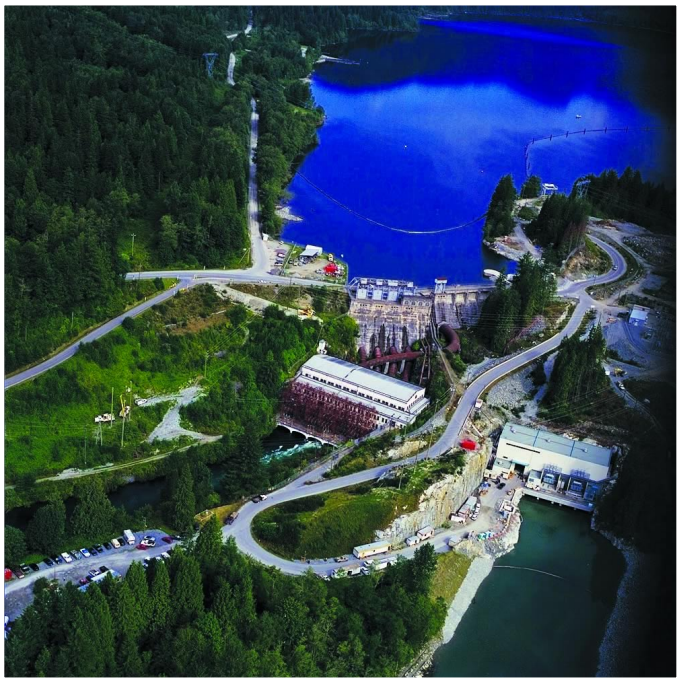
STAVE RIVER WATERSHED ACTION PLAN

FINAL November 14, 2017
Administrative Update July 21, 2020

The Fish & Wildlife Compensation Program is a partnership between BC Hydro, the Province of B.C., Fisheries and Oceans Canada, First Nations and Public Stakeholders to conserve and enhance fish and wildlife impacted by BC Hydro dams.

The Fish & Wildlife Compensation Program is conserving and enhancing fish and wildlife impacted by construction of BC Hydro dams in this watershed. From left: Ruskin Dam, Stave Falls Dam (Credit BC Hydro). Cover photos: Coho fry (Credit iStock), Great Blue Heron (Credit Phil Payne).

The Fish & Wildlife Compensation Program (FWCP) is a partnership between BC Hydro, the Province of BC, Fisheries and Oceans Canada, First Nations and Public Stakeholders to conserve and enhance fish and wildlife impacted by BC Hydro dams. The FWCP funds projects within its mandate to conserve and enhance fish and wildlife in 14 watersheds that make up its Coastal Region.

Learn more about the Fish & Wildlife Compensation Program, projects underway now, and how you can apply for a grant at fwcp.ca. Subscribe to our free email updates and annual newsletter at www.fwcp.ca/subscribe. Contact us anytime at fwcp@bchydro.com.

EXECUTIVE SUMMARY: STAVE RIVER WATERSHED

The Fish & Wildlife Compensation Program is a partnership between BC Hydro, the Province of B.C., Fisheries and Oceans Canada, First Nations and Public Stakeholders to conserve and enhance fish and wildlife impacted by BC Hydro dams.

This Action Plan builds on the Fish & Wildlife Compensation Program's (FWCP's) strategic objectives, and is an update to the previous *FWCP Watershed and Action Plans*. The Action Plan was developed with input from BC Hydro, Fisheries and Oceans Canada (DFO), Canadian Wildlife Service (CWS), Ministry of Environment (MOE), Ministry of Forests, Lands and Natural Resource Operations (FLNRO), participating First Nations, and local communities. It specifies actions that will conserve, restore and enhance fish and wildlife species and their habitats.

This Action Plan sets out Priority Actions for the FWCP that will guide funding decisions for FWCP projects in the Stave River watershed. The focus of the next five-year period will be Priority Actions identified for fish, wildlife and habitats in three broad ecosystem categories:

1. Rivers, Lakes & Reservoirs;
2. Wetland & Riparian Areas; and
3. Upland & Dryland.

These ecosystem categories are described in the Ecosystem Chapters, and proposed Priority Actions are captured in the Action Table at the end of this document. The Priority Actions are intended to support FWCP's strategic objectives of conservation, sustainable use, and community engagement. Priority Actions eligible for FWCP funding fall into one or more of the following action types:

- **Research and Information Acquisition** – These actions will collect information necessary to evaluate, review and implement subsequent conservation, restoration and enhancement actions. Examples include inventory, limiting factor assessments and other activities to address data gaps and information needs to complete other actions.
- **Habitat-based Actions** – These actions will conserve, restore, and enhance habitats. Examples include habitat creation, restoration, and enhancement, enhancing habitat connectivity, and invasive species management.
- **Land Securement** – These actions will contribute to the establishment of easements or covenants or the purchase of private land for conservation purposes.
- **Species-based Actions** – These actions will alleviate limiting factors for a species. Examples include restoration planning, captive breeding/rearing and reintroduction.
- **Monitoring and Evaluation** – These actions will monitor and evaluate projects supported by FWCP to understand the effectiveness of habitat- or species-based actions.

This Action Plan, and specifically the Action Table, sets FWCP priorities for investments in compensation activities within the watershed. However, actions may not translate into funded projects. FWCP funding limitations require priority setting across the Coastal Region's 14 watersheds. The process of selecting which actions will be implemented in any given year will occur during the annual grant intake and project cycle. See fwcp.ca for more.

About our Action Plan

This Action Plan provides important background information about the watershed, including hydro development projects by BC Hydro, and conservation and enhancement projects funded by the Fish & Wildlife Compensation Program (FWCP). This Action Plan outlines our Priority Actions for fish and wildlife eligible for an FWCP grant.

Anyone interested in applying for an FWCP grant should review our Priority Actions (see Action Table) and develop a grant application that aligns with a Priority Action(s).

Contact us to discuss our grants, Priority Actions and how we can help you develop your grant application. Subscribe and we will keep you posted about our grants and the projects we fund. Learn more at fwcp.ca

TABLE OF CONTENTS

STAVE RIVER WATERSHED BACKGROUND

Introduction

The FWCP Action Plans provide strategic direction for each region based on the unique priorities, compensation opportunities, and commitments in the region and they reflect FWCP's vision and mission. The Action Plans describe the strategies and Priority Actions to support FWCP objectives. Please refer to the Action Plan Overview for more information on the process that was followed to develop Action Plans. The structure of this Action Plan is shown in Figure 1.

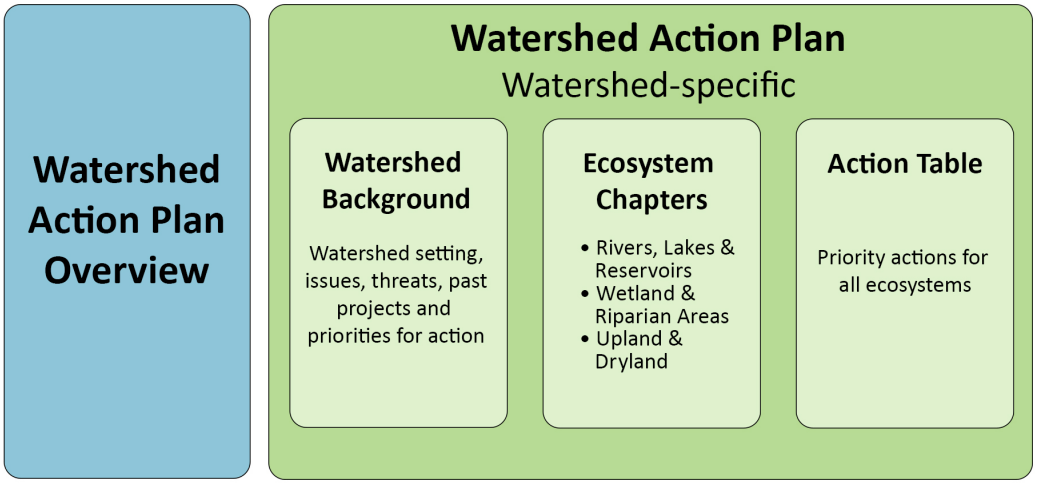


Figure 1: Structure of FWCP Action Plan Overview and Action Plan components.

Setting

The Stave River Watershed is located approximately 70 km east of Vancouver in the Fraser River Valley (Figure 2). It is adjacent to the easterly boundary of the Alouette River Watershed, both of which flow south. The Alouette River discharges into the Pitt River and then the Fraser River, while the Stave River discharges directly into the Fraser River. Two thirds of precipitation in the Stave River Watershed comes from south-westerly warm fronts during between October and March. The remaining third falls over the late spring and summer. The hydrology is dominated by spring runoff from melting snow and from storm events in the autumn.

The watershed has a diverse group of users. The Stave River system lies within the traditional territory of the Katzie and Kwantlen First Nations and is also of interest to Matsqui First Nation, Seabird Island Band, Semiahmoo First Nation, Shxw'ow'hamel First Nation, Skawahlook First Nation, and Soowahlie First Nation. The lower Stave River runs between the communities of Maple Ridge and Mission. The northern shore of the northern part of Stave reservoir borders onto Golden Ears Provincial Park.

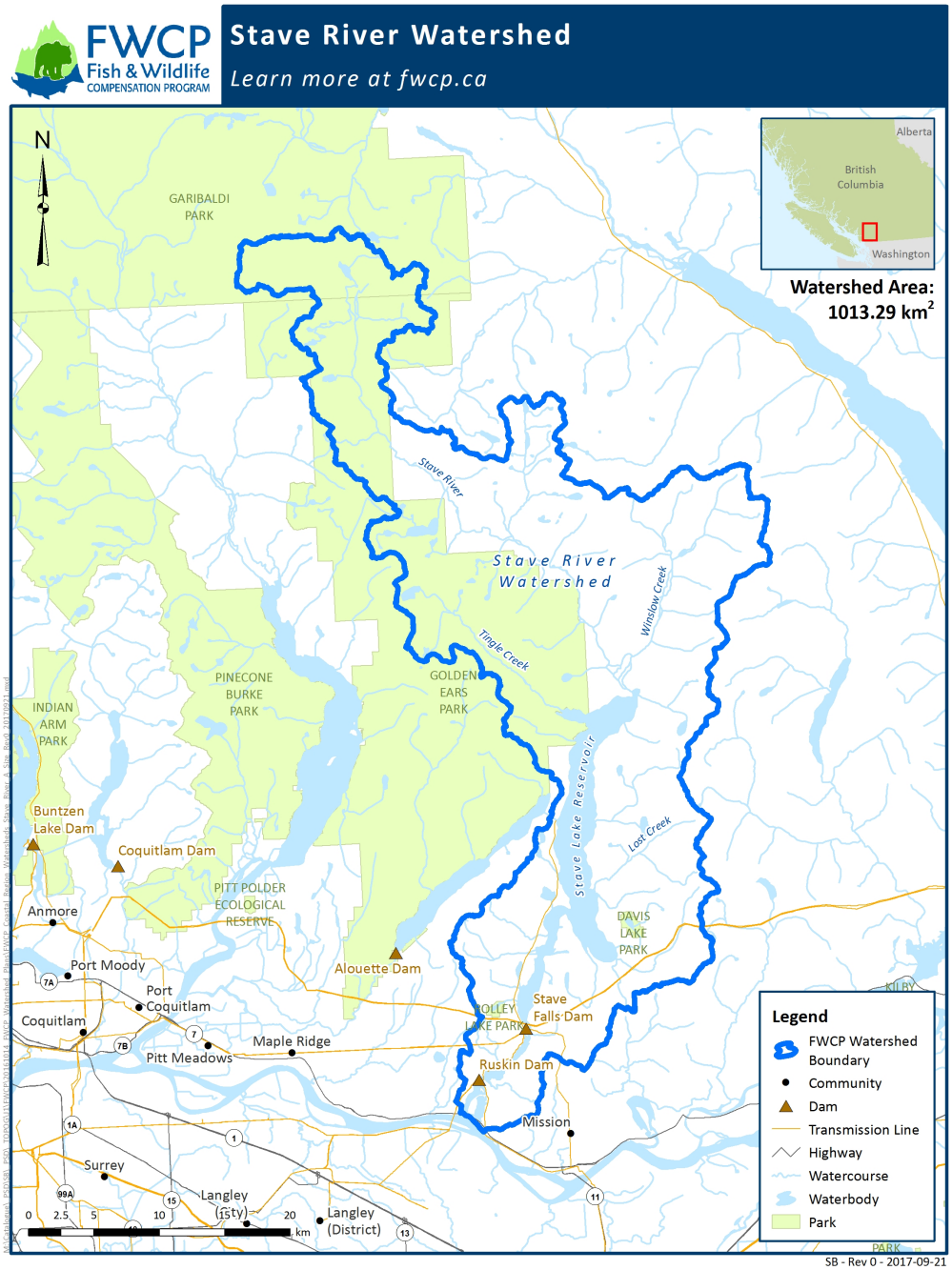


Figure 2: The FWCP Stave River Watershed boundary.

Land Ownership in the Stave River Watershed

The northern and western parts of the watershed lie within Golden Ears Provincial Park and the north end in Garibaldi Provincial Park. The southern part of the watershed is predominantly Kwantlen First Nation's reserves and suburban and

agricultural land that is privately owned. Most of the remainder of the watershed is Crown land. Proponents need to ensure proposed activities and access requirements do not conflict with local land ownership and, where necessary, provide the status of project/land owner discussions in the proposal.

Footprint Impacts and Threats

Dam construction, hydropower development, and alterations in the hydrologic regime of the system have resulted in considerable changes to habitats and the fish and wildlife populations that rely on them.

Hydro-related Impacts

Inundation: The combined reservoir area of Stave and Hayward reservoirs is 5,535 ha after flooding 2,612 hectares of land. The combined reservoir shoreline length is now 101.3 km.

Habitat Loss: Stave Reservoir flooded 22.4 km of mainstem and 32 km of tributary channels, their associated riparian zones, 1676 ha of forest and 241 ha of wetland, while the Hayward Reservoir flooded 6 km of mainstem channel and 2.7 km of lower tributary channel, plus their associated riparian zones. Former spawning, rearing and overwintering areas are permanently lost or seasonally reduced due to dam footprint, reservoir flooding, flow diversions, or operating flows; or from non-hydro sources. Dams have reduced recruitment of large woody debris and gravel downstream. Initial construction of the dam likely sluiced a large volume of sediment that degraded downstream habitat.

Migration Barriers: Ruskin Dam blocked passage, and anadromous and migratory resident stocks have been excluded from river habitats now occupied by Hayward Reservoir for 70 years. There is reduced fish access between reservoir and tributary habitat due to large drawdown regimes in both reservoirs. Blind Slough Dam cut off flows to 1 km of the downstream channel.

New Habitat: Reservoirs have created new habitat for lake species.

Fluctuating Reservoir: Drawdown of the reservoir reduces littoral productivity, strands fish and reduces access for resident fish to historic tributaries.

Altered Flow Regime: High rate of flushing through Hayward reduces littoral productivity. Periodic spills cause sedimentation of spawning habitat in the mainstream of lower Stave River. Ramping rates can contribute to fish stranding. Attraction of fish to Alouette powerhouse increases susceptibility to angling harvest. Occasional spills at Ruskin Dam alter habitat characteristics in this reach.

Diversions: 90% of the water in the Alouette river basin is diverted to the Stave. The Alouette diversion has increased annual flow volume in the lower Stave River; these altered flows have affected wetted channel area, seasonal temperatures and stream productivity.

Entrainment: Magnitude of entrainment is unknown.

Total Gas Pressure: Occasional Total Gas Pressure events have occurred associated with spills over Ruskin Dam. One goal of the Ruskin Dam and Powerhouse Upgrade Project is to improve Total Gas Pressure conditions below Ruskin Dam.

Non-hydro Impacts

Other impacts on fish populations in the Stave River Watershed include historic effects of logging, flood protection, agricultural land conversion and urbanization.

Objectives for the Stave River Watershed

Clear management objectives are needed to guide information gathering and effective prioritizing of management actions. Each Ecosystem Chapter has three objectives, which are high-level statements of desired future conditions (outcomes), consistent with FWCP strategic objectives, partner mandates and policies. Each Ecosystem Chapter also has more detailed sub-objectives, which provide more specific direction on desired future conditions. Priority Actions in the Action Table align with the objectives and sub-objectives, summarized in Table 1.

Table 1: Summary of objectives and sub-objectives in each Ecosystem Chapter.

Objectives	Sub-objectives		
	Rivers, Lakes & Reservoirs	Wetland & Riparian Areas	Upland & Dryland
Ensure a productive and diverse ecosystem	Conserve and restore habitat capacity and diversity for fish and other aquatic organisms.	Protect, enhance and create new wetland and riparian habitat.	Protect and enhance rare and ecologically significant upland/dryland habitat.
Maintain or improve the status of species of interest	Sustain and increase the population viability of: (a) Anadromous salmon (Coho, Chinook, Chum and Pink) and Steelhead; (b) Resident salmonids (Rainbow Trout, Cutthroat Trout, and Bull Trout/Dolly Varden); and (c) White Sturgeon.	Maintain and, where feasible, increase the abundance of species of interest (e.g., federally listed species-at-risk and species identified through government, community, and First Nations engagement). See Action Table for specific species.	Maintain and, where feasible, increase the abundance of species of interest (e.g., federally listed species-at-risk and species identified through government, community, and First Nations engagement). See Action Table for specific species.
Maintain or improve opportunities for sustainable use	Maintain or improve opportunities for sustainable use, including for food, social, ceremonial, recreational, or commercial purposes.		

FWCP Projects Implemented: Stave River Watershed

FWCP has been funding projects in the Stave River Watershed since 1999 under the Bridge-Coastal Restoration Program (BCRP) and subsequently under the Fish & Wildlife Compensation Program[1] Coastal Region. A full list of the reports from projects undertaken to date is available online at www.fwcp.ca. Below is a brief summary of the work undertaken during the 2010/2011 to 2015/2016 FWCP project years.

Rivers, Lakes & Reservoirs

Eight Rivers, Lakes & Reservoirs projects were undertaken in the Stave River watershed during the 2010/2011 to 2015/2016 FWCP project years with $339,156 of FWCP funding. Five of these projects were Habitat-based Actions conducted through the Fraser Valley Watersheds Coalition to create, improve and restore side channel and other spawning and rearing habitats in the Lower Stave River. These projects included the Right Bank Channel Project, the Coho Off-Channel Habitat Restoration, the Tidal Channel Restoration, the Stave River Ruskin Channel Project and the

[1] The Program changed its name in 2011 from the BCRP to the FWCP.

Restoring Salmon Spawning, Rearing and Overwintering Project. The Lower Stave River is one of the most productive salmon habitats in the province and supports the second largest Chum Salmon population in the Fraser River watershed. The construction and enhancement of side channels, habitat complexing, spawning gravel augmentation, re-vegetation, and improvements to side channel flow conducted through these projects will have long-lasting positive impacts to salmon productivity in the Lower Stave River.

The remaining three projects were Species-based Actions to support hatchery operations for Steelhead and comprise annual phases of the five-year Stave River Steelhead Smolt Imprinting and Adult Assessment project (2008-2013) conducted through the BC Conservation Foundation. With an anadromous length of less than 3 km, the Stave River offers limited rearing area and imprinting time for the production of wild adult and hatchery Steelhead. The short anadromous distance has been theorized to be a contributing factor in the low return rates of adult Steelhead and mixed success of hatchery operations. In this project, Steelhead smolts were reared in pens in Hayward Lake for a longer period of imprinting time and then released below Ruskin Dam. Results showed that there were higher rates of Steelhead adult returns using this stocking strategy as compared to standard Steelhead stocking techniques for the Lower Stave River.

Wetland & Riparian Areas

Two Wetland & Riparian Areas projects were undertaken during the 2010/2011 to 2015/2016 FWCP project years with $80,505 of FWCP funding. The first project (2010) identified critical breeding habitat and potential sites for the establishment of Wildlife Habitat Areas for the high priority Northern Red-legged Frog. The second project was the first year (2016) of a proposed four-year project that conducted inventory and habitat mapping for species at risk (Great Blue Heron, Western Screech-owl , Northern Red-legged Frog, Western Toad, Western Painted Turtle), that also prioritized sites for conservation measures and restoration and made proposals for the establishment of Wildlife Habitat Areas.

Upland & Dryland

One Upland & Dryland project was undertaken during the 2010/2011 to 2015/2016 FWCP project years with $82,641 of FWCP funding. This project (2010) conducted inventory surveys and habitat mapping for bats, and installed several artificial roost structures. Additionally, a FWCP project supported the release of Roosevelt Elk in the watershed in 2007 and 2008, resulting in a successful re-introduction.

Interactions Other Ongoing Processes

Water Use Plan (WUP) – BC Hydro undertook Water Use Planning on the Stave River to find a better balance of power and non-power interests (such as fish, wildlife and recreation) when operating the system. The resulting WUP Order directed incremental operational changes and monitoring studies to determine the effectiveness of the operational changes. FWCP partners support and coordinate with the WUP ordered monitoring studies, however FWCP does not fund the monitoring associated with operations.

Fish Passage Decision Framework – Any studies to assess the feasibility of restoring fish passage at existing BC Hydro facilities must adhere to the Fish Passage Decision Framework (BC Hydro 2016) to be funded by the FWCP.

Fish Entrainment Strategy – Fish entrainment issues are addressed through BC Hydro's Fish Entrainment Strategy (BC Hydro 2006). Grant applications to study or mitigate entrainment issues are not eligible for FWCP funding.

ECOSYSTEM CHAPTERS
STAVE RIVER WATERSHED

ECOSYSTEM CHAPTER: RIVERS, LAKES & RESERVOIRS

Actions for Rivers, Lakes & Reservoirs

The Action Table in this document (see page 20) identifies our Priority Actions to conserve and enhance fish & wildlife in this watershed. Priority Actions are organized by Action type: Research and Information Acquisition, Habitat-based Actions, Species-based Actions, Land Securement and Monitoring and Evaluation. Actions are assigned a priority ranking from 1 (highest priority) to 3 (lowest priority).

Aquatic Habitat in the Stave River Watershed

The Lower Stave River downstream of Ruskin Dam is less than 3 km in length but is considered one of the most productive salmon habitats in British Columbia. It crosses the Fraser River floodplain and has low banks composed of sands and fine sediments. This reach is highly braided with numerous gravel bars and side channels. Water levels in this reach are influenced by tides and Fraser River discharge, as well as Ruskin operations. Coho, Pink, Chum, Chinook, Sockeye and Steelhead occur in this section. Chum are by far the most numerous and are the highest priority for DFO, whereas Steelhead are the highest priority for MOE. In 1991, DFO constructed a 360 m spawning channel on the left bank below the tailrace, which is mostly used by Chum Salmon though likely benefits other species, too.

Hayward Reservoir flooded a river channel that was 6 km in length, of which the lower 2 km provided spawning habitats for all salmonid species. The upstream portions of this section were likely suitable for rearing by Steelhead parr. This section was described as a series of rapids that emptied through a narrow granite gorge, which was reported passable at high water. Hayward Reservoir now has generally low sportfish populations, due to high turnover, low nutrient levels and scarce tributary habitat.

Resident fish species like Rainbow Trout, Cutthroat Trout, Bull Trout, and Kokanee occur above Stave Falls, but there is disagreement about whether anadromous salmonids were able to ascend Stave Falls prior to construction of the dam. Largescale Sucker, Northern Pikeminnow, Peamouth Chub, Redside Shiner, Prickly Sculpin, Coastrange Sculpin, and Lamprey are also recorded above Stave Falls. Most tributaries to the reservoir are steep with widely fluctuating discharge.

There is taxonomic uncertainty about the Char that occur in the Stave system, and it is possible they are Bull Trout, Dolly Varden, or both. The two species are difficult to distinguish in the field and both occur in this region. Various documents refer to both Bull Trout and Dolly Varden in the Stave River Watershed, but there have been no definitive surveys or studies. Typically, the Char that occur in large lakes in this region are Bull Trout, but Dolly Varden also occur, particularly in smaller tributaries and in headwaters (Rick Taylor, UBC, personal communication). For convenience we refer to Char in this report as Bull Trout, but acknowledge the considerable uncertainty regarding proper identification.

Limiting Factors

Limiting factors vary among species and need to be further assessed. They are expected to include:

- **Habitat area**: Former spawning, rearing and overwintering areas are permanently lost or seasonally reduced by dam footprint, reservoir flooding, flow diversions, or operating flows; or from non-hydro sources, such as urban encroachment along banks of the lower river. There is limited parr habitat for Steelhead, and off-channel rearing habitat for Coho.

- **Habitat quality**: Physical habitat below dams has been altered by reduced gravel and wood recruitment, particularly in the lower river. Chum Salmon currently utilize all available habitat, but the habitat needs to be maintained every 10-15 years to keep it productive. Lakes and streams in this region have naturally low nutrient levels.
- **Access**: Anadromous and migratory resident stocks have been excluded from river habitats now occupied by Hayward Reservoir. Access has been reduced through the creation of dykes and diversions, as well as the alteration of the natural flow regime.
- **Diversions**: The Alouette diversion has increased annual flow volume in the lower Stave River, which has affected habitat quantity and quality.
- **Hatchery practices**: Chinook, Coho and Steelhead populations are augmented by hatchery production, which may have positive and negative effects on wild salmonid stocks. The hatchery increases the fish population, which at times is necessary for maintaining runs. At the same time, wild populations may be harvested along with hatchery fish. Genetic diversity of wild salmon can be altered by hatchery practices and hatchery-raised fish compete for food and habitat with wild salmon. Under the Wild Salmon Policy (Fisheries and Oceans Canada 2005), the Salmon Enhancement Program takes steps to minimize these risks.

Knowledge Status

Habitat

A detailed account of habitat alterations from hydropower development is provided in BCRP (2000). In addition to present and historic hydropower impacts there are impacts in the watershed from forestry and urbanization.

Changes in operations as part the Stave River Water Use Plan have been implemented to improve habitat conditions (BC Hydro 2003). The expected benefits of the WUP are an improvement in rearing habitat downstream of Ruskin Dam, reduced stranding of eggs and emerging fry, and increased carbon production in Stave Lake Reservoir. Monitoring is underway to assess the effects of the operational changes.

In the early 1990s, spawning area was enhanced and created in the mainstem below Ruskin Dam, primarily for Chum; however, Pink and Chinook also benefited. Work included scalping island bars to provide gravel replenishment. Further work has been undertaken by FWCP (BCRP), DFO and other partners (e.g., Fraser Valley Watersheds Coalition, Stave River Enhancement Society, Forest Renewal BC). In 1999 a side channel on the left bank was further improved with excavation to provide 5100 m^2 of Coho rearing habitat. Under the Water Use Plan re-grading and improving spawning areas of the mainstem resulted in the restoration of 118,000 m^2 of habitat for Chum, Pink and Chinook. More recent projects undertaken by the Fraser Valley Watersheds Coalition with FWCP support include the construction and enhancement of side channels, habitat complexing, spawning gravel augmentation, re-vegetation, and improvements to side channel flow. These projects will have long-lasting positive impacts to salmon productivity in the Lower Stave River.

Knowledge Gaps

The following knowledge gaps have been highlighted by agencies, First Nations and stakeholders:

1. To help set priorities for restoration, the program needs a better understanding of limiting factors that can be addressed by restoration initiatives.
2. Understanding the effects of previous restoration efforts and a need to develop detailed restoration plans to achieve long-term salmon conservation objectives.
3. The reasons for mixed success of hatchery reared Steelhead.
4. Bull Trout/Dolly Varden stock status and distribution in the Stave River Watershed is a continued uncertainty.
5. The use of the lower Stave River by White Sturgeon.

Objectives and Measures

The following objectives have been developed to define the scope of the Rivers, Lakes & Reservoirs Ecosystem Chapter. While the objectives are expected to remain stable over time, the projects funded may evolve as management priorities shift, or new information becomes available.

Objective 1: Ensure a productive and diverse aquatic ecosystem.
This objective addresses overall ecosystem integrity and productivity and directs compensation activities to develop productive, useable aquatic habitats. Where cost-effective opportunities exist, compensation works will be aimed at aiding multiple aquatic species to conserve and restore habitat capacity and diversity for fish and other aquatic organisms.
Measures — Measures will be ecosystem- and project-specific.

Objective 2: Maintain or improve the status of species of interest
This objective is supported by three sub-objectives:

1. Sustain and increase the population viability of anadromous salmon and Steelhead.
   Measures – Measures will be species- and project-specific.

2. Sustain and increase the population viability of resident salmonids.
   Measures – Measures will be species- and project-specific.

3. Sustain and increase the population viability of White Sturgeon.
   Measures – Measures will be species- and project-specific.

Objective 3: Maintain or improve opportunities for sustainable use.
This objective reflects the important sustainable use benefits that can be derived from healthy fish populations. Many salmonid species are the focus of First Nations, commercial and recreational fisheries. Consequently, any actions aimed at achieving the above objective also support this sustainable use objective.
Measures — There are no specific measures required at this time, aside from those associated with Objective 1 and 2.

ECOSYSTEM CHAPTER: WETLAND & RIPARIAN AREAS

Actions for Wetland & Riparian Areas

The Action Table in this document (see page 20) identifies our Priority Actions to conserve and enhance fish & wildlife in this watershed. Priority Actions are organized by Action type: Research and Information Acquisition, Habitat-based Actions, Species-based Actions, Land Securement and Monitoring and Evaluation. Actions are assigned a priority ranking from 1 (highest priority) to 3 (lowest priority).

Wetland and Riparian Areas in the Stave River Watershed

Wetland and riparian areas are the most diverse and biologically rich terrestrial ecosystems in BC and are considered highly valuable from an ecological standpoint. Riparian areas are the areas bordering on streams, lakes, and wetlands that link water to land. The blend of streambed, water, trees, shrubs and grasses directly influences and provides habitat for fish and wildlife. The abundance, distribution and condition of wetland and riparian habitats may be limiting factors for many species, especially amphibians, which depend upon them either for the majority of their lifecycles or for key periods such as breeding. Riparian and wetland habitats are often critical in terms of maintaining function and structure for natural systems, including helping to support trophic level functioning and genetic diversity, as well as providing key ecological services such as erosion control, flood control, assimilation of nutrients and water purification. Furthermore, many wetland and riparian species are the focus of sustainable use activities by First Nations and non-First Nations people. Riparian and wetland areas are commonly inundated by impoundments or adversely affected by changes in hydrological regimes that result from water management for power generation. Loss and alteration can significantly affect the services provided by these ecosystems.

The FWCP uses three general categories of riparian and wetland areas for setting objectives (Table 2). These categories define a general level of ecosystem functioning and require different management actions to maintain and improve their condition.

Table 2: Categories of riparian and wetland habitats used by the FWCP.

Category	Description
Category 1 – Natural riparian or wetland habitat	Largely intact ecosystems with natural disturbances sufficient to maintain subclimax communities and processes characteristics of wetlands and riparian ecosystems.
Category 2 – Disclimax or degraded wetland or riparian habitat, or creation of habitat	Formerly natural wetland or riparian ecosystems that have lost most or all of their natural disturbance regime and are no longer functioning effectively as wetland or riparian habitat. These areas are candidates for restoration.
Category 3 – Restored or created riparian or wetland habitat	Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.

Limiting Factors

The limiting factors for wetland and riparian areas are predominantly related to extent of the available habitat, connectivity and distribution of the habitat, and its productivity. Limiting factors need to be further assessed and are expected to include:

- **Extent:** The contribution of riparian and wetland habitats to broader ecological function is predominantly limited by the extent of the habitats on the land base. Habitats are lost through inundation and conversion to other land uses.
- **Distribution:** Connectivity among riparian and wetland habitats, and between these habitats and other habitats and features, are important for dispersal of plants and animals and for seasonal movements of some species. Wetland and riparian habitats that are isolated will likely have decreased diversity compared to those which experience a healthy connectivity between areas. Distribution is therefore related not only to the extent of healthy riparian and wetland habitats, but also to adjacent land uses.
- **Productivity:** Even where riparian and wetland habitats are adequately represented and connected, there are several factors that can affect their productivity:
    - Hydrologic conditions such as water level variability and flow rates are among the most important variables driving riparian and wetland habitat development, structure, functioning and persistence (National Research Council 2001). Wetlands and riparian ecosystems require dynamic water regimes to maintain their productivity, but managed systems can result in unnatural cycles of stability and de-watering that can impair function or result in succession to different habitat types (e.g., forest, mudflats).
    - Stressors such as invasive species or disruptive human access can affect community structure and function.
    - Loss of specific habitat features can affect life requisites of specific species, e.g., dense nesting cover for waterfowl, suitable tree cavities for nesting owls or waterfowl, basking sites to turtles.
    - Poorly understood factors limit the productivity of created wetlands. These are generally thought to be related to unnatural hydrologic regimes and soil conditions (e.g., Atkinson et al. 2010).

Knowledge Status

Habitat

Basin-wide trends in the abundance, distribution and productivity of riparian and wetland habitats have not been compiled, but inundation following dam construction was likely the most significant source of habitat loss. The area of inundation has not increased since dam construction, but the productivity of adjacent habitats is likely still affected, either directly or indirectly from BC Hydro operations, agriculture, suburban development and other stressors.

Outcomes of previous FWCP-funded projects have identified potential habitat conservation, mitigation or protection actions. Many wetlands, sloughs and lakes in the watershed have been assessed and have been surveyed for amphibians. Seven sites have been identified as high-priority sites for amphibian conservation measures, including one that is of high regional importance for Western Painted Turtles.

Knowledge Gaps

While wetland restoration and creation projects have been undertaken, the effectiveness of these projects in meeting management objectives has yet to be determined.

Objectives and Measures

The following objectives have been developed to define the scope of the Wetland & Riparian Areas Ecosystem Chapter. While the objectives are expected to remain stable over time, the projects funded may evolve as management priorities shift, or as new information becomes available.

Objective 1: Ensure productive and diverse wetland and riparian ecosystems.
This objective addresses overall ecosystem integrity and directs compensation activities to maintain ecosystem productivity by protecting, enhancing or creating new wetland and riparian habitat.

This objective is supported by three sub-objectives:

1. **Secure remaining Category 1 riparian and wetland habitat.**
   Wetland and riparian areas can be heavily impacted by conversion to other lands uses, such as agriculture development or forestry, amongst others. Securing remaining habitat to prevent loss is very important. Habitat is considered secure if it is protected from conversion to other land use, for example by purchasing the land or negotiating a covenant agreement.
   ***Measures* —** Measures will be ecosystem- and project-specific.

2. **Reduce threats to Category 1 riparian and wetland habitat.**
   Wetlands and riparian areas are subject to a variety of threats both internally and externally. Many naturally functioning riparian and wetland habitats (Category 1) can benefit from management actions that reduce specific threats (e.g., treatment for invasive species, access control, forestry in adjacent areas etc.).
   ***Measures* —** Measures will be ecosystem- and project-specific.

3. **Restore degraded or create new riparian and wetland habitat (Category 2).**
   While conservation of existing high quality habitat is always preferable, category 1 habitat may be limited or the opportunities for conservation are difficult. Restoration opportunities may be more available in areas where changes in water regime have altered successional pathways in pre-existing riparian and wetland ecosystems. Typically the regime in managed watersheds becomes more stable. Riparian and wetland ecosystems require the disturbances caused by fluctuating water levels to maintain their productivity. When these disturbances are reduced or eliminated, riparian and wetland ecosystems transition to other ecosystem types. Projects can be designed to restore the original ecological function of these areas, or to create new riparian or wetland habitats that differ from what was present historically, but still represent an improvement in function.
   ***Measures* —** Measures will be ecosystem- and project-specific.

Objective 2: Maintain or improve the status of species of interest.
Actions under this objective focus on addressing limiting factors that are not otherwise addressed by general improvements to ecosystem function under Objective 1. The intent is to maintain, or where feasible, increase the abundance of species of interest (e.g., federally listed species-at-risk or species identified through government, industry, public and First Nations engagement).
***Measures* —** Measures will be species- and project-specific.

Objective 3: Maintain or improve opportunities for sustainable use.
Many wetland and riparian species are the focus of sustainable use activities by First Nations and non-First Nations people (e.g., duck hunting, medicinal plants, wildlife viewing). Actions addressing Objectives 1 and 2 will often support this sustainable use objective.
***Measures* —** Measures will be species- and project-specific.

ECOSYSTEM CHAPTER: UPLAND & DRYLAND

Actions for Upland and Dryland Areas

The Action Table in this document (see page 20) identifies our Priority Actions to conserve and enhance fish & wildlife in this watershed. Priority Actions are organized by Action type: Research and Information Acquisition, Habitat-based Actions, Species-based Actions, Land Securement and Monitoring and Evaluation. Actions are assigned a priority ranking from 1 (highest priority) to 3 (lowest priority).

Upland and Dryland in the Stave River Watershed

Upland and dryland habitats are those that occur above areas of permanent inundation or periodic flooding. They are usually the habitats least affected by hydroelectric generating infrastructure or operation; however, footprint impacts have occurred and they contribute to the cumulative effects of human-related activities in these habitats. Upland/dryland habitats are diverse and can range from unvegetated areas to grasslands, forests and alpine ecosystems. Different habitats are associated with distinct species assemblages that react to direct or indirect stressors in their distinct habitat niches.

Within the Stave River Watershed, elevations vary from close to sea level to unvegetated alpine areas. Winters are wet and mild and summers are comparatively dry and warm. Upper elevations experience deep snowpacks as a result of winter precipitation. The watershed lies within the Georgia Depression Ecoprovince (Demarchi 1996) and low elevations are dominated by the Coastal Western Hemlock Dry Maritime (CWHdm), Submontane Very Wet Maritime (CWHvm1), and Montane Very Wet Martime (CWHvm2) subzone variants. Higher elevations are dominated by Mountain Hemlock (MHmm1) and alpine ecosystems (Green and Klinka 1994). Most of the watershed is forested, with lower elevations dominated by Western Hemlock (*Tsuga heterophylla*), Amabilis Fir (*Abies amabilis*), Western Redcedar (*Thuja plicata*), and Douglas-fir (*Pseudotsuga menziesii)*. Shrub layers include Red Huckleberry (*Vaccinium parvifolium*), Alaskan Blueberry (*V. alaskaense*), Salal (*Gaultheria shallon*) and Dull Oregon-grape (*Mahonia nervosa*). Higher-elevation forests are dominated by Yellow-cedar (*Chamaecyparis nootkatensis*) and Mountain Hemlock (*Tsuga mertensiana*; Green and Klinka 1994).

Limiting Factors

Limiting factors vary among species and need to be further assessed. They are generally associated with:

- **Habitat loss and alteration:** The cumulative effects of forestry and hydro-electric development have resulted in substantial losses and alterations to habitat and habitat connectivity.
- **Habitat connectivity**: Habitat loss and road development have resulted in lost connectivity between habitats, which alter wildlife movement.

Knowledge Status

Habitat

Upland and dryland habitats in the Stave River Watershed are impacted by forest harvesting, which is extensive in the eastern portions of the watershed, and high levels of suburbanization and agriculture along the lower reaches of the Stave River. However, significant portions of the watershed are protected in Golden Ears and Garibaldi parks as well as two smaller provincial parks (Rolley Lake and Davis Lake).

Knowledge Gaps

Past investments in the Stave River watershed has led to gains in knowledge about various wildlife species. There have been extensive species at risk inventories in the Stave, but specific knowledge of ecosystems in the Stave River Watershed is limited. Additional inventory is required to determine the distribution and abundance of other species of interest, and management plans are required to address their management.

Objectives and Measures

The following objectives have been developed to define the scope of the Upland & Dryland Ecosystem Chapter. While the objectives are expected to remain stable over time, the projects funded may evolve as management priorities shift, or as new information becomes available.

Objective 1: Ensure productive and diverse upland and dryland ecosystems.
Actions under this objective are aimed at protecting/enhancing rare or ecologically significant features.
***Measures* —** Measures will be ecosystem- and project-specific.

Objective 2: Maintain or improve the status of species of interest.
Actions under this objective focus on addressing limiting factors that are not otherwise addressed by general improvements to ecosystem function under Objective 1. The intent is to maintain, or where feasible, increase the abundance of species of interest (e.g., federally listed species-at-risk or species identified through government and First Nations engagement).
***Measures* —** Measures will be species- and project-specific.

Objective 3: Maintain or improve opportunities for sustainable use.
Upland and dryland habitats and associated species are also a focus of sustainable use activities by First Nations and non-First Nations people (e.g., hunting, medicinal plant collection, wildlife viewing). Actions addressing Objectives 1 and 2 will often support this sustainable use objective.
***Measures* —** Measures will be species- and project-specific.

ACTION TABLE

This Action Table identifies the FWCP's Priority Actions to conserve and enhance fish and wildlife impacted by BC Hydro dams in this watershed. Actions identified as OPEN (see Delivery Approach column) are eligible for a grant. When completing your online grant application, you will be required to identify a Priority Action(s) that best aligns with your project idea. A high-quality grant application will clearly demonstrate alignment with Priority Action(s) in an Action Table.

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
1	All	Research & Information Acquisition	**SFN.ALL.RI.01.01 Develop a current habitat assessment map-P1**	**1**	Fish & Wildlife	Develop a **current habitat assessment map** for priority fish & wildlife species in the Stave watershed. Habitats to be assessed & mapped include: • Wetlands • Riparian Areas • Stream Habitats • Connectivity Corridors • Forested Ecosystems (e.g., seral stage distribution) • Over-wintering habitat for species that utilize talus or rock features (e.g., bats, snakes) • Culturally Important Areas Mapping is to include as much on-the-ground information as possible relevant to the subject fish & wildlife species. The assessment should focus on practical conservation and restoration opportunities. For fish, this work should inform development of habitat restoration and protection plans for priority species and habitats. Consideration should be given to potential impacts from available climate change predictions relevant to the specific habitats (i.e., potential changes to vegetation communities, precipitation, wetland hydro-periods, snowpack, wildfire risk, wildlife movements, etc.). Work should build upon mapping completed in COA-F17-W-1207 Species at Risk Conservation in the Stave River Watershed and should review the resource plan being developed by BC Timber Sales in 2017. Recommendations should be made through this work for future management actions and assessments.	Improved strategic planning for conservation and restoration opportunities.	Directed	Throughout

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
2	All	Research & Information Acquisition	**SFN.ALL.RI.02.01 Conduct a limiting factors analysis-Lower Stave River-P1**	1	Fish & Wildlife	Conduct a **limiting factors analysis** for priority fish and/or wildlife in the Stave River watershed or sub-basins to support prioritization of future projects. This will include an assessment of population status, habitat status or habitat capacity and/or a cost-benefit analysis of any habitat-based actions proposed by the program, and should be considerate of the root causes of degraded habitats and limitations to productive potential. For fish, sub-basins for assessment include the Lower Stave River (Priority 1), the Hayward Reservoir and tributaries (Priority 3), and the Upper Stave including Stave Lake Reservoir and tributaries (Priority 2). Analyses should build upon previous and ongoing assessments, including the Water Use Plan studies and any existing restoration plans, in association with local agency, First Nation and BC Hydro staff, landowners and other land managers. *Please note that the FWCP may develop templates for this work. Please check with FWCP to see if these templates are available.		Directed	Throughout
			SFN.ALL.RI.02.02 Conduct a limiting factors analysis-Hayward Reservoir&tributaries-P3	3					
			SFN.ALL.RI.02.03 Conduct a limiting factors analysis-Upper Stave incl.Stave Lake Reservoir&tributaries-P2	2					
			SFN.ALL.RI.02.04 Conduct a limiting factors analysis-Stave Watershed-P2	2					
3	All	Research & Information Acquisition	**SFN.ALL.RI.03.01 Develop a comprehensive restoration and protection plan-Lower Stave River-P1**	1	Fish & Wildlife	**Develop a comprehensive restoration and protection plan** for fish and/or wildlife in the Stave River watershed or sub-basins in relation to limiting factors analyses and assessment of population status/habitat capacity. Restoration refers to habitat or species-based actions that restore habitat capacity or population viability, while protection includes habitat-based actions or land securement that protect important habitat from further degradation. Plans must include: • Baseline description of the watershed (hydrology, climate, topography); • Priorities of local First Nations for conservation and restoration; • Previous assessment and restoration works; • Distribution, timing, biological and critical habitat requirements and status of species in the watershed; • Clear goals and objectives based on a desired future condition;	To determine high priority, cost-effective habitat and/or species-based actions that can be supported by the FWCP.	Directed	Throughout

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
3 cont.			**SFN.ALL.RI.03.02 Develop a comprehensive restoration and protection plan-Hayward Reservoir&tributaries-P3**	**3**		• Summary of habitat indicators and limiting factors (based on analyses of habitat pressure indicators, habitat state indicators, limiting factors analysis); • Knowledge gaps and recommended research and/or assessment priorities; • Restoration priorities with rationale/discussion; • Selected indicators and performance standards for effectiveness monitoring program; and, • Monitoring protocol and schedule. Plans may be multi-species and habitat-based or they may be focused on individual high priority species in the watershed. High priority fish species include Chinook, Chum, Pink and Coho Salmon, Steelhead/Rainbow Trout, Bull Trout, Cutthroat Trout, Nooksack Dace, Salish Sucker and White Sturgeon. High priority wildlife include bats, amphibians, and riparian-associated mammals and birds, as well as Category 1 wetland and riparian areas. Plans should be developed in association with local agency, First Nation and BC Hydro staff, landowners and other land managers. Sub-basins for fish plans include the Lower Stave River (Priority 1), the Hayward Reservoir and tributaries (Priority 3), and the Upper Stave including Stave Lake Reservoir and tributaries (Priority 2). Restoration plans are best developed as 'living documents' so that they can be updated over time. A number of Priority Actions have been developed already and are described in this Action Table, but further development of restoration actions would be beneficial. *Please note that the FWCP may develop templates for this work. Please check with FWCP to see if these templates are available.			
			SFN.ALL.RI.03.03 Develop a comprehensive restoration and protection plan-Upper Stave incl.Stave Lake Reservoir&tributaries-P2	**2**					
4	All	Habitat-based Actions	**SFN.ALL.HB.04.01 Implement high priority habitat-based actions for fish and/or wildlife-P1**	**1**	Fish & Wildlife	**Implement high priority habitat and/or species-based actions for fish and/or wildlife** as recommended by mapping activities **(Action 1),** inventory **(Action 18)**, or by the restoration and protection plan **(Action 3)**, or other similar plans already developed in the watershed. Note that a number of priority habitat and/or species-based actions have been developed already and are described in this Action Table, but further	Implement high priority, cost-effective habitat and/or species-based actions that	Open	Throughout

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
4 cont.		Species-based Actions	**SFN.ALL.SB.04.02 Implement high priority species-based actions for fish and/or wildlife-P1**	**1**		development of restoration actions would be beneficial.	can be supported by the FWCP.		
5	All	Land Securement	**SFN.ALL.LS.05.01Conduct an options assessment for land securement - P1**	**1**	Fish & Wildlife	Considering ecosystem, conservation, and/or local management objectives, **conduct an options assessment for land securement** that establishes priority areas to be protected through land securement and identifies feasible mechanisms (e.g., fee-simple purchase, covenants, WHAs, etc.).	Prioritize locations and secure partnerships for land securement.	Open	Throughout
6	All	Land Securement	**SFN.ALL.LS.06.01 Land securement-P1**	**1**	Fish & Wildlife	**Land securement** in association with partner organizations to address fish and wildlife management objectives or to support habitat-based actions proposed by the FWCP. Land securement could address ecosystem function objectives across the watershed plan chapters of Rivers, Lakes & Reservoirs, Riparian/Wetland, and Upland/Dryland. Refer to options assessment findings, in **Action 5 a**bove, before conducting land securement activities.	Conserve, protect and restore ecosystem function and resilience through land securement.	Open	Throughout
7	All	Monitoring & Evaluation	**SFN.ALL.ME.07.01 Develop and implement an integrated monitoring plan for fish and/or wildlife-P1**	**1**	Fish & Wildlife	**Develop and implement an integrated monitoring plan for fish and/or wildlife** in the Stave River watershed or sub-basins in relation to existing agency monitoring programs, limiting factors analyses (**Action 2**), restoration plans (**Action 3**) and/or habitat or species-based actions supported by the FWCP. Monitoring should inform limiting factors analyses and/or habitat restoration and should be compatible with existing programs.	Support prioritization of monitoring associated with actions to sustain and restore habitat capacity and population viability of fish & wildlife.	Open	Throughout

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
8	All	Monitoring & Evaluation	**SFN.ALL.ME.08.01 Assess success of habitat-based actions supported by FWCP-P1**	**1**	Fish & Wildlife	**Assess success of habitat-based actions supported by the FWCP**. Success could be assessed through monitoring of biological and/or physical habitat responses. Success could be assessed on a graduated schedule such as every 1, 3, 5 and 10 years or based on high flow events or other natural or human-caused disturbances.	Assess success of habitat-based actions and support future planning and prioritization.	Open	Throughout
9	All	Monitoring & Evaluation	**SFN.ALL.ME.09.01 Conduct condition assessments and/or maintenance on habitat enhancements-P1**	**1**	Fish & Wildlife	**Conduct condition assessments and/or maintenance on habitat enhancements supported by the FWCP**. This could include the development of an inspection and maintenance schedule if required. If part of a multi-year study, provide information about future objectives and actions.	Maintain functioning of habitat enhancements supported by the FWCP.	Open	Throughout
10	Rivers, Lakes & Reservoirs	Research & Information Acquisition	**SFN.RLR.RI.10.01 Assess Bull Trout/Dolly Varden stock status&distribution … determine opportunites for restoration-P1**	**1**	Bull Trout/Dolly Varden	**Assess Bull Trout/Dolly Varden stock status and distribution in the Stave watershed and determine opportunities for restoration.** The study could include assessments of historical versus present status in the Upper Stave, and should also consider assessments completed through Independent Power Producers in the watershed. Any assessment/inventory should meet the criteria outlined in **Action 18**.	Determine the current distribution and viability of Bull Trout/Dolly Varden and opportunities for restoration.	Open	Throughout
11	Rivers, Lakes & Reservoirs	Research & Information Acquisition	**SFN.RLR.RI.11.01 Identify methods to control invasive fish species-P3**	**3**	Invasive fish	**Identify methods to control invasive fish species**, in particular Bass in the Lower Stave River.	Develop plan to address concerns associated with invasive fish species.	Open	Lower Stave River
12	Rivers, Lakes & Reservoirs	Research & Information Acquisition	**SFN.RLR.RI.12.01 Identify stock origin of the early Chinook Salmon run in the Lower Stave River-P2**	**2**	Chinook Salmon	**Identify stock origin of the early Chinook Salmon run in the Lower Stave River**, potentially through an angler survey. Any assessment/inventory should meet the criteria outlined in **Action 18.**	Inform conservation and restoration of Chinook Salmon.	Open	Lower Stave River

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
13	Rivers, Lakes & Reservoirs	Research & Information Acquisition	**SFN.RLR.RI.13.01 Assess use of the lower Stave River by White Sturgeon-P2**	2	White Sturgeon	**Assess use of the lower Stave River by White Sturgeon**, particularly for spawning and juvenile rearing. Any assessment/inventory should meet the criteria outlined in **Action 18**.	Support conservation of White Sturgeon.	Open	Lower Stave River
14	Rivers, Lakes & Reservoirs	Habitat-based Actions	**SFN.RLR.HB.14.01 Implement habitat enhancements in Lower Stave River-P2**	2	Anadromous & Resident Salmonids	**Implement habitat enhancements in Lower Stave River.** If a restoration plan has been completed under **Action 3**, please reference that plan for more information.	Sustain and restore habitat capacity and population viability of anadromous and resident salmonids.	Open	Lower Stave River
15	Rivers, Lakes & Reservoirs	Habitat-based Actions	**SFN.RLR.HB.15.01 Conduct gravel replenishment &upgrading of existing spawning areas in the Lower Stave River-P1**	1	Anadromous & Resident Salmonids	**Conduct gravel replenishment and upgrading of existing spawning areas** in the Lower Stave River. Restoration of spawning sites could benefit Chum, Pink and Chinook Salmon, Steelhead, Rainbow Trout and Cutthroat Trout.	Sustain and restore spawning habitat capacity for anadromous and resident salmonids.	Open	Lower Stave River
16	Rivers, Lakes & Reservoirs	Habitat-based Actions	**SFN.RLR.HB.16.01 Improve access to suitable tributaries and off-channel habitats-P1**	1	Chinook Salmon & Coho Salmon & Cutthroat Trout	**Improve access to suitable tributaries and off-channel habitats** for Coho and Chinook Salmon and Cutthroat Trout in the Lower Stave River, and maintain and improve habitat in areas such as Thompson Creek and Thompson Creek wetlands.	Sustain and restore habitat capacity and population viability of anadromous and resident salmonids.	Open	Lower Stave River

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
17	Rivers, Lakes & Reservoirs	Habitat-based Actions	**SFN.RLR.HB.17.01 Implement habitat enhancements in Upper Stave-P2**	2	Anadromous & Resident Salmonids	**Implement habitat enhancements in Upper Stave**, including Stave Lake Reservoir and tributaries. If a restoration plan has been completed under **Action 3**, please reference that plan for more information.	Sustain and restore habitat capacity and population viability of anadromous and resident salmonids.	Open	Stave Lake Reservoir/ Upper Stave
18	All	Research & Information Acquisition	**SFN.ALL.RI.18.01 Inventory for species of interest that are likely in the watershed-P2**	2	Wildlife	**Inventory for species of interest that are likely in the watershed. Inventory actions must meet the following criteria:** • The data collected will clearly inform a specific natural resource management decision or conservation action; this includes a clear understanding of: - The data or knowledge gap that is currently limiting a decision-maker or party(ies) from making a conservation decision or undertaking a conservation action; - How the inventory has been specifically designed to fill the above-noted data/knowledge gap; and - The decision-makers' commitment to using the data or information to support a specific decision. • The data collection is well informed by a clear and specific management objective (land use plan, recovery plan etc.) that also informs the management decision or conservation action; this includes clarity of: - How the inventory work has been designed to specifically assess the status or condition of the objective; and, - How the data will be used to inform/improve/clarify the management objective.	Habitat enhancement opportunities. Maintain or, where feasible, increase the abundance of species of interest.	Open	Throughout

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
18 cont.						Species of interest reflect engagement from FWCP partners and include, but are not limited to: • Grizzly Bear. Need inventory to determine occupancy, lacking baseline information. • Mesocarnivores. Conduct risk assessment and evaluate population sustainability through monitoring program as part of multi-carnivore surveys in the watershed. Species of interest: Pacific Marten, American Mink. If necessary, implement enhancement strategies to maintain sustainable populations. • Long-Tailed Weasel (*altifrontalis* subspecies) and Wolverine. Inventory required to assess if and where these species still occur in Lower Mainland watersheds. No specific surveys for the weasel subspecies have been conducted to date, so unclear if the species are extant in these watersheds. • Western Spotted Skunk. Inventory required. There is a poor understanding of species distribution (and other rare carnivores) within region, and of the effects of habitat alteration and loss in watersheds. More information on distribution would provide a better understanding of conservation challenges and priorities. • Snowshoe Hare, *washingtonii* subspecies. Inventory required to evaluate occurrences in watershed. • At-risk invertebrates. If found, implement restoration plan if required. Potential species of interest: Emma's Dancer.			

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
19	All	Habitat-based Actions	**SFN.ALL.HB.19.01 Implement priority species- and habitat-related conservation actions...-P1**	**1**	Wildlife Species at Risk	**Implement priority species- and habitat-related conservation actions in the following (or most recent) Recovery Strategies and Management Plans for species at risk that are known to be in the watershed.** Conservation actions must be well informed by a clear and specific management objective and must be well informed by previous inventory in the watershed. • Management Plan for the Mountain Goat (*Oreamnos americanus*) in British Columbia (B.C. Ministry of Environment 2010). Location: NW end of Stave Lake. • Management Plan for Roosevelt Elk in British Columbia (Ministry of Forests, Lands and Natural Resource Operations 2015). • Recovery Strategy for the Pacific Water Shrew (*Sorex bendirii*) in Canada (Environment Canada 2014). Build upon work conducted in project COA-F17-W-1207 Species at Risk Conservation in the Stave River Watershed. There is critical habitat mapped for the species in the watershed (CDC 2016). • Recovery Strategy for the Northern Spotted Owl (*Strix occidentalis caurina*) in British Columbia (Environment Canada 2006). • Management Plan for the Great Blue Heron *fannini* subspecies (*Ardea herodias fannini*) in Canada [Proposed] (Environment Canada 2016). Foraging observations have been made as part of multi-year SAR project (see reports), new colony (Dale Rd) detected in 2016 by incidental observation. Any wetland, riverine or fish restoration activities will benefit herons. Any detected colonies should have trees mapped and protected (possibly identified as wildlife trees). Nest tree recruitment will likely have long-term benefits for this species. Build upon work already completed in project COA-F17-W-1207 Species at Risk	Habitat enhancement opportunities. Maintain or, where feasible, increase the abundance of species of interest.	Open	Throughout

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
19 cont.						Conservation in the Stave River Watershed. • Recovery Strategy for the Common Nighthawk (Chordeiles minor) in Canada (Environment Canada 2016). • Recovery Plan for the Western Screech-owl, *kennicottii* subspecies (*Megascops kennicottii kennicottii*) in British Columbia (Ministry of Environment 2013). Build upon work already completed in project COA-F17-W-1207 Species at Risk Conservation in the Stave River Watershed. • Recovery Plan for the Painted Turtle – Pacific Coast Population (*Chrysemys picta* pop. 1), in British Columbia (The Western Painted Turtle Recovery Team 2016). Monitor and build upon restoration activities undertaken in project COA-F17-W-1207 Species at Risk Conservation in the Stave River Watershed. • Management Plan for the Coastal Tailed Frog (*Ascaphus truei*) in Canada [Proposed] (Environment and Climate Change Canada 2016). Build upon work already completed in project COA-F17-W-1207 Species at Risk Conservation in the Stave River Watershed. • Management Plan for the Northern Red-legged Frog (*Rana aurora)* in Canada [Proposed] (Environment Canada 2016). Build upon work already completed in 16.W.SFN.01 and COA-F17-W-1207 Species at Risk Conservation in the Stave River Watershed. • Management Plan for the Western Toad (*Anaxyrus boreas*) in British Columbia (Provincial Western Toad Working Group 2014). Build upon work already completed in COA-F17-W-1207 Species at Risk Conservation in the Stave River Watershed. Identify threats to migration routes during summer emergence and recommend or implement mitigation for these threats (e.g., fencing and underpass crossings designed to keep toads from crossing roads, etc.). Build on knowledge gained in COA-F17-W-1207 Species at Risk Conservation in the Stave River Watershed regarding migration issues at Allan Lake and Sylvester Rd. • Recovery Strategy for the Oregon Forestsnail (Allogona townsendiana) in Canada (Environment Canada 2016). Build upon work already completed in project COA-F17-W-1207 Species at Risk Conservation in the Stave River Watershed.			

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
20	Upland & Dryland	Research & Information Acquisition	**SFN.UAD.RI.20.01 Year-round acoustic monitoring…to determine if bats are active during winter-P3**	**3**	Bats	**Year-round acoustic monitoring in the lower mainland watersheds is a priority to find migration routes and timing and to determine if bats are active during winter.** Participants should participate in the the North American Bat Monitoring Program acoustic monitoring and BC Community Bat Program Roost Counts. Build upon work conducted in project COA-F17-W-1207 Species at Risk Conservation in the Stave River Watershed.	Maintain or, where feasible, increase the abundance of species of interest.	Open	Throughout
21	Upland & Dryland	Habitat-based Actions	**SFN.UAD.HB.21.01 Determine presence, identify/protect bat maternity roosts & winter hibernacula-P1**	**1**	Bats	1) Determine **presence of bat species** (build upon surveys conducted in project COA-F17-W-1207), especially those species potentially vulnerable to White Nose Syndrome; 2) Through acoustic monitoring or other methods (e.g., radio-tracking, DNA), **identify maternity roosts and winter hibernacula**; 3) Pursue **protection of hibernacula and maternity roosts** (e.g., critical habitat, WHAs or wildlife habitat feature designations).	Maintain or, where feasible, increase the abundance of species of interest.	Open	Throughout
22	Upland & Dryland	Habitat-based Actions	**SFN.UAD.HB.22.01 Assess impacts on Black-tailed Deer&implement restoration/conservation opportunities-P2**	**2**	Black-tailed Deer	**Assess impacts on Black-tailed Deer and implement restoration/conservation opportunities where feasible** (such as winter range enhancement through thinning, spacing, and prescribed burns).	Sustain and increase the food, social, ceremonial, recreational and/or commercial use of fish and wildlife resources.	Open	Throughout
23	Upland & Dryland	Habitat-based Actions	**SFN.UAD.HB.23.01 Restore and enhance the supply of cavities in trees for large cavity user-P2**	**2**	Northern Flying Squirrel + Pacific marten	**Restore and enhance the supply of cavities in trees for large cavity users** (e.g., Pacific Marten, Flying Squirrels, various bird species) after mesocarnivore surveys have been completed. Identify factors that control formation of large cavities in trees to better manage this population-limiting resource for priority wildlife species in the watershed. Increase education about the importance of wildlife trees to reduce their removal as "danger trees".	Protect and/or restore rare and ecologically significant upland/dryland habitat.	Open	Throughout

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
24	All	Habitat-based Actions	**SFN.ALL.HB.24.01 Conserve or enhance important habitats or mitigate habitat threats for priority bird species-P2**	2	High priority birds	**Conserve or enhance important habitats or mitigate habitat threats for priority bird species** in the watershed. This watershed is within Bird Conservation Region 5 and falls under the Pacific Birds Habitat Joint Venture. See the lists of priority species under the North American Wetlands Conservation Act at: http://www.pacificbirds.org/nawca-priority-species/. Proposed projects should refer to the priority lists and recommended conservation actions/guidance in the implementation plans (http://www.pacificbirds.org/science-and-planning/state-or-regional-plans/).	Varied types of species and habitat conservation, protection and enhancement opportunities.	Open	Throughout
25	Wetland & Riparian	Habitat-based Actions	**SFN.WAR.HB.25.01 Implement wetland & riparian restoration projects that are identified as high priorities...-P2**	2	Wildlife	**Implement wetland and riparian restoration projects that are identified as high priorities through inventory, mapping or assessment in the Stave watershed** (e.g., sites of amphibian conservation priority in COA-F17-W-1207 Species at Risk Conservation in the Stave River Watershed). If a restoration plan has been completed under action 3, please reference that plan for more information. This can include managing invasive plants as needed.	Protect, restore and/or create new wetland and riparian habitat.	Open	Throughout, especially Allan Lake
	Upland & Dryland	Habitat-based Actions	**SFN.UAD.HB.25.02 Implement wetland & riparian restoration projects…through inventory, mapping or assesments-P2**	2	Wildlife				
26	Wetland & Riparian	Monitoring & Evaluation	**SFN.WAR.ME.26.01 Evaluate the effectiveness of the nest box program for Western Screech-owl-P1**	1	Western Screech-Owl, *kennicottii* subspecies	**Evaluate the effectiveness of the nest box program for Western Screech-owl.** Nest boxes have been installed in the watershed with FWCP Coastal funding (project COA-F17-W-1207) and should be monitored as per the Western Screech-Owl Working Group recommendations. Adaptive management following monitoring should be applied. Evaluation should include placement locations and style of boxes used.	Maintain or, where feasible, increase the abundance of species of interest.	Open	Throughout

STAVE RIVER WATERSHED ACTION TABLE									Version: 21July2020
Action #	**Ecosystem Chapter**	**Action Type**	**Priority Action Short Description**	**Priority**	**Target Species**	**Priority Action**	**Intended Outcome**	**Delivery Approach**	**Location**
27	All	Research & Information Acquisition	**SFN.ALL.RI.27.01 Inventory & restoration for at-risk...and/or culturally important plant species-P3**	**3**	At-risk Plants	**Inventory and restoration for at-risk (e.g., SARA-listed, red- and blue-listed) and/or culturally important plant species and ecological communities.** Potential species of interest: Cascade parsley fern, northern water-meal.	Habitat restoration opportunities. Maintain or, where feasible, increase the abundance of species of interest. Prevention of destruction of at-risk habitats while carrying out other projects.	Open	Throughout

REFERENCES

Atkinson, R. B., J. E. Perry, G. B. Noe, W. L. Daniels, and J. Cairns, Jr. 2010. Primary productivity in 20-year old created wetlands in southwestern Virginia. Wetlands 30:200-210.

BC Hydro. 1999. Stave River Water Use Plan - Report of the Consultative Committee. Executive Summary available at: https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/environment/pdf/wup_stave_river_executive_summary_pdf.pdf

BC Hydro. 2003. Stave River Water Use Plan (Stave Falls and Ruskin Projects). Revised for Acceptance by the Comptroller of Water Rights. Available at: https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/environment/pdf/wup_stave_river_water_use_plan_pdf.pdf

BC Hydro. 2006. BC Hydro Fish Entrainment Strategy. Prepared for BC Hydro Generation Operations, Burnaby, BC.

BC Hydro. 2016. Fish passage decision framework for BC Hydro facilities.

Fisheries and Oceans Canada. 2005. Canada's Policy for Consevration of Wild Pacific Salmon. Available at: http://www.pac.dfo-mpo.gc.ca/fm-gp/species-especes/salmon-saumon/wsp-pss/docs/wsp-pss-eng.pdf

Green, R.N., and K. Klinka. 1994. A Field Guide for Site Identification and Interpretation for the Vancouver Forest Region. Report Land management handbook #28. British Columbia Ministry of Forests, Burnaby, BC.

National Research Council. 2001. Compensating for wetland losses under the Clean Water Act. National Academy Press, Washington, DC.

Pearson, M., Pearson Ecological, Vancouver, B.C. Email Correspondence with Natashia Cox, February 28, 2017.

PREVIOUS STRATEGIC PLANNING DOCUMENTS

Bridge-Coastal Restoration Program. 2000 Strategic Plan, Volume 2, Watershed Action Plans, Chapter 7: Stave River.

Fish & Wildlife Compensation Program. 2011 Stave River Watershed – Watershed Plan. Final Draft.

Fish & Wildlife Compensation Program. 2011 Stave River Watershed – Riparian and Wetlands Action Plan. Final Draft.

Fish & Wildlife Compensation Program. 2011 Stave River Watershed – Salmonid Action Plan. Final Draft.

Fish & Wildlife Compensation Program. 2011 Stave River Watershed – Species of Interest Action Plan. Final Draft.