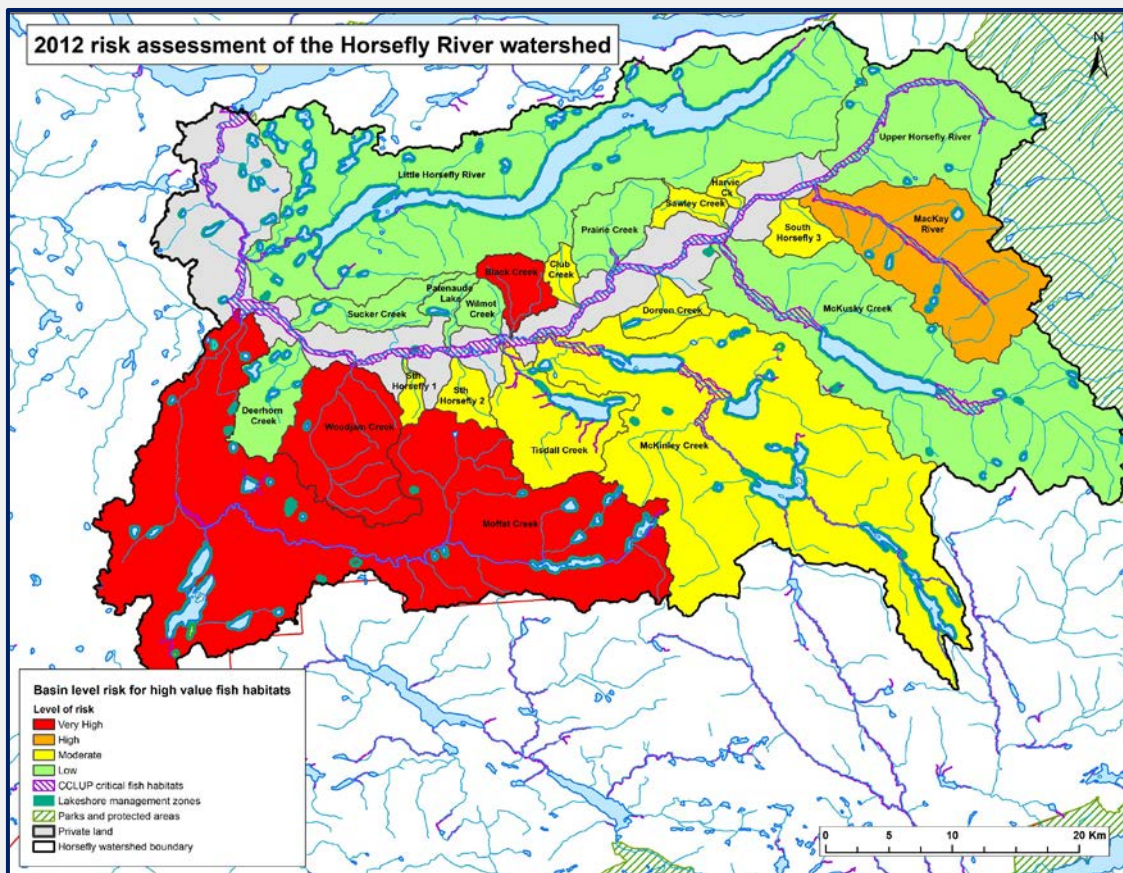


FIGURE 4. Results of 2012 risk analysis of the Horsefly River watershed and basins. (Source: M Milne 2012)^{xxii}

2. Protection of important or vulnerable habitats at the site level

Site level designations are part of a “fine filter” approach to management, providing specific measures to manage important habitat features that would not otherwise be protected under FRPA. For example, an important habitat feature for fish such as a fen or seasonal channel might not be captured within FPPR minimum requirements for riparian retention. There are three GAR designations that can be applied to fish habitats at the site level: temperature sensitive streams, wildlife habitat areas, and wildlife habitat features.



Photo: Merritt Herald

Temperature sensitive streams

The temperature sensitive stream designation is a tool to protect critical fish-bearing streams that are vulnerable to increased temperatures through the removal of riparian vegetation. The designation applies to streams that do not have mandatory riparian reserves in FRPA (i.e., small fish-bearing streams and their direct, non-fish-bearing tributaries). Practice requirements for forestry activities adjacent to a designated

temperature sensitive stream are in section 53 of the FPPR. These require retention of riparian vegetation to provide shade and thermal buffering to the designated stream reaches to prevent water temperatures from increasing to the extent where they have a material adverse effect on fish.

Criteria for candidate temperature sensitive streams include:

(i) vulnerability of a salmonid or fish species at risk to elevated temperatures, (ii) strong evidence of the data on temperature sensitivity and fish vulnerability, and (iii) evidence that retaining or restoring riparian vegetation will be beneficial to the stream’s thermal-buffering capacity.

As of June 2018, there were no temperature sensitive streams designated under FRPA. Two rivers (Nadina and Nicola) were designated as temperature-sensitive under the Code but the designations were not transferred to FRPA. The same two rivers are currently being piloted for a re-designation and other regions are holding off on designations until these two are approved. This designation may be particularly important in light of rising temperatures due to climate change.

Wildlife habitat areas

Wildlife habitat areas (WHAs) are areas designated under the GAR with legal objectives to minimize alteration or disturbance to wildlife (including fish) and their habitats during vulnerable periods.

WHAs can be designated under FRPA as *species at risk*¹³ or as *regionally important wildlife*.¹⁴ No regionally important wildlife have been listed under FRPA. In June 2018, 4 of the 31 freshwater and anadromous fish species at risk in BC (listed by the Conservation Data Centre) were added to the list of species at risk under FRPA:

1. cutthroat trout *lewisi* subspecies,
2. bulltrout,
3. Vananda Lake limnetic stickleback, and
4. Vananda Lake benthic sticklebacks

As of June 2018, 22 WHAs had been established for bull trout and one for stickleback, containing objectives to maintain the quality and function of habitats and to control road access.¹⁵

There were no WHAs for cutthroat trout, *lewisi* sub-species.

Wildlife habitat features

A wildlife habitat feature is a feature used by one or more species “to meet some or all of their life history requirements, and where special management is required to ensure the feature is protected from damage during forest and range activities.”^{xxiii} Fisheries sensitive features are one of the types of wildlife habitat feature that may be identified by government as requiring special management. A fisheries sensitive feature is defined in section 1(1) of the FPPR as:

- a) the littoral zone of a lake;
- b) a freshwater area where the water is less than 10 metres deep;
- c) a flooded depression, pond or swamp that is not a stream, wetland or lake but i) either perennially or seasonally contains water, and ii) is seasonally occupied by a species of fish referred to in the definition of a fish stream in the FPPR.



Photo: Fisheries and Oceans Canada

¹³ *Species at risk* are defined as endangered or threatened or vulnerable species that are negatively affected by forest or range management on Crown land and are not adequately protected by other mechanisms.

¹⁴ *Regionally important wildlife*, including fish, are species that are not deemed at risk, but are considered important to a region, rely on habitats that are not otherwise protected under FRPA, and may be adversely impacted by forest or range practices.

¹⁵ One of the reasons Vananda Lake stickleback are considered at risk is that they only exist in one location in three small lakes in coastal BC.

No fisheries sensitive features had been formally established as of June 2018. The first GAR order to establish wildlife habitat features was approved in the Kootenay-Boundary Region in May 2018 but fisheries sensitive features were not included because their definition in the FPPR was considered too broad.

Freshwater marsh fisheries sensitive feature that cannot be designated for protection under the current FPPR wording.

Photo: Alex Inselberg



Other site level designations

Some strategic land use plans designate areas along important fish-bearing streams for enhanced protection of riparian vegetation. These include the Cariboo-Chilcotin Land Use Plan critical fish habitats, Haida Gwaii Strategic Land Use Agreement Type 1 and Type 2 fish habitats, and the Atlin-Taku Land Use Plan critical aquatic habitats and salmon management areas. The Okanagan-Shuswap Land and Resource Management Plan includes an objective to maintain enhanced riparian reserves over 10 000 hectares of the timber harvesting landbase and enhanced retention in riparian management zones.

Other designations may also contribute to conservation of fish habitats, such as lakeshore management zones on lakes occupied by shore-spawning trout.

Findings: Government has been slow to implement tools to conserve fish habitats

While some progress has been made, government has been slow to implement the tools available under FRPA to provide special management for fish habitats, where needed.

There have been few FSW designations to date, although progress in recent months is encouraging. Some watersheds with known high fish values have been proposed for FSW designation for many years, but approvals have been delayed due to concerns about impacts to timber supply. In the meantime, developments continue without the guidance of strategic objectives at the watershed scale to conserve fish habitats.

Likewise, few site level designations have been granted for important or vulnerable fish habitats, other than WHAs for bull trout and stickleback. No regionally important wildlife species have been identified and only 4 of 31 fish species at risk have been placed on the list of species at risk protected under FRPA.

Designations for known temperature sensitive streams have been proposed for a number of years and these designations are likely even more important under climate change.

As a result of this slow progress, important and vulnerable fish habitats may not be adequately conserved or protected from the impacts of forestry activities.

Question 3. Is government monitoring the effectiveness of FRPA in conserving fish habitats?

FREP is government's program to monitor the effectiveness of the FRPA regulatory regime and provide feedback to enable continuous improvement in forest practices. Monitoring is done by forest district staff at randomly selected cutblocks that have been recently harvested. Sites are sampled according to protocols established under the FREP program.

FREP does two levels of monitoring relevant to the state of fish habitats:

Site level monitoring

FREP has undertaken extensive monitoring of water quality and stream condition over the years. The results of this monitoring are being applied in discussions between government and forest licensees about ways to improve FRPA practices around small streams and sediment.

Fish/ Riparian: As discussed in question 1 on page 5, FREP has been monitoring the health of stream channels and their adjacent riparian areas since 2005, with over 2400 samples taken across all stream classes (S1 to S6). FREP assesses the "functioning condition" of stream reaches in and adjacent to recent cutblocks, with site classifications ranging from properly

...important and vulnerable fish habitats may not be adequately conserved or protected...

functioning to not properly functioning.¹⁶ FREP assumes that streams with proper functioning sites will also have functional fish habitat if fish are normally present or if they support fish habitat downstream in the case of non-fish streams located upstream of fish bearing streams.

Data on stream functioning condition has been summarized and reported since 2009 with the first FREP Chief Forester's Report.^{xxiv} FREP does not specifically monitor WHAs or other site level designations for fish.

Water quality: FREP has been assessing water quality since 2008 with a focus on fine sediment in sites disturbed by forestry activities. Data was gathered from over 4000 sample sites in 24 forest districts from 2008 to 2012, and sampling is ongoing.^{xxv}

Watershed level monitoring

FREP has developed a procedure to monitor “the effectiveness of FRPA requirements within fisheries sensitive watersheds to maintain natural watershed functions and processes and conserve healthy fish populations.” There are two levels of monitoring: Tier 1, which is office-based and uses computer mapping of cutblock and road developments, and Tier 2, which is field-based and monitors on-the-ground indicators in watersheds that have been identified as higher risk through the Tier 1 analysis.

FREP completed an office-based Tier 1 assessment in 2015 of watersheds meeting the criteria for a FSW (i.e., high fish values and watershed sensitivities).^{xxvi} As of June 2018, intensive, field-based monitoring had occurred in five of these watersheds, but there were no published reports on the results.

FREP does limited field-monitoring of watersheds that are fisheries sensitive and there is no requirement in FRPA for licensees to undertake watershed level assessments.

Assessments of aquatic ecosystems under government's cumulative effects framework will provide a coarse level indication of the condition of watersheds based on computer analysis (Appendix 2).

¹⁶ *Proper functioning condition in the FREP Protocol for Evaluating the Condition of Streams and Riparian Management Areas* (2009) is the ability of a stream, river, wetland, lake and its riparian area to:

- withstand normal peak flood events without experiencing accelerated soil loss, channel movement or bank movement;
- filter runoff;
- store and safely release water; and
- maintain fish habitat in streams and riparian areas that are fully connected, so that fish habitat is not lost or isolated as a result of a management activity.

Findings: There are gaps in monitoring FRPA effectiveness at the watershed level

While considerable monitoring of fish habitat values has occurred at the site level, the Board is concerned that government is not adequately tracking the effectiveness of FRPA in conserving fish habitats at the watershed level. Without monitoring, government has no way of knowing how forest development activities are changing the condition of fish habitats and when the cumulative effects of development are putting fish habitats at risk.

Other issues related to fish-forestry interactions

This section describes two areas of concern that were identified during interviews with fish habitat experts:

1. Effects of forest regrowth on low flows
2. Effects of salvage logging above large lakes

Research in BC and adjacent jurisdictions is identifying issues of concern related to the effects of forestry activities on fish habitats that are not currently addressed by FRPA. More work is needed to determine the significance of these issues in a BC context.

1. Effects of forest regrowth on low flows in streams

Current watershed assessment procedures focus on peak flows, but recent studies indicate that the risk of harm to aquatic ecosystems from reduced summer flows may also increase with forest regeneration following logging.

Studies in coastal environments in BC^{xxvii} and Oregon^{xxviii} indicate that vigorously growing young stands of trees intercept and take more water than old growth stands and, therefore, can significantly reduce flow levels in streams. In the BC Interior, clear-cut logging has been associated with higher daily water yields in April and May but lower yields in June and July.^{xxix} Studies are underway in the Interior of BC through the University of British Columbia to assess these effects in the late summer months of August and September.

Reduced stream flow during the summer low flow period can cause harm to fish populations by reducing the total area of a stream that is available to fish, elevating water temperatures, and reducing dissolved oxygen levels (Figure 5).^{xxx} Scientists in Alaska have linked high fish densities and low stream flow to hypoxic (low oxygen) conditions in streams and die-offs of salmon when they congregate in streams to spawn.^{xxxi} There is concern that reduced stream flows under climate change will result in increased frequency of harmful conditions for fish.

The Board is concerned that government is not adequately tracking the effectiveness of FRPA in conserving fish habitats at the watershed level.

The BC FSW Technical Working Group is exploring the use of a metric for the proportion of equivalent second growth forest in its watershed evaluation procedures in order to account for low flow effects.

2. Effects of salvage logging above large lakes

The quality of water in lakes has a significant influence on the productivity and health of fish and fish habitat within that water body. Larger lakes have been thought to be highly resilient because their depth and volume of water are assumed to buffer inputs of nutrients. Research in BC's Interior is showing that even large lakes can be vulnerable to eutrophication related to extensive logging of upland areas (see text box on page 28). More research is needed to evaluate the effects of extensive harvesting upstream of large mesotrophic lakes that provide important fish habitat.



a. Flows in the Coldwater River in early summer. The white arrow shows the location of rearing habitat for juvenile steelhead at 20 percent mean annual discharge.



b. Flows in the Coldwater River in late summer, showing the location of rearing habitat for juvenile steelhead at 5 percent mean annual discharge. This is considered critical flow, when water restrictions are introduced.

FIGURE 5. Effects of low stream flows on rearing habitat for juvenile steelhead.

Fish Die-offs at Roche Lake

Roche Lake, in BC's Central interior, was one of the most highly used sports fishing lakes in the province, supporting over 30,000 angler days/ year and generating more than \$3 million annually to the BC economy.

Until 2011, this large, deep lake had been stable in its nutrient cycling, making it highly productive for stocked rainbow trout. Starting in 2011, the lake experienced an unprecedented series of algal blooms, which culminated in a near total trout winterkill event in 2014. The following year, based on dissolved oxygen sampling in the winter of 2015, the trout stocks were declared "dead" but were saved by an unprecedented early February freshet that re-introduced oxygenated water to part of the lake.

Over half of the watershed draining into Roche Lake is park. In the last 10 years, in the period leading up to the die-off, extensive logging occurred in the forests above the park to salvage stands of trees killed by mountain pine beetle. The strategy at the time was to focus salvage harvesting in watersheds with lakes to buffer increased inputs of sediment and nutrients (compared to watersheds with intermediate slopes and no lakes). By 2018, approximately 75 percent of the forests above the park had been logged (Figure 6).

Recent studies of lake sediment cores and patterns of eutrophication at Roche Lake suggest a link to large-scale salvage harvesting but further studies are needed. Similar phenomena have been observed in other lake headed watersheds in salvage logged areas of the Cariboo and Thompson-Okanagan regions.

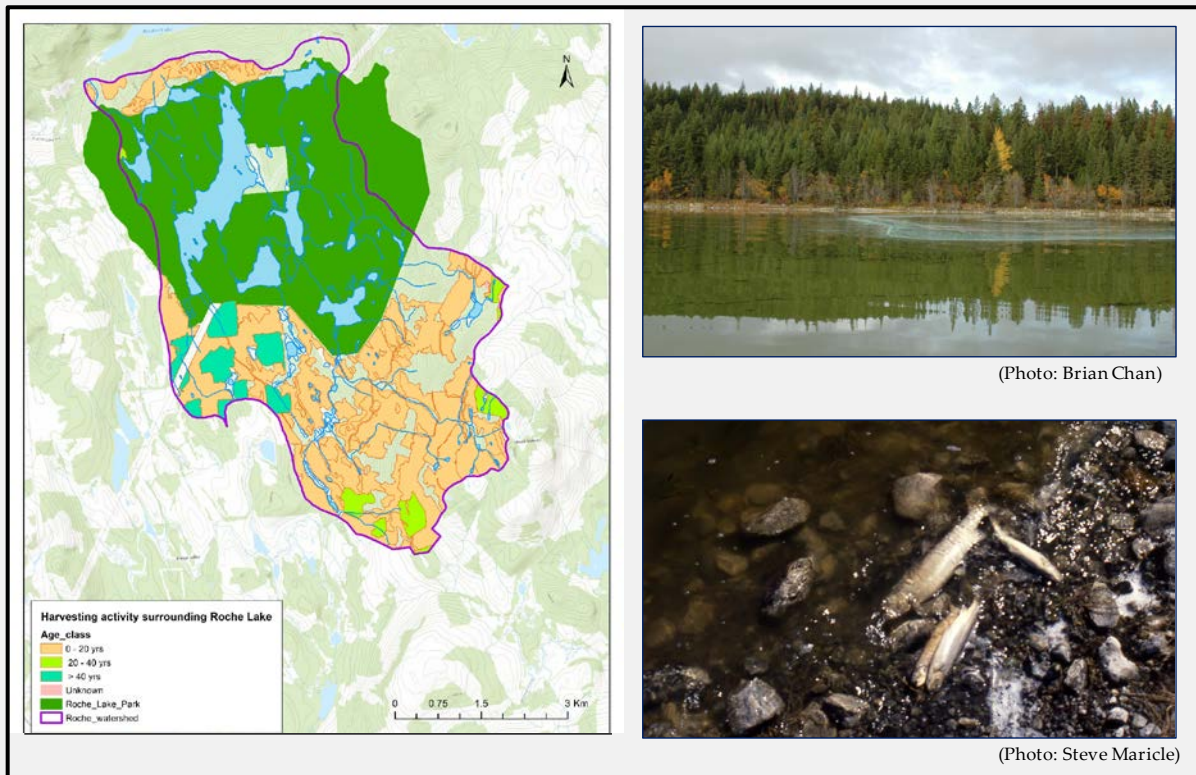


FIGURE 6. Extend of logging above Roche Lake Provincial Park over time (map) and evidence of eutrophication and fish die-off (photos).

One of the most significant gaps in FRPA's management of fish habitats is a lack of clear objectives to manage cumulative effects of forestry activities at the watershed level.

CONCLUSIONS

The Board examined government's approach to conserving fish habitats under FRPA. The report is based on interviews with fish experts, habitat managers and forest stewardship professionals, and reviews of legislation and policy as well as reports from BC and adjacent jurisdictions. In evaluating government's approach, the Board asked three questions.

Question 1. Are FRPA's planning and practice requirements adequate to conserve fish habitats across the forested landbase?

FRPA regulations contain numerous practice requirements that, directly and indirectly, influence the quality and functionality of fish habitats, primarily at the site level. Forest licensees must include results and strategies in their FSPs to meet FRPA requirements. Board reports and FREP monitoring have documented improvements to the conservation of fish habitats since regulations were introduced under the Code and continued under FRPA. Nonetheless, there are some areas of FRPA that could be strengthened.

One of the most significant gaps in FRPA's management of fish habitats is a lack of clear objectives to manage cumulative effects of forestry activities at the watershed level. Most watersheds do not have legal objectives for rates of change from developments such as forest harvesting, road development and density of road crossings. The risk of cumulative effects of developments at the watershed level is greatest where there are multiple, overlapping forest licences.

Two areas of concern at the site level are management next to small streams and prevention of sediment inputs into streams:

- The greater part of each watershed is made up of small streams (less than 3 metres in width). These make a vital contribution to the ecology of downstream fish habitats. Under FRPA, there is no requirement to retain riparian vegetation next to small streams despite considerable evidence that buffers prevent loss of stream functioning condition. Discussions are underway between government and licensees on ways to better protect small streams during forestry activities.
- FRPA contains several practice requirements to prevent inputs of sediment into streams. However, Board investigations and FREP monitoring are showing ongoing issues with sedimentation, with associated risks for fish habitats. Road-related sedimentation occurs from all kinds of roads, not just forestry.

Question 2. Is government implementing FRPA tools to conserve fish habitats in areas requiring special management?

FRPA enables the designation of important or vulnerable fish habitats not otherwise addressed in FRPA regulations. Designations include watersheds with high fish values and sensitivity to development as well as sites containing specific habitats important for fish.

Few special management designations to protect fish habitats have been implemented as of June 2018, despite assessments showing they are warranted, including in some critical habitats and in watersheds with very high values for fish. Delays in designating sites and watersheds can increase risks to fish habitats as forestry activities continue without objectives to conserve critical or vulnerable fish habitats.

Question 3. Is government monitoring the effectiveness of FRPA in conserving fish habitats?

Government's FREP program has gathered a strong set of data at the site level on the effectiveness of FRPA in managing to maintain the quality of water and the functioning condition of individual stream reaches. However, FREP monitoring is weak at the watershed scale; aside from some office-based assessments of watershed condition, few field assessments have been completed.

Research and monitoring are revealing new information about the interaction between forestry activities and fish habitats, such as a relationship between young regenerating stands and low stream flows and potential effects on water quality of extensive logging above large lakes. The FRPA framework is based on continuous improvement over time. However, no substantive changes to FRPA legislation have occurred since enactment. To be fully effective at conserving fish habitats and other FRPA values, there is a need to update the FRPA framework to reflect new information as it becomes available from research and monitoring.

...there is a need to update the FRPA framework to reflect new information...

APPENDIX 1: List of Acronyms

AAC	Allowable Annual Cut
ABCFP	Association of BC Forest Professionals
CABIN	Canadian Aquatic Biomonitoring Network
CEF	Cumulative Effects Framework
EGBC	Engineers and Geoscientists BC
FLNRO	Forests, Lands and Natural Resource Operations and Rural Development
FPPR	Forest Planning and Practices Regulation
FREP	Forest and Range Evaluation Program
FRPA	Forest and Range Practices Act
FSP	Forest stewardship plan
FSW	Fisheries sensitive watershed
GAR	Government Actions Regulation
HCTF	Habitat Conservation Trust Foundation
KMB	Knowledge Management Branch
TSA	Timber supply area
TSS	Temperature sensitive stream
WLPPR	Woodlot Planning and Practices Regulation
WSA	Water Sustainability Act
WHA	Wildlife habitat area

APPENDIX 2: BC Government Programs that Contribute to the Conservation of Fish Habitats

Government coordinates a number of programs that contribute to the conservation of fish habitats through the Ministry of Environment & Climate Change Strategy (MECC) and Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRO). Some of the key programs are described below.

Information and data management

Information and data are collected and managed through a range of programs run by government and industry. Government provides a central role in managing data collected by its own agencies, industry, and other organizations and in making this information available to the broader public, where appropriate.

MECC's Knowledge Management Branch (KMB) manages authoritative datasets on fish and fish habitats and has guidelines in place to encourage consistency and reliability of data. Other government ministries, including FLNRO and the Environmental Assessment Office, convey most of their data on fish and fish habitats to KMB as the provincial custodian of this data. KMB is working with ministry staff to ensure as much data as possible on fish and fish habitats is loaded into the corporate system. KMB also has agreements with non-governmental groups, such as the Freshwater Fisheries Society of BC and Habitat Conservation Trust Foundation (HCTF), to submit this data to government.

Government operates on a policy of open access to its data. The BC Species Information and Ecosystems Portal provides a broad scope tool for locating information on animals, plants and ecosystems. Government-held data on fish and fish habitats is accessible through Fish HabitatWizard, Fish Inventory Data Queries, and EcoCat Ecological Reports Catalogue.

The BC government has a number of internet-based map applications that provide members of the public with access to spatial files from the BC Geographic Warehouse related to fish and fish habitats. Applications include iMapBC, HectaresBC, and the BC Economic Atlas. Mapster is a web map service operated by Fisheries and Oceans Canada that provides spatial data on fish and fish habitats that includes BC.

Government staff do their own surveys of fish and fish habitats supported by FLNRO operational budgets and other funding sources such as HCTF and the Land Based Investment Account. Government currently does not have a strategic inventory plan for fish and fish habitats.

A large amount of data on fish and fish habitats comes from major development projects, which means that data is collected where projects are proposed. For example, annual monitoring of fish habitats and populations may occur as a condition of an environmental assessment. A Scientific Fish Collection permit is required to capture fish for the purposes of confirming fish presence/absence (e.g., for the

purposes of stream classification) and permit holders must submit all fish occurrence data to government. However, it is not compulsory for companies to submit habitat-related information and government rarely receives this kind of information. Any data collected, developed or derived by companies or individuals under a standard contract with the provincial government becomes the property of the province (e.g., funded through the Forest Investment Account).

BC cumulative effects framework

The Board has previously reported on the need for greater attention to the cumulative effects of all activities on the landbase.^{xxxii} Cumulative effects on fish habitats may arise from the combined landbase changes from settlement and agriculture, forestry, roads and other land-based industries and activities that cross jurisdictional boundaries.

Government is addressing this issue through its BC Cumulative Effects Framework (CEF). When completed, the CEF will contain policies, procedures and decision-support tools to identify and manage cumulative effects of multiple land-based activities and natural processes. Aquatic ecosystems, including fish habitats, are a core value for assessment under the CEF. A team of specialists in aquatic ecosystems has developed procedures to assess the levels of development-related pressures on aquatic ecosystems¹⁷ with a focus on watershed level processes that sustain water quality and quantity, as well as hydrologic and aquatic ecosystem functions and processes. The CEF procedures for fish and aquatic ecosystems consider road density, stream crossing density, peak flow index, riparian disturbance and total land disturbance.¹⁸

Government has approved an Interim Policy for its Cumulative Effects Framework. CEF assessment outputs are intended to inform priority setting and decisions at the strategic, operational and tactical scales of government operations. At the operational scale, decision-makers are to consider CEF assessment information and the need for mitigation, particularly, when land-based conditions are approaching benchmarks of concern.

CEF implementation is being put forward in a policy context; however, government has stated that this policy will not result in new legislative requirements. Implementation will be monitored and evaluated, and the need for new or revised legislation may be considered in the future.

Fish habitat restoration programs

Some parts of BC have a long history of forestry activities. Particularly on the Coast, forest stands that were logged 60 or more years ago are now available for logging a second time. Until the 1990s, there were a number of common forest practices that had the potential to severely damage fish habitats that

¹⁷ Indicators for the CEF aquatic ecosystems assessment are road density, including density of roads on steep slopes and within 100 metres of streams, stream crossing density, percent riparian disturbance, peak flow index, total land disturbance, and the number of mines, permitted waste discharges, water withdrawals and dams.

¹⁸ The CEF procedure for aquatic ecosystems has been applied by the Pacific Salmon Foundation to assess cumulative development pressures at the landscape level on salmon habitats and freshwater ecosystems in the Skeena watershed. <http://salmonexplorer.ca/#skeena§ion=habitat&habitat=development>

are no longer considered acceptable. These included building roads and landings within riparian areas immediately adjacent to streams and lakes, logging to the banks of all fish and non-fish bearing streams, and falling and yarding across streams.¹⁹

Long-running research projects, such as those run in the Fish-Forestry Interaction Program, are showing that recovery of fish habitat characteristics in streams from forestry-related disturbances, including riparian clearcutting and/or mass wasting upstream, may take many decades.^{xxx} There is a risk that streams and fish habitats damaged through historic logging may not recover within standard forest harvest rotations and may continue to decline with repeated harvesting, even when that harvesting is based on sound practices.

The current focus for watershed restoration in BC is on fish passage. There is a strong business case for fish passage restoration since many kilometres of high quality fish habitat can be made once again accessible to fish with each restored crossing structure. In 2009, a Board investigation showed that, of 19 watersheds assessed, only 42 percent of stream crossings in fish-bearing habitat had a high likelihood of passing fish.^{xxxiv} Older (pre-1995) transportation corridors, with closed-bottom culverts, are particularly problematic, including forestry roads, highways, secondary roads, municipal roads, private roads and railway lines.

At the same time, there may be other opportunities to promote the restoration of watersheds damaged by historic logging with a whole-basin approach, considering connections from the hillslopes to the mainstream channel. This would include sediment source and transport control such as road deactivation and/or on-going maintenance to reduce chronic sediment supply and the risk of mass wasting, re-establishing natural drainage patterns where necessary, replacing lost channel-structuring elements within streams and restoring the diversity of vegetation in riparian areas.

Restoration projects continue to be funded or implemented through federal programs, such as the Recreational Fisheries Conservation Partnerships Program, as well as organizations, such as the Habitat Conservation Trust Foundation, Freshwater Fisheries Society of BC, Pacific Streamkeepers, and Central Westcoast Forest Society. BC Hydro undertakes restoration work as part of its Fish and Wildlife Compensation Program to compensate for the impacts to fish, wildlife and their supporting habitats affected by BC Hydro owned and operated generation facilities in its Peace, Columbia and Coast regions. In February 2018, the federal government announced measures to restore degraded habitats and rebuild damaged fish stocks as part of their proposed amendments to the federal *Fisheries Act*.

Long-term Responses to Historic Forest Practices

A 47 year study of the effects of historic (pre-1995) forest practices on salmonid populations at Carnation Creek on Vancouver Island suggests that negative effects on fish habitats may not be apparent for several decades and habitat degradation (e.g., channel widening, sediment accumulation, and streambank instability) may continue over the longer term.^{xxxiv}

¹⁹ Clearcutting to the banks is still allowed under FRPA for class S4, S5, and S6 streams. Cross stream falling/yarding is still allowed for class S6 streams.

Research and monitoring

Research programs

Both MECC and FLNRO support research programs, in Victoria or the regions, that conduct research projects applicable to provincial strategic goals for conserving fish habitats. In addition, a number of research institutions, environmental and sport fishing organizations conduct projects to examine the effects of changes to land and water on fish habitats and fish. The province has supported a number of long-running research projects over the years (e.g., under the Fish-Forest Interaction Program). These studies provide vital information on the effects of development activities on the structure and function of streams and fish habitats.

The following are examples of government-supported projects in BC to study fish–forest interactions. The Prince George and Bowron River projects have now concluded.

- *Carnation Creek* (west coast of Vancouver Island): Begun in 1970, this is an intensive, single-watershed case study into the effects of forestry practices on biological and physical watershed processes and fish populations.
- *Prince George Small Streams Project*: From 2001 to 2006, this project studied the ecological effectiveness of a district policy to retain riparian vegetation next to S4 streams.²⁰
- *Bowron River*: This research, investigated the future condition of riparian zones and streams in mountain pine beetle affected forests 20-30 years after large scale salvage harvesting.

Government agencies also benefit from the work of research by other organizations, such as universities and non-governmental organizations, such as the following:

- *Malcolm Knapp Research Forest (University of British Columbia)*: This study assesses the effects of different riparian management treatments within Coastal Western Hemlock forests. Baseline data collection began in 1996-97 and continued to 2007. Researchers plan to revisit the sites in 2017-2019.
- Research centres, such as the Bulkley Valley Research Centre (an independent society) and Quesnel River Research Centre (affiliated with University of Northern BC), bring together researchers from various disciplines to study interactions between humans and the natural environment, including fish–forest interactions.

Monitoring programs

There are a number of monitoring programs operated within government or supported by government, but implemented through other programs such as the HCTF and Freshwater Fisheries Society of BC. In addition, monitoring occurs by industry and non-governmental organizations.

The Forest and Range Evaluation Program is the monitoring program that evaluates the impact of forest and range development on FRPA values, including fish and aquatic ecosystems.

²⁰ S4 streams are less than 1.5 metres bankfull width and fish-bearing.

The BC MECC has partnered with Environment and Climate Change Canada to implement the Canadian Aquatic Biomonitoring Network within BC (CABIN). The purpose of CABIN is to measure the health of freshwater ecosystems using standardized methods. Indicators include benthic invertebrates, reach characteristics, water quality, and substrate quality.

Government has initiated an integrated monitoring program to coordinate monitoring and reporting of data across natural resource sectors, including monitoring of fish habitat values. The first report, entitled, *Natural resource stewardship monitoring and assessment report for the Wet'suwet'en Hereditary Territory*, was published in November 2017.

ENDNOTES

- ⁱ Fisheries and Oceans Canada. No date. Canada's fish habitat law. Available at <http://www.dfo-mpo.gc.ca/Library/140198.pdf>
- ⁱⁱ Standing Committee on Fisheries and Oceans. 2017. Review of changes made in 2012 to the Fisheries Act: Enhancing the protection of fish and fish habitat and the management of Canadian Fisheries. Available at <http://www.parl.gc.ca/content/hoc/Committee/421/FOPO/Reports/RP8783708/foporp06/foporp06-e.pdf>.
- ⁱⁱⁱ Tschaplinski, P.J. 2010. State of Stream channels, fish habitats, and their adjacent riparian areas: Resource stewardship monitoring to evaluate the effectiveness of riparian management, 2005 – 2008. FREP Report #27. BC Forest and Range Evaluation Program, Ministry of Forests, Lands and Natural Resource Operations. Available at https://www.for.gov.bc.ca/ftp/hfp/external!/publish/frep/reports/FREP_Report_27.pdf
- ^{iv} Chatwin, S., P. Tschaplinski, G. McKinnon, N. Winfield, H. Goldberg, and R. Scherer. 2001. Assessment of the condition of small fish-bearing streams in the central interior plateau of British Columbia in response to riparian practices implemented under the Forest Practices Code. BC Ministry of Forests Research Branch Working Paper No. 61. Available at <https://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp61.htm>
- ^v Forest Practices Board. 1998. Forest planning and practices in coastal areas with streams (FPB/SIR02) Available at <https://www.bcfpb.ca/sites/default/files/reports/SIR02.pdf>
- ^{vi} Tschaplinski, P.J. 2010. State of stream channels, fish habitats, and their adjacent riparian areas: Resource stewardship monitoring to evaluate the effectiveness of riparian management, 2005 – 2008. FREP Report #27. BC Forest and Range Evaluation Program, Ministry of Forests, Lands and Natural Resource Operations. Available at https://www.for.gov.bc.ca/ftp/hfp/external!/publish/frep/reports/FREP_Report_27.pdf
- ^{vii} BC Ministry of Forests, Lands and Natural Resource Operations. 2017. Natural resource stewardship monitoring and assessment report for the Wet'suwet'en Hereditary Territory. Available at <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/integrated-monitoring/nrsmonitoringandassessmentreport-wetsuweten.pdf>
- ^{viii} Pickard, D., M. Porter, L. Rees-Hansen, R. Thompson, D. Tripp, B. Carson, and P. Tschaplinski 2016 Draft. Memekay watershed status evaluation. Extension Note #33. Forest and Range Evaluation Program, Ministry of Forests, Lands and Natural Resource Operations.
- ^{ix} BC Ministry of Forests, Lands and Natural Resource Operations. 2016. Kamloops Timber Supply Area: Rationale for allowable Annual Cut (AAC) Determination. Available at http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/kamloops_tsa_rationale.pdf
- ^x Sommer, R. District Manager, Thompson Rivers Forest District, FLNRO. 2016. Thompson Rivers Forest District, District Manager letter of expectation regarding FSPs distributed to all forest licensees and forest professionals. Available at http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/laws-and-policies/dm-letters-of-expectation/thompson_rivers_forest.pdf
- ^{xi} Gomi, T., R.C. Sidle, and J.S. Richardson, 2002. Understanding processes and downstream linkages of headwater systems. *BioScience*, Vol. 52, Issue 10. Available at <https://academic.oup.com/bioscience/article/52/10/905/354918>
- ^{xii} Nordin, L., J. Rex, and P. Tschaplinski. 2017. The condition of small streams after harvesting: A summary of FREP data from 2006 – 2015. BC Forest and Range Evaluation Program Extension Note #40. Available at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/frep/extension-notes/frep_extension_note_40.pdf
- ^{xiii} Tripp, D., L. Nordin, J. Rex, P. Tschaplinski, and J. Richardson. The importance of small streams in British Columbia. BC Forest and Range Evaluation Program Extension Note #38. Available at <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/frep/extension-notes/frep-extnt38-smallstreams.pdf>
- ^{xiv} Rex, J., D. Maloney, E. MacIsaac, H. Herunter, P. Beaudry, and L. Beaudry. 2011. Small stream riparian retention: the Prince George Small Streams Project. Extension Note 100. B.C. Ministry of Forests and Range, Forest Science Program. Available at www.for.gov.bc.ca/hfd/pubs/Docs/En/En100.htm
- ^{xv} Tschaplinski, P.J., and D. Tripp. 2017. Post-harvest condition of stream channels, fish habitats, and adjacent riparian areas: Resource stewardship monitoring to evaluate the effectiveness of riparian management 2005 – 2014. FREP Extension Note #39. Available at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/frep/extension-notes/frep_extension_note_39.pdf

- ^{xvi} Forest and Range Evaluation Program. 2016. Assistant Deputy Minister Resource Stewardship Regional Results from the Forest and Range Evaluation Program. FREP Report #41. Available at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/frep/frep-docs/reports/adm_resource_stewardship_report_frep_results_2016.pdf
- ^{xvii} Horel, G. 2006. Summary of landslide occurrence on northern Vancouver Island. Streamline Watershed Management Bulletin Vol10(1): 1 – 9. Available at http://www.forrex.org/sites/default/files/publications/articles/Streamline_Vol10_No1_art1.pdf
- ^{xviii} Tschaplinski, P. J. 2012. The effects of roads on the post-harvest condition of streams, riparian areas and fish habitats in British Columbia 1996 – 2010. In Resource Roads in British Columbia: Environmental challenges at the site level (Workshop proceedings; November 7 – 8 2012 in Cranbrook, BC), Columbia Mountains Institute of Applied Ecology, Revelstoke, BC.
- ^{xix} Tschaplinski, P.J. 2010. State of stream channels, fish habitats, and their adjacent riparian areas: resource stewardship monitoring to evaluate the effectiveness of riparian management, 2005–2008. BC Ministry of Forests, Mines and Lands, Forest and Range Evaluation Program, Victoria, B.C. FREP Report No. 27. http://www.for.gov.bc.ca/ftp/hfp/external!/publish/FREP/reports/FREP_Report_27.pdf
- ^{xx} Forest Practices Board. 2017. Impacts of harvesting and road construction on water quality in McClure Creek. Report #FPB/IRC/211. Available at <https://www.bcfpb.ca/wp-content/uploads/2017/10/IRC211-McClure-Creek.pdf>
- ^{xxi} BC Ministry of Forests, Lands and Natural Resource Operations and BC Ministry of Environment. 2013. Government Actions Regulation Policy and Procedures. Available at <https://www.for.gov.bc.ca/ftp/hth/external!/publish/web/frpa-admin/frpa-implementation/gar-guide.pdf>
- ^{xxii} Milne, M.J. 2012. Horsefly River – watershed risk analysis. Prepared for the BC Ministry of Forests, Lands and Natural Resource Operations, Williams Lake, BC.
- ^{xxiii} BC Ministry of Environment Ecosystems Branch. 2017. Wildlife Habitat Features Guidance Document (Kootenay Boundary Region) (June 30 2017 Draft). Available at http://www.env.gov.bc.ca/wld/frpa/WHF.Guidance.Document_KootenayBoundary_30June2017.pdf
- ^{xxiv} Forest and Range Evaluation Program. 2009. Chief Forester’s Report: Considerations for forest and range stewardship under the Forest and Range Practices Act. Available at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/frep/frep-docs/reports/chief_foresters_report_2009.pdf
- ^{xxv} Carson, B., and D. Maloney. 2013. Provincial water quality effectiveness evaluation results (2008 – 2012). FREP Report #35. BC Forest and Range Evaluation Program, Ministry of Forests, Lands and Natural Resource Operations. Available at https://www.for.gov.bc.ca/ftp/hfp/external!/publish/frep/reports/FREP_Report_35.pdf
- ^{xxvi} Porter, M., S. Casley, N. Ochoski, and S. Huang. 2015. Watershed status evaluation: An assessment of 71 watersheds meeting BC’s fisheries sensitive watershed criteria. FREP Report #39. Available at <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/frep/frep-docs/frep-fsw-watershedeval-2015.pdf>
- ^{xxvii} Hudson, R. and G. Horel. 2007. An operational method of assessing hydrologic recovery for Vancouver Island and south coastal BC. BC Ministry of Forests and Range, Research Section, Coast Forest Region, Nanaimo, BC, Technical Report TR-032/2007.
- ^{xxviii} Perry, T.D., and J.A. Jones. 2017. Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA. *Ecohydrology* 10(2): DOI:10.1002/eco.1790.
- ^{xxix} Winkler, R., Spittlehouse, D. and Boon, S. 2017. Streamflow response to clear-cut logging on British Columbia’s Okanagan Plateau, *Ecohydrology*, 10(2), p. e1836. doi: 10.1002/eco.1836.
- ^{xxx} Rosenfeld, J. S. 2017. Developing flow-ecology relationships: Implications of nonlinear biological responses for water management, *Freshwater Biology*, 62(8), pp. 1305–1324. doi: 10.1111/fwb.12948.
- ^{xxxi} US Forest Service Pacific Northwest Research Station. 2017. Even fish need oxygen: Investigating hypoxia in rivers where salmon spawn. Available at <https://www.fs.fed.us/pnw/research/science-stories/fish-oxygen.shtml>
- ^{xxxii} Forest Practices Board. 2011. Cumulative effects: From assessment towards management. Report #FPB/SR/39. Available at <https://www.bcfpb.ca/wp-content/uploads/2016/04/SR39-Cumulative-Effects.pdf>
- ^{xxxiii} Tschaplinski, P.J. and R. G. Pike. 2017. Carnation Creek watershed experiment—long-term responses of coho salmon populations to historic forest practices. *Ecohydrology* 10 (2): e1812.



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