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FISH AND WILDLIFE
COMPENSATION PROGRAM

**CHEAKAMUS WATERSHED
RIPARIAN AND WETLANDS
ACTION PLAN
FINAL DRAFT**

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Table of Contents

1. Introduction	2
2. Overview context.....	4
2.1 Impacts and Threats	5
2.2 Limiting factors	6
2.3 Trends and Knowledge Status	7
Habitat Trends.....	7
Knowledge Gaps.....	8
3. Action Plan Objectives, Measures and Targets.....	9
3.1 Objective Setting	9
3.2 Objectives, Measures and Targets.....	10
4. Action Plan.....	13
4.1 Overview	13
4.2 components.....	13
5. References.....	16

Table of Figures and Tables

Figure 1: Relationship between the Riparian and Wetlands Action Plan and higher level planning and objectives.....	3
Figure 2. The Cheakamus River watershed.....	4
Figure 3: Relationship between actions, sub-objectives and objectives in this Riparian and Wetlands Action Plan and the FWCP strategic objectives in the Cheakamus River Watershed Plan.....	13
Table 1: Actions for wetlands and riparian areas in the Cheakamus River Watershed .	14

Cheakamus River Riparian and Wetlands 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 original 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 the 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 Riparian and Wetlands Action Plan sets out priorities for the Fish and Wildlife Compensation Program to guide projects in the Cheakamus River project area, which for the purposes of this planning document includes the Squamish River diversion reach to the Squamish estuary. The plan builds on the FWCP's strategic objectives and the Cheakamus River Watershed Plan (FWCP, 2011). Action plans have also been developed for species of interest and salmonids; 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 Squamish (17 June, 2010)

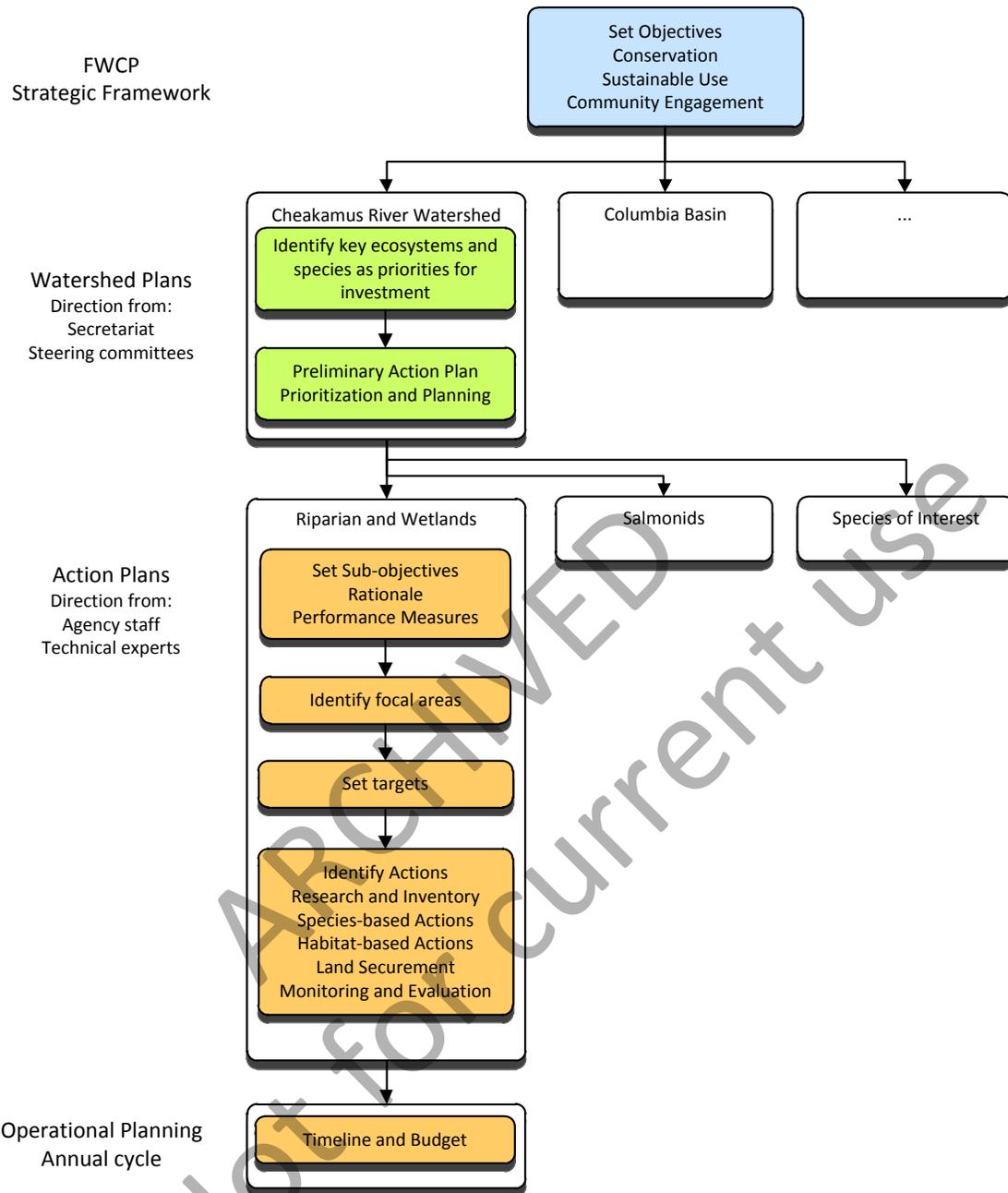


Figure 1: Relationship between the Riparian and Wetlands Action Plan and higher level planning and objectives.

2. OVERVIEW CONTEXT

The Cheakamus River is a tributary of the Squamish River, which flows into the head of Howe Sound. The Cheakamus River originates in the Fitzsimmons Range of the Coastal Mountains approximately 100 km north of Vancouver, between the communities of Whistler and Squamish (**Figure 2**). The watershed has an area of 1,070 km² and ranges in elevation between 30 m at its confluence with the Squamish River to 2300 m at its headwaters. 75% of the watershed is upstream of Daisy Lake Reservoir. The valley is steep and consists of coastal hemlock and Douglas fir in the lower reaches and mountain hemlock in the upper elevations. It experiences a Pacific Coastal climate resulting in prolonged and heavy precipitation between October and January, predominantly on the western facing slope, with as much as 700 mm in November. Summers are often sunny and warm. Runoff is dominated by spring snow melt with high flows in May and June and low flows in the late summer. Late autumn and winter storms may also result in large inflow.

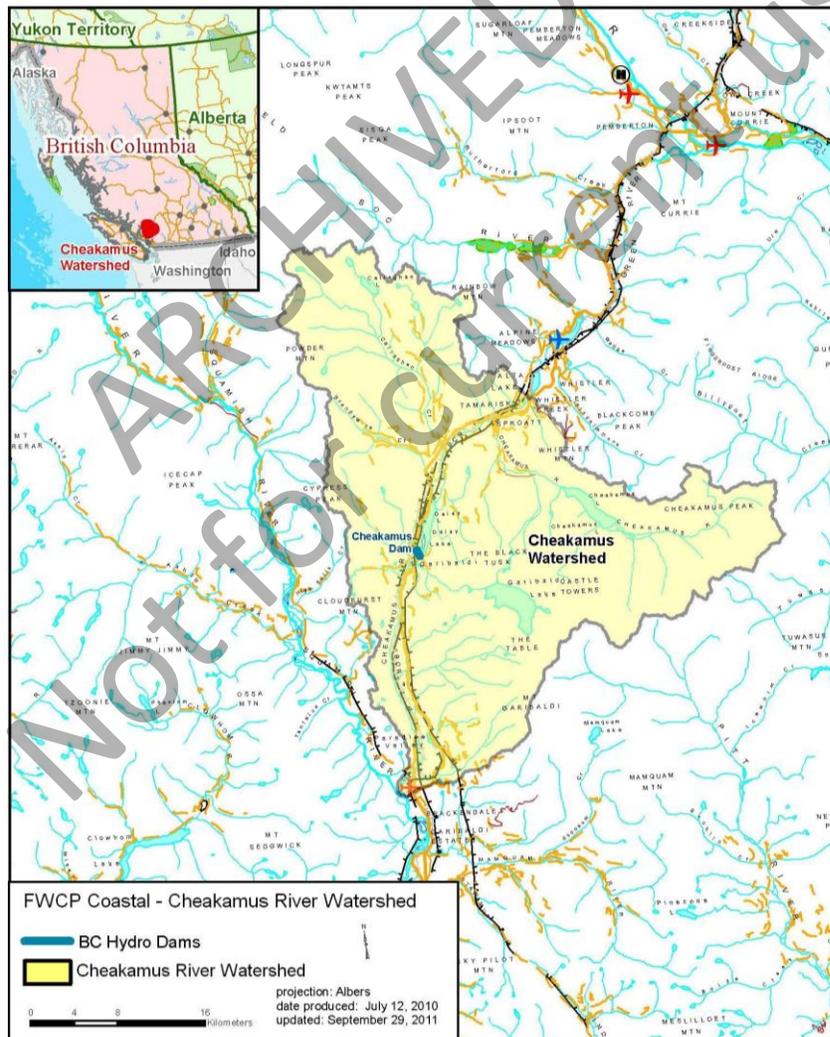


Figure 2. The Cheakamus River watershed.

The Cheakamus and Squamish Rivers are in Squamish First Nations territory. The eastern portion of much of the Cheakamus watershed lies within Garibaldi Provincial Park. The lower reaches of the Squamish River is in Tantalus and Brackendale Eagles Provincial Parks and Baynes Island Ecological Reserve, and the mouth of Squamish lies in the Skwelwil'em Squamish Estuary Wildlife Management Area.

The Cheakamus project includes Daisy Lake Dam, Daisy Lake Reservoir, a diversion tunnel and two penstocks, the Cheakamus Generating Station, and a channel that takes flow from the powerhouse to the Squamish River. Water withdrawn from Daisy Lake Reservoir flows via canal under the Sea-to-Sky Highway into Shadow Lake, a small (< 4 ha) headpond at the diversion tunnel entrance. All flows diverted from the Cheakamus are released to the Squamish River about 21 km upstream of its natural confluence with the Cheakamus. 80% of the annual inflow to Daisy Lake Reservoir is diverted to the Squamish River, with the remainder released to the 26 km stretch of Cheakamus River below the Daisy Lake Dam. The hydropower facilities were constructed by BC Electric Co. and became operational in 1957.

DFO operates the Tenderfoot Hatchery on the Cheakamus 5 km above its confluence with the Squamish River. The hatchery augments Chinook, coho, steelhead, pink and chum populations.

2.1 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:

- the BCRP Strategic Plan, Volume 2, Chapter 13, Cheakamus River, (December 2000);
- Cheakamus River Water Use Plan Consultative Committee Report (October, 2003); and
- Findings in the Community Workshop (Squamish, 17 June, 2009).

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

Cheakamus River upstream of Daisy Lake Dam.

1. Daisy Lake Reservoir inundated a pre-existing lake (21ha), flooded 15 km of mainstem channel, 5 km of tributary channels, 12 ha of wetlands, and riparian habitat around each.
2. Large drawdown (13 m) reduces littoral productivity, and may affect access to tributaries for fish.

Daisy Lake Dam and lower Cheakamus River

3. The dam footprint led to loss of instream and riparian habitat.
4. The dam has reduced recruitment of gravel and large woody debris (LWD) to downstream areas.
5. Reduced flow in the lower Cheakamus has diminished habitat capacity.
6. Loss of active side channel habitat is likely due to dyking and altered flow regime.
7. Reduced flow from upper Cheakamus allows colder Rubble Creek flow to dominate the lower Cheakamus River, which may have caused declines in some species.
8. Entrainment occurs, but the magnitude and impact is unquantified.

Diversions

9. The large diversion of water from Cheakamus to Squamish River impacts productivity in the Cheakamus River downstream of Daisy Lake Dam.
10. There is potential for short-term elevated TGP events.
11. Flow fluctuations in the Cheakamus Generating Station tailrace channel may affect salmon spawning.

Non-hydro Impacts - Other impacts on fish populations in the Cheakamus watershed include effects of harvest, dyking, logging activities and the construction of roads, railways and power lines. A large spill occurred in 2005 from a CN Rail derailment, which spilled 40,000 litres of sodium hydroxide into the Cheakamus River just downstream of Daisy Lake Reservoir, with estimates of over 500,000 fish killed, including coho, Chinook, pink, chum and rainbow trout. The ultimate effects of the spill are not known, and monitoring of effects continues to be conducted.

2.2 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.

1. 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, and often detrimental fluctuations in water levels.

2. 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 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.

3. 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). Hydrologic conditions also influence the extent and distribution of habitats. For example reduced peak flows in a river, due to regulation, result in succession to upland habitat types. Also, Extreme fluctuations both in timing and extend, such as in a drawdown zone of reservoirs, can reduce the ability of plant communities to be established and thus the establishment of wetlands.
- 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, loafing sites to turtles.
- Poorly understood factors limit the productivity of created wetlands. These are generally thought to be related to unnatural hydrologic regimes, soil conditions, and/or cattle grazing (e.g., Atkinson et al. 2010).

2.3 TRENDS AND KNOWLEDGE STATUS

HABITAT TRENDS

Basin-wide trends in the abundance, distribution and productivity of riparian and wetland habitats have not been compiled (other than direct BC Hydro footprint impacts). The area of inundation has not increased since dam construction, but the productivity of adjacent habitats has continued to be affected, either directly or indirectly as a result of BC Hydro operations.

FWCP partners have undertaken restoration of tidal channels and marsh areas in the Squamish estuary. In addition FWCP investments have been used to assist in

the purchase of the Mamquam Blind Channel and areas in Squamish estuary. It has been recognised that the estuary houses significant riparian and wetland habitat in the area. There is also a relatively new Skwelwil'em Squamish Estuary Wildlife Management Area in the estuary. Nevertheless, development and urbanization in adjacent lands continue to pose a threat to riparian and wetland areas in the estuary.

Upstream of the estuary there are areas of riparian and off-channel habitat both along the Squamish and Cheakamus Rivers. Much of the area lies in conservation zones with the lower reaches of the Squamish River is in Tantalus and Brackendale Eagles Provincial Parks and Baynes Island Ecological Reserve.

Significant changes to riparian and wetlands in the area include:

- Unknown loss of habitat from conversion to other land uses or succession to different habitat types; and,
- Deterioration in productivity from hydrology changes and stressors such as invasive species.

Riparian and wetland habitat losses can be monitored via remote sensing, air photo interpretation or ground reconnaissance. Assessing deterioration in habitat productivity is more difficult.

KNOWLEDGE GAPS

It is not clear what opportunities and possibilities remain for riparian and wetland conservation and protection in the Cheakamus-Squamish area. Consideration of the land status is important.

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 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 riparian and wetland species and habitats. Complementary actions may also be identified in the separate Species of Interest Action Plan.

There are three general categories of riparian and wetland habitats defined for setting objectives:

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 or creation of wetlands.
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.

The categories contrast different levels of ecosystem function that require different management approaches. Note that there are no category 3 wetlands in the Cheakamus system at this time.

3.2 OBJECTIVES, MEASURES AND TARGETS

There are two riparian and wetlands management objectives for the Cheakamus system as a whole.

Objective 1. Ensure productive and diverse wetland and riparian ecosystems.

Rationale — This objective addresses overall ecosystem integrity and directs compensation activities to develop productive, useable habitats. Riparian and wetland areas have been heavily impacted by the creation of dams, and continue to be severely degraded in the remaining areas. They may be the limiting factor for many species, including fish, which depend upon them, either for the majority of their lifecycles or for key periods such breeding. Riparian and wetland areas are the most diverse and biologically rich terrestrial ecosystems in BC and are considered as highly valuable from an ecological standpoint. They are often critical in terms of maintaining function and structure for natural system, including helping to support trophic level functioning, genetic diversity, as well as providing key ecological services such as erosion control, flood control and assimilation of nutrients.

This objective is supported by three sub-objectives:

Sub-objective 1: Secure remaining Category 1 riparian and wetland habitat.

Rationale —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.

As further opportunities in the Cheakamus system may be limited, consideration could also be given to secure off-site category 1 wetlands (for instance in the Squamish River above the confluence of the Cheakamus) that would help compensate losses in the Cheakamus system. In dollar terms and effort there may be more effective opportunities off-site to provide compensation for habitat losses.

Measure — Hectares (or percentage) of Category 1 riparian and wetland habitat secured or conserved over a 5-year period.

Targets — Specific targets will be developed as part of the action plan implementation as current areas are not known.

Sub-objective 2: Reduce threats to Category 1 riparian and wetland habitat.

Rationale — 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.).

Measure — Hectares (or percentage) of Category 1 riparian and wetland habitat improved annually.

Targets — Specific targets will be developed as part of the action plan implementation as current areas are not known.

Sub-objective 3: Restore degraded or create new riparian and wetland habitat (Category 2).

Rationale — 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 — Hectares of riparian and wetland habitat that are restored or created over a 5-year period.

Targets — Specific targets will be developed as part of the action plan implementation as current areas are not known.

Objective 2. Maintain or improve opportunities for sustainable use.

Rationale — Many wetland and riparian species are the focus of sustainable use activities by First Nations and non-first nations people. For example some riparian and wetland dependant species are hunted (e.g., elk) while bird and wildlife viewing is also a popular recreational use in the watershed. Consequently, any actions aimed at achieving the above objectives indirectly support this sustainable use objective. Although there are no direct actions aimed at improving sustainable use at this time, it is conceivable that projects aimed at generally improving opportunities for sustainable use activities could be identified by the program partners in the future.

Measures and Targets — There are no specific measures or targets required at this time aside from those associated with the above objectives.

As part of their overall management responsibilities, MOE periodically collects information regarding abundance trends, hunter reports, catch per unit effort (CPUE) and number of hunting licences sold in the region.

4. ACTION PLAN

4.1 OVERVIEW

The Action Plan has several 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.

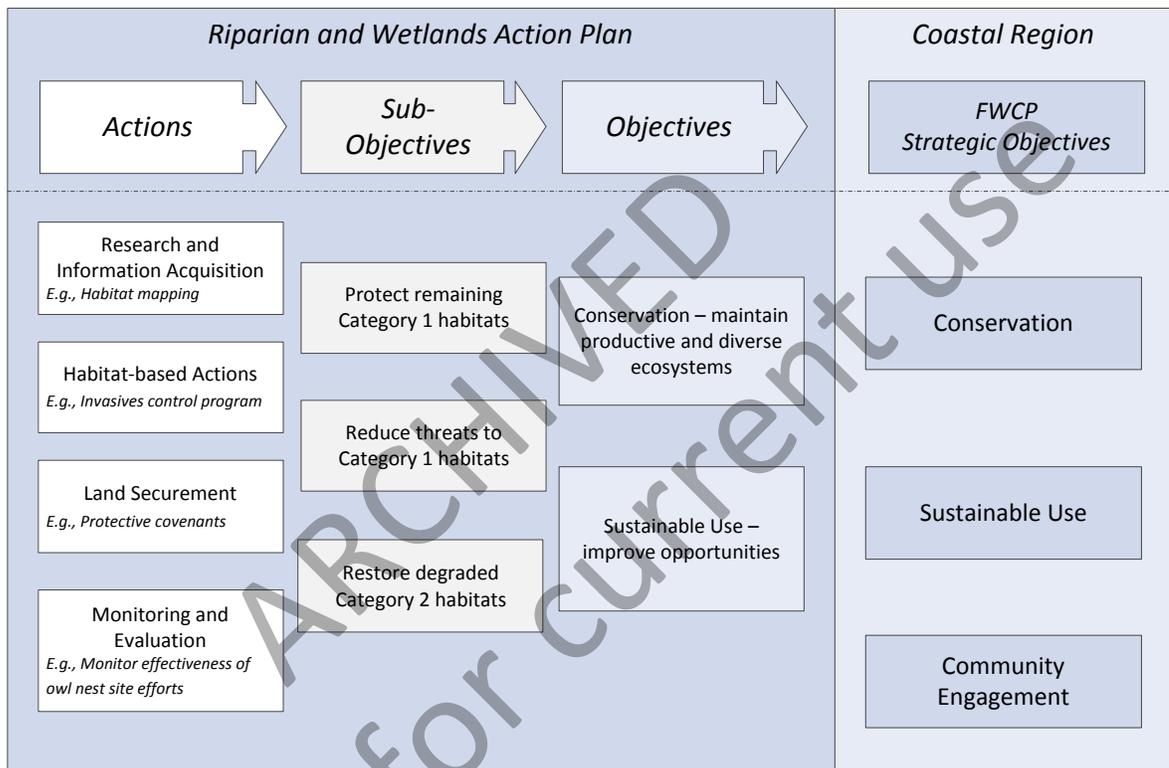


Figure 3: Relationship between actions, sub-objectives and objectives in this Riparian and Wetlands Action Plan and the FWCP strategic objectives in the Cheakamus River Watershed Plan.

4.2 COMPONENTS

This section presents the main actions identified for riparian and wetland areas in the Cheakamus River system along with the supporting rationale for why the action is required and what it will achieve (Table 1 below). While there are significant riparian and wetland areas protected in the area, there are remaining areas in the lower Squamish and Cheakamus rivers that warrant protection. In particular, areas with cottonwoods and older trees provide nesting sites for both cavity nesters, as well as eagles, herons etc. Snag densities may limit some wildlife species so snag creation may be worthwhile. Additionally, there were

significant loss of wetlands around Daisy Lake and some assessment should be conducted regarding the possibility of developing benching in parts of the drawdown zone.

Consequently, the initial focus of this action plan is solely on research and information acquisition related to new opportunities. At such time as enough information is collected, the action plan should be revisited and updated with opportunities for habitat-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.

Table 1: Actions for wetlands and riparian areas in the Cheakamus River Watershed

#	Action	Rationale	Priority
Research and information acquisition			
1	Conduct mapping of area to determine abundance, distribution, and category of riparian and wetland habitat currently outside of protected areas.	There remain opportunities outside the current protected areas to conserve riparian and wetland areas.	1
2	Identify opportunities to secure category 1 areas in the Cheakamus-Squamish system.	Once Category 1 areas have been identified, coherent plans need to be made to secure them. Legal status of different lands must be known to determine appropriate actions for protection.	1
3	Identify opportunities to secure off-site category 1 areas.	There may be more cost effective opportunities off-site.	3
4	Determine threats and potential mitigation strategies to improve category 1 areas	There may be potential threats reducing category 1 area productivity	2
5	Identify opportunities for restoration or creation of category 2 areas.	Daisy Lake area represents a significant potential for constructing benches. Other areas in the lower	2

#	Action	Rationale	Priority
		Squamish and Cheakamus may also exist.	
Habitat-based actions			
6	Implement riparian and wetland restoration projects that are identified as high priorities through inventory, mapping or assessment.	Primary target is Category 2 areas.	2
Land securement			
Monitoring and adaptive management			

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