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FISH AND WILDLIFE
COMPENSATION PROGRAM

ALOUETTE WATERSHED

SALMONID ACTION PLAN

FINAL DRAFT

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Alouette Salmonid Action Plan

1 INTRODUCTION

The Fish and Wildlife Compensation Program (FWCP): Coastal Region evolved from its origin as the Bridge-Coastal Restoration Program (BCRP), a program initiated voluntarily by BC Hydro in 1999 to restore fish and wildlife resources that were adversely affected by the footprint of the development of hydroelectric facilities in the Bridge-Coastal generation area. Footprint impacts include historical effects on fish and wildlife that have occurred as a result of reservoir creation, watercourse diversions and construction of dam structures.

In 2009, the program developed a strategic framework that guides overall planning for compensation investments (MacDonald 2009). The framework has guided the development of strategic plans for each watershed within the FWCP program area, which are in turn informing action plans that focus on specific priorities within each watershed (Figure 1).

This Salmonid Action Plan sets out priorities for the Fish and Wildlife Compensation Program to guide projects in the Alouette River project area. It identifies actions to be undertaken throughout the Alouette River in support of salmonid fish species. The plan builds on the FWCP's strategic objectives and the Alouette River Watershed Plan (FWCP 2011). Action plans have also been developed for riparian and wetland areas and species of interest; and some actions may be complementary across the different plans.

The actions and priorities outlined in this plan have been identified through a multi-stage process involving BC Hydro, Fisheries and Oceans Canada (DFO), Canadian Wildlife Service (CWS), Ministry of Environment (MOE), local First Nations, and local communities. Initial priorities were developed through consultation with agency staff. These priorities were then reviewed and discussed at a workshop¹ to allow First Nations, public stakeholders, and interested parties to comment and elaborate on the priorities.

It is important to understand, however, that planning priorities within action plans may not translate immediately into funded projects. Limited program funding requires that priority-setting has to also be developed across the program as a whole, not just within action plans. The process of selecting which actions will be implemented in any given year will occur during the annual implementation planning cycle.

¹ Pitt Meadows 19 February, 2009

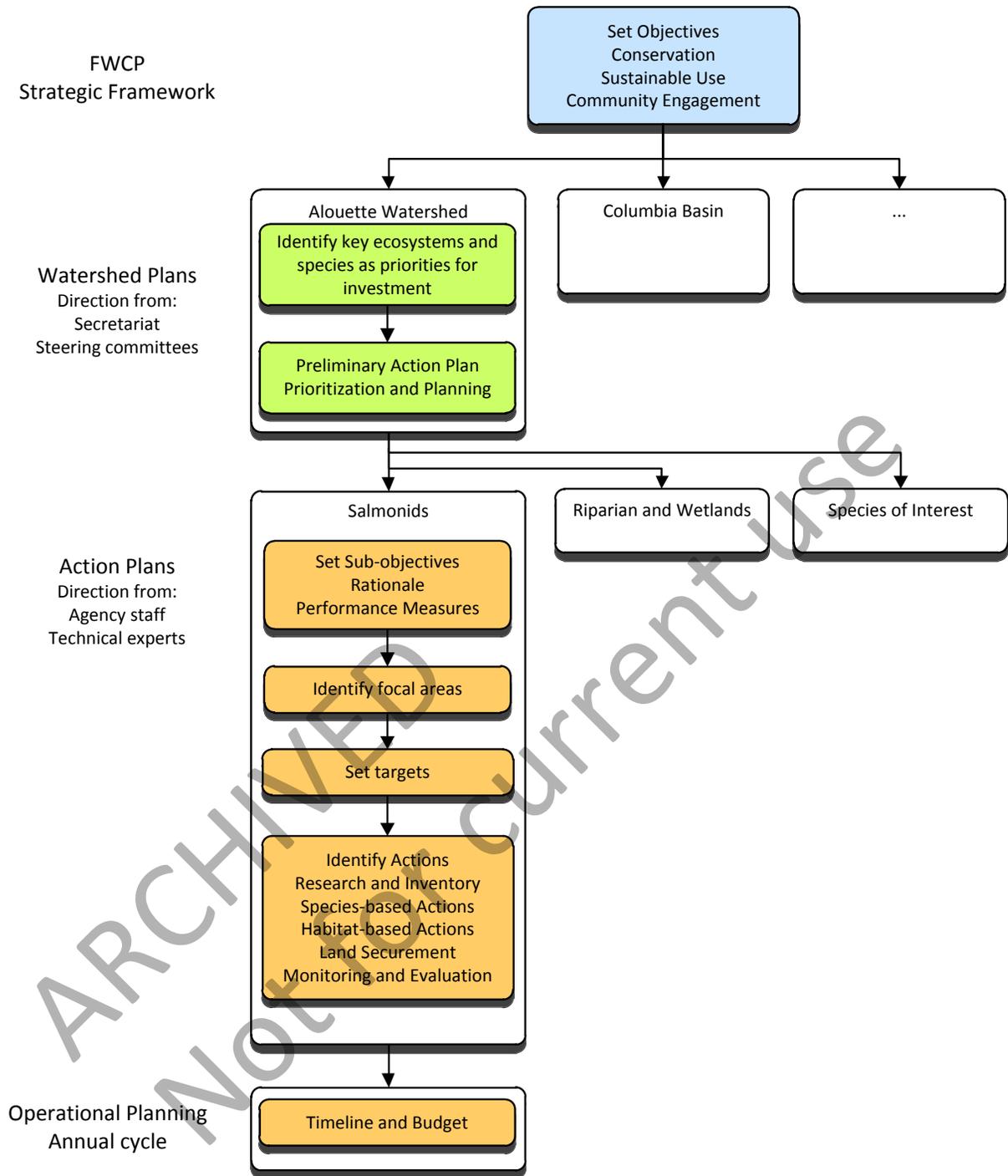


Figure 1: Relationship between the Salmonid Action Plan and higher level planning and objectives.

2 OVERVIEW CONTEXT

The Alouette watershed is located approximately 50 km east of Vancouver, next to the Stave watershed on the north side of the Fraser Valley (Figure 2). The Alouette watershed has a drainage area of 202 km² that ranges in elevation from 120m to 1800m. The Alouette River (sometimes called the South Alouette River) flows predominantly southwest and discharges into the Pitt River, less than 6 km upstream of its confluence with the Fraser River. Inflows to the Alouette system come primarily from heavy rain in the fall from Pacific frontal systems and snowmelt in the spring. Average rainfall in November is close to 500 mm, but can reach 900 mm.

The Alouette River system lies within the traditional territory claimed by the Katzie and Kwantlen First Nations. The lower Alouette River flows through parkland, residential area and intensive farmland; it flows through Golden Ears Provincial Park and the municipality of Maple Ridge.

The Alouette-Stave Falls-Ruskin generating complex includes four dams, a 1090 m long diversion tunnel and three powerhouses. Alouette Dam at the south end of Alouette Lake Reservoir provides water storage in the Alouette watershed. About 94% of the annual inflow into Alouette Lake Reservoir is diverted through the diversion tunnel to the Alouette Generating Station on the shore of Stave Lake Reservoir. At the south end of Stave Lake Reservoir are Blind Slough and Stave Falls dams, and Stave Falls Generating Station. Flows from Stave Falls Dam discharge into Hayward Reservoir. Outflow from Hayward Reservoir is controlled by Ruskin Dam, with power being generated at the Ruskin Generating Station. Water diverted from Alouette Lake Reservoir is thus used for power generation at three separate generating stations.



Figure 2: The Alouette Watershed hydropower project.

2.1 FISH AND FISH HABITAT IN THE ALOUETTE RIVER

Descriptions of fish and fish habitat come primarily from BCRP (2000). Historically, anadromous salmon and steelhead had access to Alouette Lake and its tributaries. Alouette Dam was built in the 1920s and has no fish passage facilities. The dam extirpated the Alouette Chinook and sockeye stocks; both spring and fall run sockeye occurred in the system. Pink salmon were extirpated by gravel mining in the early 1950s, but have been re-established by DFO. Resident fish species

occur in the reservoir and tributaries today, including rainbow trout, cutthroat trout, bull trout, kokanee, largescale sucker, longnose sucker, northern pikeminnow, peamouth chub, redbreast shiner, spottail shiner, threespine stickleback, and sculpins. Lake trout were introduced in 1968, but did not establish a self-supporting population. The majority of reservoir fish biomass is made up of non-salmonids. Gold Creek, Moyer Creek and the upper Alouette River provide important spawning and rearing habitats; most other tributaries are steep and have intermittent or erratic flows.

Chum, coho and steelhead occur in the lower Alouette, below the dam, and increased following an improved minimum flow release in 1971. Additional fish habitat improvements are expected from further increases in minimum flows implemented as part of the Alouette Water Use Plan (BC Hydro 2009). Production of hatchery coho began in 1980. As part of the WUP there is a program attempting to re-anadromize kokanee from the reservoir, to form a local sockeye run.

Nooksack dace and Salish sucker may occur in the Alouette watershed, but their presence has not been confirmed (M. Pearson, Pearson Ecological, personal communication). Both species are listed as Endangered under the Species at Risk Act, and they are priority 1 species under the BC Conservation Framework. Determining whether these species occur in the Alouette watershed is a high priority for DFO. Suitable habitat exists for both species, and the watershed is within the normal range of each species. The primary actions at this time are to complete inventory and genetic analyses.

There is taxonomic uncertainty about the char that occur in the Coquitlam 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 Coquitlam 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.

2.2 IMPACTS AND THREATS

Fish and Wildlife habitat and species have been significantly altered due to the construction of the dams, the development of hydro-power, and alterations in the hydraulic regimes of the systems. The following summary of the primary footprint impacts is derived from:

- Bridge-Coastal Restoration Program: Strategic Plan, Volume 2: Watershed Plans, Chapter 6: Alouette River (December 2000);
- Alouette River Water Use Plan Consultative Committee Report (April, 2009); and
- Findings in the Community Workshop (Pitt Meadows, February 19, 2009).

Hydro-related Impacts — The impacts that occurred are based on location in the watershed as follows:

Upstream of Alouette Dam.

1. The reservoir impounded Alouette Lake, and inundated 0.3 km of mainstem, 4km of tributaries and associated riparian habitat.
2. Annual reservoir drawdown of 9.5 m reduces access to tributaries and reduces littoral productivity.

Alouette Dam and Lower Alouette River.

3. The dam footprint led to loss of instream, riparian and upland habitat. Loss of spawning habitat at the lake outlet was compensated by construction of a spawning channel below the dam in 1994.
4. The dam blocked fish passage for anadromous and resident migratory fish, including all species of salmon, steelhead and possibly anadromous cutthroat trout.
5. Diversion of more than 90% of total flow into the Stave system affected spawning and rearing habitat quantity and quality, and reduced access to off-channel habitat.
6. Periodic spilling may cause scouring of spawning habitat in the mainstem.
7. Dam reduced recruitment of large woody debris (LWD) downstream.

Diversions

8. Diversion of water to Stave Reservoir reduces Alouette Reservoir productivity.
9. Entrainment occurs, but the magnitude and impact is unquantified.

Non-Hydro Impacts — Other impacts on fish populations in the Alouette watershed include high levels of urbanization and agriculture in the lower Alouette River.

2.3 LIMITING FACTORS

Limiting factors vary among species and include availability of useable habitat, access to habitats (e.g., passage) and nutrient limitations. There are both natural and human-induced aspects, and the latter include effects from hydropower and other developments. The factors are summarized here.

1. **Competition for habitat:** One of the main limiting factors in the lower Alouette River is competition for spawning habitat between chum and other species. The alteration from the natural flow regime, including operations determined under the WUP, currently favours chum.

2. **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. Impacts to riparian habitats in the lower river are a limiting factor for some species, as there are disturbances and loss of habitat. Pool and boulder habitat is limiting for the rearing of steelhead and rainbow parr.
3. **Habitat quality:** Physical habitat below dams has been altered by reduced gravel and wood recruitment. Productivity of Alouette Lake Reservoir has been affected by long-term reservoir drawdowns and loss of salmon-derived nutrients. Lakes and streams in this region have naturally low nutrient levels.
4. **Access:** Anadromous and migratory resident stocks have been excluded from the upper Alouette. Access has been reduced through alteration of the natural flow regime. For example, access to side channel habitat is reduced due to lower mainstem flows. Access to tributaries has been affected by reservoir drawdowns and lower flows in the mainstem. Lack of fish passage at Alouette Dam has blocked inputs of salmon-derived nutrients.
5. **Diversions:** The Alouette diversion has decreased annual flow volume to the lower Alouette River, which has affected habitat quantity and quality, seasonal temperatures and stream productivity.
6. **Entrainment:** The extent of entrainment from the Alouette Reservoir to Stave Reservoir is unknown.
7. **Hatchery practices:** Salmon populations are augmented by hatchery production, which may have positive and negative effects on wild salmonid stocks. The hatchery increases abundance, 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, the Salmon Enhancement Program takes steps to minimize these risks.

2.4 TRENDS AND KNOWLEDGE STATUS

HABITAT TRENDS

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 agriculture and urban land use, particularly in the lower reaches of the river.

Changes in operations as part the Alouette Water Use Plan have been implemented to improve aquatic habitat conditions (BC Hydro 2009). The expected

benefits of the WUP are the maintenance or improvement of fish habitat conditions in Alouette River below Alouette Dam, including possible increases in habitat and improved water quality. The WUP is not expected to affect fish productivity in Alouette Lake Reservoir. The use of a spring surface release regime is expected to encourage out-migration of kokanee to further the reintroduction of sockeye salmon to the Alouette River system. Monitoring is underway to assess the effects of the operational changes.

Since 2000 several restoration projects have been undertaken on the Alouette system by FWCP partners and the local community, including:

- Installation of 25 large woody debris structures.
- Restoration works have been conducted on off channel and tributary areas resulting in the creation of and improved access to approximately 5100 m² of spawning and rearing habitat and access to an additional 4 km of tributary habitat.

STOCK TRENDS

Pink — Pink salmon in the lower Alouette are a high priority for DFO. Pink salmon were extirpated by gravel mining in the early 1950s, but DFO re-established a population in the early 1980s through transplants. Pinks now spawn in areas of the Alouette used by chum and it is believed that competition currently favours chum. Due to the success of restoration efforts, pink salmon are no longer target species for hatchery enhancement. Abundance of pink salmon fry is measured as part of the smolt enumeration program under WUP monitoring and adult spawner escapements are back-calculated from fry abundance. Adult spawners have been estimated as recently ranging from 4,500 to 20,000 (Westslope Fisheries 2010).

Chinook — Chinook were historically present in the Alouette system, but in 1985 were considered extirpated (Westslope Fisheries 2010). Since 1998, smolt enumeration studies have documented naturally spawned Chinook out-migrants (Westslope Fisheries 2010). DFO has provided hatchery augmentation since the mid 1990s, transplanting Harrison stock raised at the Chilliwack Hatchery, and is continuing this annually. Chinook appear to be affected by competition for spawning from chum and DFO hope to shift the timing of returning adults one month earlier by collecting early arrivals into the Alouette and using them for brood stock. Alouette River Chinook are a high priority for DFO.

Coho — Coho historically accessed the upper reaches of the watershed, but are now confined to the lower Alouette River. The population is thought to be stable, but about 30% less than expected based on a coho production model by Bradford et al. (1997). There appear to be opportunities for improving access to off-channel habitats and restoration of those habitats. DFO considers Alouette coho to be a medium priority.

Sockeye — A stock of early run sockeye salmon, unique to the Coquitlam and Alouette rivers, was present in the system as well as a smaller stock of fall-run sockeye. Both were extirpated with the construction of Alouette Dam in 1926. There are ongoing efforts to establish a self-supporting sockeye stock in the Alouette by “re-anadromizing” kokanee from Alouette Lake Reservoir. Studies are being funded under the Water Use Plan monitoring program. Ultimate success may be linked to passage at the dam, but a number of pre-cursor biological studies are required before passage is considered (BC Hydro 2008).

Steelhead — Steelhead historically accessed the upper watershed, but are now confined to the Alouette River below Alouette Dam. Current winter steelhead spawning escapements are estimated to be 200-500, which is at or near the Conservation Concern Level of 300-450 for this stock. Pool and boulder habitat is considered limiting for steelhead and rainbow trout parr in the lower Alouette River. Steelhead are a high priority in the Alouette for MOE.

Cutthroat Trout — Coastal cutthroat are blue-listed and are considered a high priority for MOE, but there is only limited information on current stock status and habitat capacity. MOE staff identified access to tributaries and instream complexing within tributaries as candidates for restoration projects for cutthroat trout, but initial feasibility assessments should be conducted. Cutthroat trout occur in the reservoir and its tributaries, but little is known about their status there or opportunities for restoration.

Kokanee — Kokanee appear to be increasing in abundance in Alouette Lake Reservoir in response to lake fertilization that was initiated as a component of compensation for the Stave Falls Power Plant upgrade. Given this response restoration work for kokanee is not a priority at this time.

Other fish — Rainbow trout and bull trout occur throughout the system, including the reservoir and its tributaries. Opportunities appear to exist within Gold Creek to create multi-species restoration projects, and such projects are a high priority for MOE. Carp and bass also use the lower Alouette River, but these are undesirable invasive species.

KNOWLEDGE GAPS

Several knowledge gaps have been highlighted by agencies and stakeholders:

- To help set priorities for restoration, the program needs a better understanding of limiting factors that can be addressed by restoration initiatives, and a better understanding of the effects of previous restoration efforts.
- Information on rainbow trout, cutthroat trout and bull trout populations is limited, as is an understanding of habitat limitations and opportunities for restoration for these species.
- The feasibility and effects of increased fish passage is a critical uncertainty, including possible implications for resident fish above Alouette Dam.

3 ACTION PLAN OBJECTIVES, MEASURES AND TARGETS

Clear and realistic management objectives are necessary to guide information acquisition and prioritize management actions. Priority actions and information needs will change as both improvements to the system are realized and information is gained. The current plan reflects the information available and values expressed by stakeholders (FWCP partners, First Nations and local communities) through reports, interviews and regional workshops held between 2009 and 2011.

3.1 OBJECTIVE AND TARGET SETTING

The following terminology is used in this report.

Objectives:	Objectives are high-level statements of desired future conditions (outcomes), consistent with FWCP partner mandates and policies.
Sub-objectives and Status Indicators:	Sub-objectives are detailed statements of desired future conditions within objectives, from which status indicators can be derived and alternative management actions evaluated. Sub-objectives and indicators provide the details necessary to translate policy into actions and to evaluate their consequences. They may be arranged hierarchically within objectives, and usually indicate conditions necessary to attain the objective to which they refer.
Measures:	Measures are specific metrics whose values indicate the degree to which desired future conditions have been achieved. They can be either qualitative or quantitative. There is a preference to develop the latter where possible for ease of monitoring.
Targets:	Targets are the values of measurable items that indicate the attainment of a desired condition. In the current context these may be expressed as a single value or as a range to acknowledge the inherent variability of ecosystems.
Actions:	Management actions, plans or policies for achieving the objectives.

Objectives are the “ends” or the outcomes we ultimately care about. Actions are the “means,” or the things we do to achieve them. This report focuses on describing the actions required to achieve the objectives in relation to Salmonid species and fish in general. Actions relating to specific species or habitats may also be related to actions in other Action Planning documents such as the Riparian and Wetlands or Species of Interest plans.

3.2 OBJECTIVES, MEASURES AND TARGETS

Management objectives are common to all locations in the Alouette watershed, although the species of interest vary between the upper and lower watershed and thus the list of indicators and targets may differ.

This section briefly summarizes the objectives, sub-objectives and status indicators. While the objectives are expected to remain stable over time, the indicators and targets may evolve as management priorities for agencies shift, or new information becomes available.

There are two management objectives for salmonids in the Alouette River:

1. Conservation – Ensure a productive and diverse aquatic ecosystem,
2. Sustainable Use – Maintain or improve opportunities for sustainable use.

Supporting these objectives are sub-objectives that break each into its key components and provide further clarity.

Objective 1. Ensure a productive and diverse aquatic ecosystem.

Rationale — This objective addresses overall ecosystem integrity and productivity and directs compensation activities to developing productive, useable aquatic habitats. Where cost-effective opportunities exist, compensation works will be aimed at aiding multiple fish species.

There are two sub-objectives, which divide salmonids into anadromous and resident species, since priorities tend to fall along these lines in different locations in the Alouette watershed.

1. Maximize the viability of anadromous salmon and steelhead,
2. Maximize the viability of resident salmonids.

The sub-objectives are supported by the following status indicators:

1. Anadromous salmon and steelhead
 - a. pink salmon
 - b. chum salmon
 - c. coho salmon
 - d. Chinook salmon
 - e. sockeye salmon
 - f. steelhead trout
2. Resident salmonids
 - a. cutthroat trout
 - b. rainbow trout
 - c. bull trout

The indicators focus on species of greatest management concern. There is a tacit assumption that these are to some extent true indicator species and that meeting targets for these species will support conservation of other fish species.

There are different priority species in different parts of the Alouette watershed. Projects need not focus solely on these species, but they are the species of greatest interest to most stakeholders. From a conservation perspective, the priorities are as follows.

Pink salmon are a high priority for DFO, as they try to rebuild a stock that was extirpated. Coho and Chinook have relatively modest populations, which are augmented by hatchery operations. Overall, Chinook are high priority and coho are a medium priority for DFO. There are opportunities to enhance Chinook and coho habitat in the lower Alouette River. The chum salmon population is currently healthy and is a lower priority for DFO relative to other anadromous salmon. The agencies are supporting efforts being undertaken by the WUP monitoring program and local watershed groups to re-establish a sockeye stock in the Alouette.

Cutthroat and steelhead are high priorities for MOE in the lower Alouette River. The steelhead population is at or near the Conservation Concern level. Relatively little is known about cutthroat trout, rainbow trout and bull trout population status, distribution and opportunities for restoration.

Measures — Measures for the sub-objectives relate to the long-term viability of indicator fish populations, and may include distribution, population structure, abundance, and size or age distribution. At this time, the focus will be on abundance. Compensation activities may focus on improving habitat, but success will ultimately be assessed with measures of abundance. Abundance is currently measured through escapement estimates, snorkel swims, and Water Use Plan monitoring activities, such as the Alouette smolt enumeration program (Westslope Fisheries 2010). Where necessary, additional monitoring may be required for the compensation program to assess progress under this objective.

Targets — Species targets were determined by DFO and MOE and are indicated in Table 1.

Table 1: Species management targets by location in the Alouette system.

Location	Species	Target (5 year average)
Lower Alouette	Coho	1400 smolts / km. This target is considered to be average to above average for streams in similar latitudes.
	Chinook	500 naturally producing adult spawners.
	Steelhead	4600 smolts and 600 adults, based on 13% marine survival.
	Chum	125,000 chum spawners.
	Rainbow	no target
	Cutthroat	no target
	Sockeye	no target; work is ongoing with assessing re-anadromization of reservoir kokanee.
	Pink	15,000 spawners, or one million fry. This target is based on a review of DFO escapement records from the 1940s prior to major gravel extraction.
Alouette Reservoir and Upper Alouette	Bull Trout	no target
	Cutthroat	no target
	Rainbow	no target
	Kokanee	no target

Objective 2. Maintain or improve opportunities for sustainable use.

Rationale — 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 objective 1 also support this sustainable use objective. Although there are no direct actions for improving sustainable use at this time, it is conceivable that projects aimed at generally improving opportunities or increasing the participation in the fisheries could be identified by the program partners in the future.

As additional context, it should be noted that fisheries management agencies have an overall responsibility to manage the fisheries resource at a level of abundance and distribution to support First Nations' traditional uses and rights. These responsibilities are dealt with through the ongoing process of decision-making, which is not a formal part of this FWCP plan. In addition to this, First Nations' interests in overall conservation and sustainable use benefits have been incorporated into the development of this plan.

Measures and Targets — There are no specific measures or targets required at this time, aside from those associated with objective 1.

As part of their overall management responsibilities, DFO uses information such as abundance trends and escapement estimates to regulate angling and commercial harvest. MOE collects information on angler days, catch per unit effort, and number of fishing licences sold in the region, which informs decisions related to angling regulations.

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4 ACTION PLAN

4.1 OVERVIEW

The Action Plan has many individual actions, which are presented in Section 4.2. Some actions support multiple sub-objectives, which in turn support multiple objectives. Figure 3 provides an overview of the link between actions and objectives.

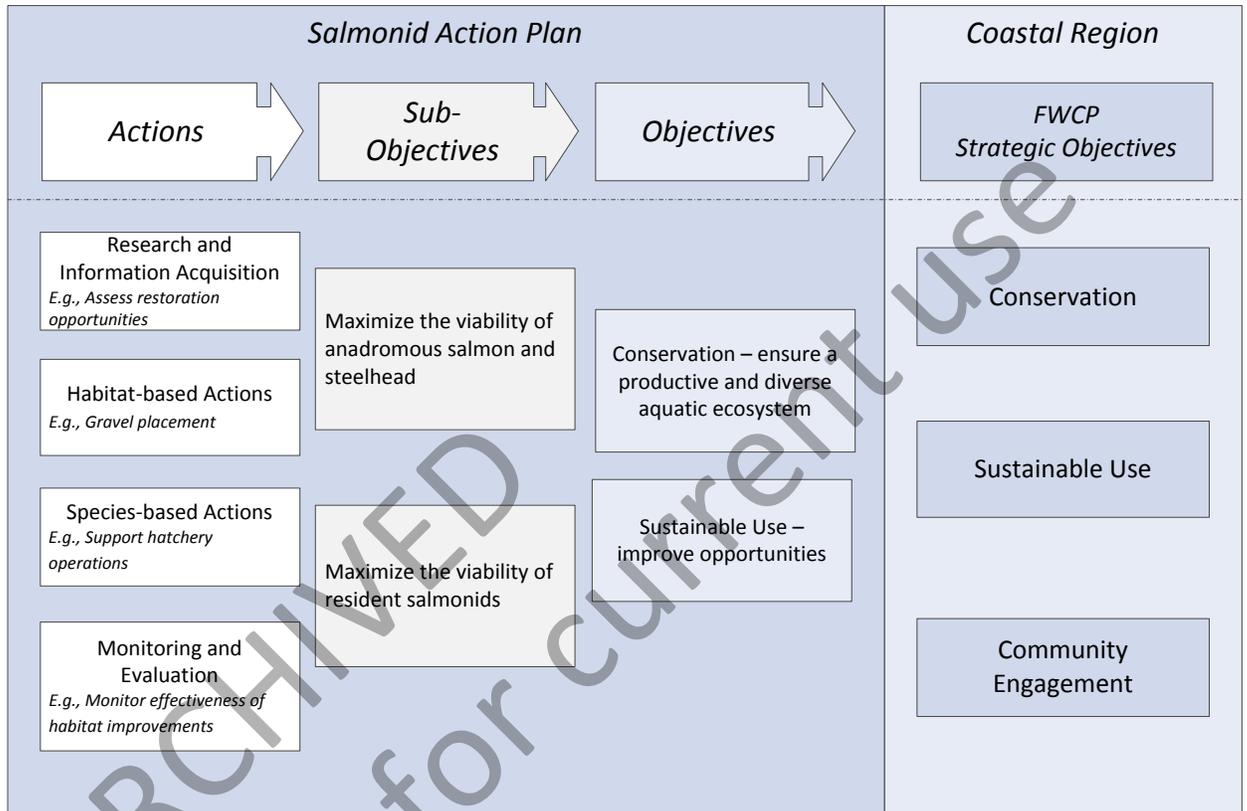


Figure 3: Relationship between actions, sub-objectives and objectives in this Salmonid Action Plan and the FWCP strategic objectives in the Alouette River Watershed Plan.

4.2 COMPONENTS

This section presents the main actions identified under each sub-objective (Tables 2 and 3) along with the supporting rationale for why the action is required and what it will achieve. Actions are organized under five broad categories: Research and Information Acquisition, Habitat-based Actions, Species-based Actions, Land Securement and Monitoring and Evaluation. Also provided are priority ratings to guide investment planning efforts. Actions are assigned priorities from 1-3. Note that low priority actions are not included in the table.

Sub-objective 1: Maximize the viability of anadromous salmonids.

Table 2: Actions with associated priorities and target species in the Alouette River.

Actions	Lower Alouette	Alouette Lake Reservoir	Upper Alouette	other	multiple species	Anadromous					Resident					
						Chum	Coho	Chinook	Steelhead	Pink	Sockeye	Cutthroat	Bull trout	Rainbow		
Research & Information Acquisition																
Continue to collect baseline data for sockeye in relation to re-introduction of sockeye to the system. Any assessment must adhere to the Fish Passage Decision Framework.	1	1	1										x			
Research options to improve productivity of Chinook by reducing competition with chum on spawning grounds.	2							x								
Assess the benefit of a selective fishery for chum salmon in a year with high pink runs to reduce competition for pinks.	3									x						
Develop an integrated habitat restoration plan for the Alouette system, and ensure compatibility with WUP implementation and monitoring. Proponent should discuss project scope with program staff before submitting a proposal.	3				x											
Assess cost effective options to enhance fish production through access or restoration in the North Alouette.				3	x											
Habitat Based Actions																
Develop new spawning areas for Chinook that are in areas not favoured by chum, such as in the vicinity of the dam.	1							x								
Develop new spawning areas for pink that are in areas not favoured by chum, such as in the North Alouette River, where natural fluctuations do not favour chum.	1										x					
Increase pool, wood and boulder habitat areas for steelhead (may also assist coho).	1						x		x							
Maintain existing constructed habitat enhancements for all salmonids.	1				x											
Improve habitat and rearing capacity for Chinook and coho (e.g., access to off channel habitat).	1						x	x								
Species Based Actions																
When outmigration numbers for pink and Chinook are low compared to previous brood escapements, then hatchery augmentation may be required to meet targets.	1							x		x						
Land Securement																
There are possible opportunities in the lower Alouette where land securement may address fisheries management objectives.	2				x											
Monitoring & Evaluation																
Assess efficacy of habitat enhancements undertaken by the program	2				x											
Assess adult returns and out-migrating smolts as a measure of overall fish production in relation to specified targets.	2				x											

Rationale.— To support targets for anadromous salmon and steelhead a number of actions are proposed. Most actions focus on improving habitat for different species and life stages, but there is much we don't know biologically and physically about the species and habitats of interest, so actions also include collecting information to help evaluate and implement compensation options and assessing performance of implemented restoration activities.

Compensation requires increasing present biological productivity to offset hydro development-related declines in productivity. There are myriad ways to compensate for fisheries impacts, and some work better for some species than others and some may be more suited to certain physical settings. To make informed choices on implementing the most cost-effective projects requires understanding what is possible and the costs and benefits of different approaches.

More detailed options assessments are required in some circumstances so that costs and projected benefits can be better understood when prioritizing among potential projects. This would aid priority setting both within and among water bodies within the Alouette system.

FWCP (BCRP) and other programs have completed a number of habitat enhancements in the Alouette watershed including establishment and development off channel and tributary areas and installation of large woody debris structures. Despite these works, certain key species such as pink, Chinook, steelhead and cutthroat would benefit from increased restoration efforts. DFO has indicated that the main priority for restoration in the system are pink followed by Chinook, both of which are thought to be limited through competition for spawning areas due to the large chum population. Some restoration projects addressing pink may also be designed to address Chinook. Coho have a stable population and are generally less of a priority, though there are specific high priority restoration projects for coho. Due to the high abundance and stability of chum in the Alouette, further restoration work affecting this species would be low priorities.

Steelhead stocks are a conservation concern and MOE has indicated that the limiting factor is pool and boulder habitat for rearing parr. There is limited information on cutthroat trout stocks, but it is thought that improving access to tributaries, (e.g., removal of man-made barriers) and increased stream complexity would benefit this species.

Improving connectivity and access to tributary or off-channel areas would, in general, assist with productivity of a number of species. Specifically, improving access to off channel habitats would help Chinook and coho. The broader issue of fish passage at Alouette Dam is currently outside the scope of FWCP. Ongoing studies related to re-anadromizing Alouette Reservoir kokanee are being funded under WUP monitoring.

Invasive species, such as bass and carp, are a substantial concern in the lower Alouette, but no specific activities have been identified for their control. In general, care should be taken to ensure that restoration projects do not benefit these or other invasive species.

Many of the activities that enhance the ecological integrity and the status of salmonid species may also benefit a sustainable fishery. Enhancement of sustainable fisheries will support First Nations and recreational fisheries.

Monitoring is a cornerstone of good resource management because it provides information on present status and trends and allows post-implementation assessment of management decisions and programs. Monitoring provides direction on adjustments that may be necessary. There are multiple elements related to anadromous salmon and steelhead that require monitoring. Realistically, monitoring will likely focus on abundance of different life stages of sportfish and species of concern, and the level of effort will likely vary among locations and species. Results of monitoring should feed directly into compensation program evaluation and help revise objectives and targets, where necessary. Special care

will be required to ensure that implementation and monitoring of FWCP: Coastal projects complements that of the Water Use Plan.

Sub-objective 2: Maximize the viability of resident salmonids.

Table 3: Actions with associated priorities and target species in the Alouette River.

Actions	Lower Alouette	Alouette Lake Reservoir	Upper Alouette	other	multiple species	Anadromous					Resident				
						Chum	Coho	Chinook	Steelhead	Pink	Sockeye	Cutthroat	Bull trout	Rainbow	
Research & Information Acquisition - Assessments															
Develop a restoration plan for cutthroat trout and bull trout, including an evaluation of stocks (population and distribution), habitat capacity, and identification of restoration options. Possible restoration projects could focus on removal of barriers, such as culverts, increasing stream complexity, and stream fertilization.	1	1	1										x	x	
Support inventory efforts for Nooksack dace and Salish sucker. Identify appropriate restoration opportunities.	1														

Rationale.— The rationale for the proposed actions related to resident salmonids is similar to that discussed above for anadromous salmon and steelhead, and some of those proposed projects will benefit resident fish also. The primary actions required for resident salmonids are to develop a better understanding of present stock status and possible restoration options for different species. For example, population status and opportunities for habitat improvements require assessments of rainbow trout, cutthroat trout, kokanee and white sturgeon.

Both Nooksack dace and Salish sucker may occur in the Alouette watershed, and information is needed regarding their presence and distribution to determine if appropriate restoration actions are required. Until more information is available to confirm presence or absence, restoration projects should carefully consider whether there may be detrimental effects on these species.

4.3 UNSUPPORTABLE PROJECTS

DFO and MOE have indicated they would not support the following projects.

- BC Hydro has implemented a number of operational changes under the Alouette River Water Use Plan, which is expected to improve conditions for fish and other resources. There are concerns that some restoration works could confound results from studies underway to evaluate aspects of the WUP. FWCP partners support the WUP and its associated monitoring studies and recognize the need to avoid confounding WUP monitoring results.

- Projects related to fish passage at BC Hydro facilities must adhere to the Fish Passage Decision Framework for BC Hydro Facilities (BC Hydro 2008), including requirements for evaluation of specific prerequisite biological studies.
- Habitat enhancement projects (e.g., improving fish passage at natural barriers, modifications to specific habitats) may require agency review, and in some cases prerequisite biological studies, to evaluate risks and benefits.

ARCHIVED
Not for current use

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- M. Pearson, Pearson Ecological, Vancouver, BC. Telephone conversation with Todd Hatfield, 22 February 2011 and Email correspondence, 19 September 2011.
- Rick Taylor, Zoology Department, University of British Columbia. Email correspondence with Todd Hatfield, 24 February 2011.