FWCP
Fish & Wildlife
COMPENSATION PROGRAM
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CLOWHOM RIVER WATERSHED ACTION PLAN

FINAL November 14, 2017
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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 existing BC Hydro dams.

BC Hydro Power smart · British Columbia · Fisheries and Oceans Canada

The Fish & Wildlife Compensation Program is conserving and enhancing fish and wildlife impacted by construction of BC Hydro dams in this watershed. Clowhom Dam and Reservoir (Credit BC Hydro). Cover photos: Western Painted Turtle (Credit Ben Meunier), Western Screech- Owls (Credit: J. Hobbs), and Roosevelt Elk (Credit, iStock).

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: CLOWHOM 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 Clowhom River watershed. The focus of the next five-year period will be Priority Actions identified for fish, wildlife, and habitats in three broad ecosystems categories**:**

- Rivers, Lakes & Reservoirs;
- Wetland & Riparian Areas; and
- Upland & Dryland.

These ecosystem categories are described in the Ecosystem Chapters, and proposed Priority Actions are 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. Actions fall into one or more of the following 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 out 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 selection 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

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CLOWHOM 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 needed to support FWCP objectives. Please refer to the Action Plan Overview for more information on the on the process that was followed to develop Action Plans. The structure of this Action Plan is shown in Figure 1.

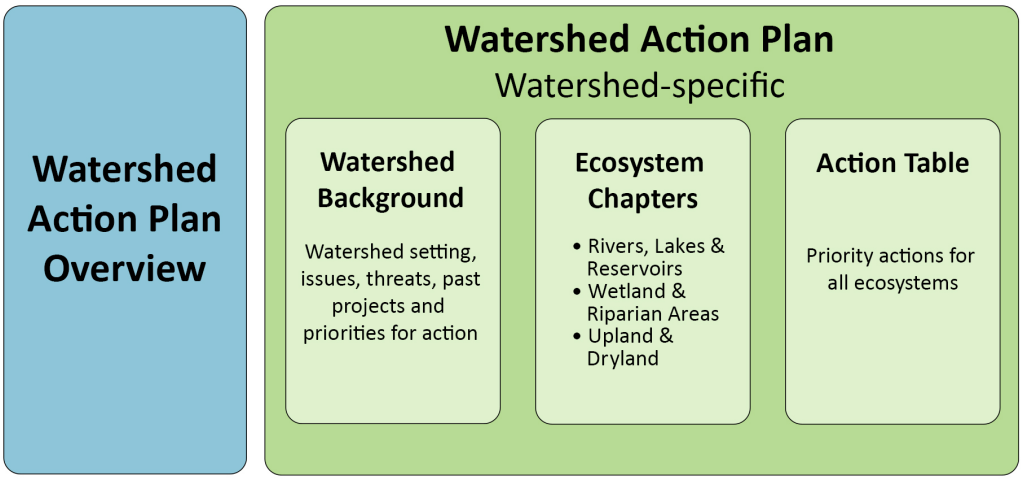

Figure 1: Structure of FWCP Action Plan Overview and Action Plan components.

Setting

The Clowhom River Watershed is on the Sunshine Coast and drains into the Salmon Inlet. It is approximately 32 km northeast of Sechelt (Figure 2). The Clowhom Reservoir drains an area of 382 km^2 with inflows that can sometimes have large, short-term fluctuations. The watershed includes the Clowhom River, which flows into the reservoir, and several smaller streams entering the sides of the river and the reservoir. Impoundment of Clowhom Reservoir inundated two previously existing lakes. Elevation within the basin ranges from sea level to 2400m and the vegetation varies from dense forest to alpine. While there are glaciers, they do not cover a significant portion of the drainage basin. The basin is influenced by Pacific Ocean air masses and cyclonic storms that produce heavy and prolonged rainfall from October to March. The average rainfall for November is 350 mm.

Clowhom Dam is a concrete gravity dam with two gated spillways that reduce the spill discharge by surcharging the reservoir during times of high flows. Water is diverted through a penstock to the generating station, which has a capacity of 33 MW. Water is discharged directly into the Salmon Inlet. The facility normally runs continuously during the summer snowmelt and autumn storm events. During the rest of the year, the facility is operated as a peaking plant to meet high demand periods.

The watershed is of interest to the Sechelt First Nation.

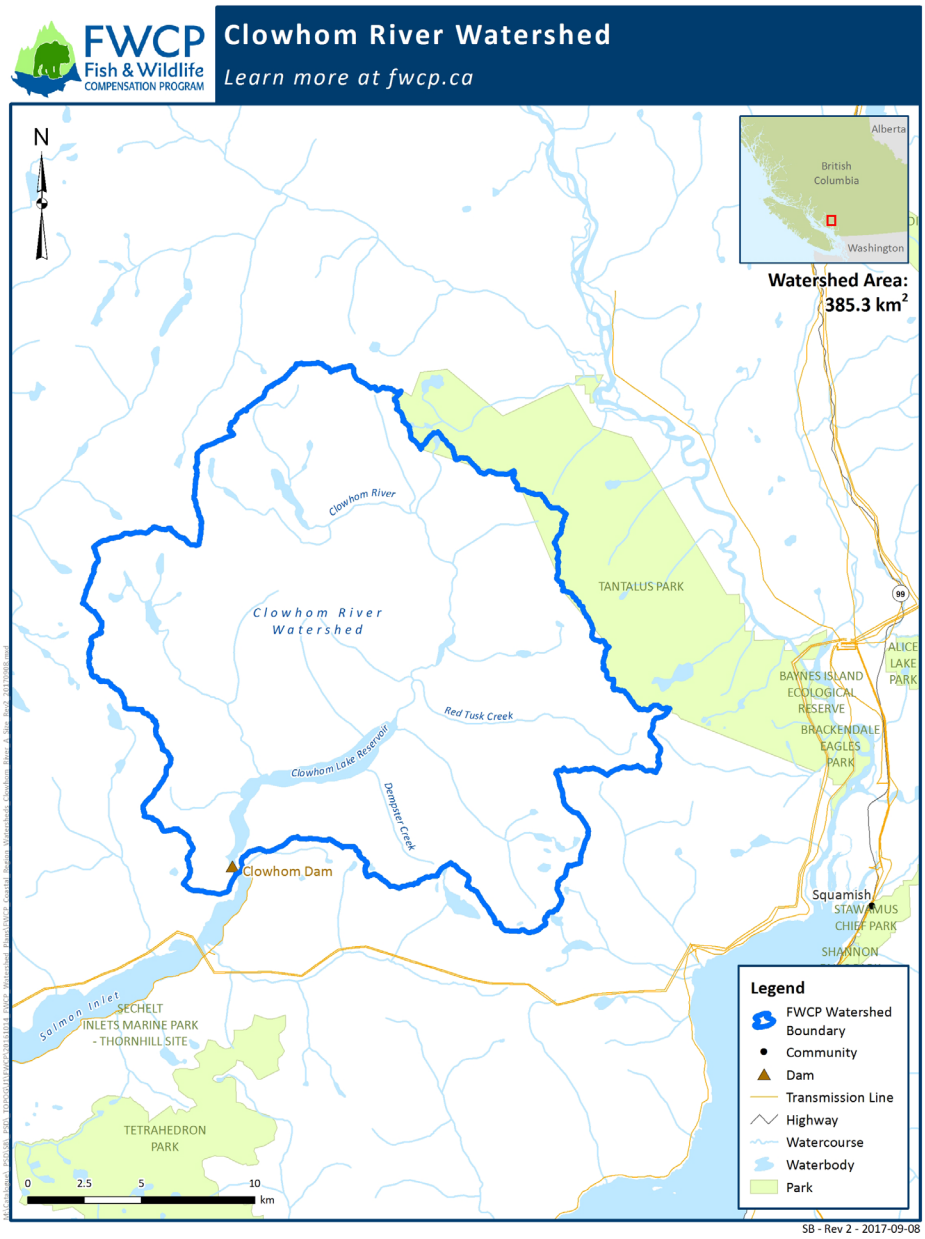

Figure 2: The FWCP Clowhom River watershed boundary.

Land Ownership in the Clowhom River Watershed

The Clowhom River Watershed is almost entirely Crown land. The northeastern side of the watershed is bordered by Tantalus Provincial Park. BC Hydro owns a small amount of land around its facilities. 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.

Impacts and Threats

Fish and wildlife habitat and, consequently, species have been altered due to the construction of the dams, the production of hydropower, and alterations in the hydrologic regimes of the systems.

Hydro-related Impacts

Inundation: The dam inundated two existing lakes that covered 430 ha and 17 km of shoreline, as well as 315 ha of land.

Habitat loss: 41 ha of riparian habitat, 6km of river mainstem and 3 km of lower tributary channels were flooded. The dam eliminated large woody debris and gravel recruitment downstream.

Migration barriers: Construction of two dams has eliminated a narrow, 200-m long side channel around the falls that may have provided access for anadromous fish species. There are none present now. Drawdown may limit access to tributaries for rainbow trout. The flooding of the lakes represents a greater barrier to the movement of wildlife than existed before inundation.

New habitat: New lake and shoreline habitat has been created, including open water habitat for osprey, waterfowl, freshwater fish and other wildlife species.

Altered flow regime: Altered flows may have localized effects on the salinity regime in marine foreshore. Drawdown may limit establishment of aquatic and riparian vegetation that has negative effects on ungulates, furbearers, and some small mammals.

Entrainment: Magnitude of entrainment is unknown.

Non-hydro Impacts

Impacts to wildlife in the watershed are mostly from forestry operations and roads, which increase human access to the watershed and may disturb wildlife and increase species' harvest.

Objectives for the Clowhom 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) resident salmonids (Kokanee, Rainbow Trout and Cutthroat Trout); and, (b) Pacific Herring.	Maintain and, where feasible, increase the abundance and distribution of species of interest (e.g., federally listed species-at-risk listed species and species identified through government, community, and First Nations engagement). See Action Table for specific species.	Maintain and, where feasible, increase the abundance and distribution of species of interest (e.g., federally listed species-at-risk listed species and species identified through government, community, and First Nations engagement). See Action Table for specific species.

Objectives	Sub-objectives		
	Rivers, Lakes & Reservoirs	Wetland & Riparian Areas	Upland & Dryland
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: Clowhom River Watershed

FWCP has been funding projects in the Clowhom River Watershed since 1999 under the Bridge-Coastal Restoration Program (BCRP) and subsequently under the Fish and 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 under each Ecosystem Chapter during the 2010/2011 to 2015/2016 FWCP project years.

Rivers, Lakes & Reservoirs

No projects were undertaken during the 2010/2011 to 2015/2016 FWCP project years that addressed Rivers, Lakes & Reservoirs species or habitats in the Clowhom River Watershed.

Wetland & Riparian Areas

A single multi-year project was undertaken during the 2010/2011 to 2015/2016 FWCP project years that addressed Wetland & Riparian species and habitat with $225,000 of FWCP funding. This four-year project (three years have been funded from 2013/2014 to 2015/2016) focused on wetland and riparian mapping and assessment as well as inventory of several wetland/riparian and upland/dryland species at risk. Inventory surveys were conducted for Western Toad, Northern Red-legged Frog, Coastal Tailed Frog, and Western Painted Turtle (all high priority species), as well as for Pacific Water Shrew (no priority rating but federally listed as *Endangered*), which resulted in a variety of recommendations for operating practices, habitat protection and enhancement, and establishment of a provincial Wildlife Management Area.

Upland & Dryland

One multi-year project and one single-year project were undertaken during the 2010/2011 to 2015/2016 FWCP project years that addressed Upland & Dryland species with $240,000 of FWCP funding. The multi-year project is the same project that targeted Wetland & Riparian species and habitat, although it also provided baseline inventory for Western Screech-owl, Northern Goshawk, and bats, and included installation of habitat structures (owl nest boxes and bat boxes). The single-year project expanded the previously existing Strathcona TSA habitat models for Roosevelt Elk to achieve complete model coverage for the Clowhom River Watershed. No inventories or other work have been conducted on Black-tailed Deer, which is also a high priority species.

Interactions with Other Ongoing Processes

Water Use Plan (WUP) – BC Hydro undertook Water Use Planning on the Clowhom 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.

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

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

CLOWHOM RIVER WATERSHED

ECOSYSTEM CHAPTER: RIVERS, LAKES & RESERVOIRS

Actions for Rivers, Lakes & Reservoirs

The Action Table in this document (see page 18) 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 Clowhom River Watershed

The Clowhom River drains into Clowhom Lake Reservoir from the northeast. Water is discharged directly from the powerhouse into Salmon Inlet, which is saltwater. There are no anadromous populations present in the watershed currently, although anecdotal evidence suggests that salmon may have been present in the watershed historically. The watershed hosts Kokanee Salmon, Rainbow Trout and Cutthroat Trout. Pacific Herring spawn in Salmon Inlet.

Limiting Factors

Limiting factors vary among species and include poor water quality, availability and quality of spawning and rearing habitat, and access to habitats (e.g., fish passage at natural barriers).

- **Habitat area:** The construction of Clowhom Dam resulted in the loss of 350 m of mainstem channel and a small side channel between the dam and Salmon Inlet. However, it is likely that little spawning or rearing habitat existed in the high gradient bedrock channel below the falls prior to dam construction (Sigma Engineering 2005).
- **Habitat quality:** Alterations in the flow regime have likely impacted fish productivity, including reduced recruitment of sediment and large woody debris. Drawdown of the Clowhom Lake Reservoir likely reduced to the productivity of the littoral zone, which affects resident stocks. Forestry and run-of-river projects in the upper watershed also have likely impacted habitat quality of the tributaries to Clowhom Lake Reservoir.
- **Access:** The construction of Clowhom Dam in the 1950s may have blocked anadromous access to Clowhom Lake. There is anecdotal evidence that anadromous salmon may have been historically present, although not likely in large or consistent numbers (Bengeyfield *et al*. 2001).
- **Water quality:** Increased turbidity from natural erosion or mass wasting events in the upper watershed and/or during periods of heavy rain or rapid snowmelt can increase turbidity throughout the watershed.

Knowledge Status

Habitat

Archival information indicates the absence of anadromous fish in the Clowhom basin in the last century, at least in large or consistent numbers (Bengeyfield *et al*. 2001). A small secondary channel was reported to exist prior to initial dam construction in 1950 that apparently enabled Coho Salmon and Steelhead to ascend the falls and possibly contained some spawning and rearing functions (BCR Strategic Plan 2000). However, there is also a report of a small tributary creek near the powerhouse that had small numbers of spawning salmon for a short distance upstream of tidewater.

An extensive sport fishery for Rainbow Trout and Cutthroat Trout existed in the original lakes from 1927 to 1956 (Keller and Leslie 1996). The pre-impoundment lakes were judged to be unproductive due to their depth and the lack of benthic organisms and observable plankton (Smith and Larkin 1950). It is speculated however that fish productivity has decreased post-impoundment as a result of the loss of littoral habitat in Clowhom Lake Reservoir, although little data exists to support this hypothesis (Bates and Coombes 2012). The upper Clowhom River has extensive spawning gravels (BCR Strategic Plan 2000). Most other reservoir tributaries are presently limited in habitat quality due to steep gradients, coarse substrates, obstructions, and low summer flows (Lewis *et al*. 1996).

Knowledge Gaps

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

- There is relatively little known about the presence of anadromous salmon in the watershed historically.
- The current distribution and abundance of anadromous salmon in the Lower Clowhom and nearby tributaries is also not well known.
- There is relatively little known about the habitat quality and productive capacity of the tributary habitats for resident salmonids. Some of this information could be compiled from independent power producer's operating in the watershed.
- More information could be acquired regarding Kokanee population status and trends over time.
- There is relatively little known about the extent and year-to-year variability in Pacific Herring spawn in the Clowhom estuary and if these are affected by the Clowhom facility.

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 measures 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 two sub-objectives:

1. **Sustain and increase the population viability of resident salmonids**
   Kokanee, Rainbow Trout and Cutthroat Trout reside in Clowhom Lake Reservoir and are important species in the Clowhom system.
   Measures – Measures will be species- and project-specific.

2. **Sustain and increase the population viability of Pacific Herring**
   Pacific Herring spawn in Salmon Inlet at the mouth of the Clowhom River and are an important species for the local community.
   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 18) 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 Clowhom 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 system, 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.

In the Clowhom River Watershed, wetland and riparian areas were affected by the impoundment of Clowhom Lake Reservoir, which flooded two smaller lakes and 41 ha associated riparian habitat. A 40 ha wetland and riparian complex upstream of the reservoir is a significant feature in the watershed and has been the focus of a 20-year wildlife and hydrology monitoring project conducted under the Water Use Plan (Bates and Ferguson 2010).

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.

- **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 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, soil conditions, (e.g., Atkinson et al. 2010).

Knowledge Status

Habitat

Extensive wetland and riparian mapping and amphibian and bird surveys have been completed in the Clowhom River Watershed (Evelyn et al. 2016). Although riparian and wetland habitats were lost to inundation, some habitats remain adjacent to the reservoir and upstream along tributaries.

Evelyn et al. (2016) noted that remaining riparian and wetland habitat and associated specie are affected by hydro operations, forest harvesting, as well as roads and transmission lines. Hydro operations result in drawdowns of water levels in habitats close to the reservoir, negatively affecting the breeding success of pond-dwelling amphibians. Forest harvesting has reduced the abundance of structural attributes associated with old forest, and roads and transmission lines have increased risks of road mortality, invasive species, and human disturbance.

Changes in the abundance, distribution and productivity of wetlands and riparian habitat have resulted in species-specific impacts. Evelyn et al. (2016) identified 127 vertebrate species, including 12 federally listed and 14 provincially listed species at risk.

Knowledge Gaps

Evelyn et al. (2016) addressed previous knowledge gaps regarding the status of ecosystems and species in the Clowhom River Watershed. They recommended ongoing monitoring to better characterize impacts. Their surveys were confined to vertebrate species, so the distribution and abundance of other taxa (e.g., rare plants) are not well characterized.

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 measures 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.
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.
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 & Dryland

The Action Table in this document (see page 18) 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 Clowhom 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 forests, and alpine ecosystems. Different habitats are associated with distinct species assemblages that react to direct or indirect stressors in their distinct habitat niches.

Lower elevations of the Clowhom River Watershed lie within the Coastal Western Hemlock Very Wet Maritime Subzone Submontane variant (CWHvm1), above which lays the Coastal Western Hemlock Very Wet Maritime Montane variant (CWHvm2), and above that, the Mountain Hemlock Moist Maritime Windward variant (MHmm1). Upper elevations are within the Coastal Mountain-heather alpine (undifferentiated and parkland; CMAunp) subzone. Low elevations receive little snow but accumulations can be deep at high elevations, due to high winter rainfall.

Limiting Factors

Limiting factors vary among species but are generally associated with habitat loss, alteration, and reduced connectivity.

- **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

Habitats of the Clowhom are characteristic of south coastal watersheds, with high-volume forests at low elevations rising to parkland and alpine habitats and permanent snowfields. Upland habitats have not been specifically surveyed.

Changes in the productivity and composition of upland and dryland habitat have resulted in species-specific impacts. Although Evelyn's et al. (2016) surveys were focused on riparian and wetland habitats, they made many observations of upland birds, reptiles and mammals that likely provides a relatively complete inventory of vertebrate species diversity in the watershed.

Knowledge Gaps

Upland habitats in the watershed have not been specifically surveyed for rare ecosystems, species or habitat features.

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 measures 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 restoring conditions similar to those that exist under natural and local disturbance regimes, or 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.

CLOWHOLM 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	**COM.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 Clowhom watershed. Habitats to be assessed & mapped include: • Wetlands • Riparian Areas • Stream Habitats • Estuary • 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 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.). Recommendations should be made through this work for future management actions and assessments. Extensive wetland and riparian mapping and amphibian and bird surveys have been completed in the Clowhom watershed (Projects: 13.W.COM.01; 14.W.COM.01; 16.W.COM.01.). Project 16.W.COM.01 identified priority sites for wetland restoration and enhancement, undertook detailed ecological assessments at these candidate sites, and developed restoration plans. Next steps should be to monitor known breeding sites, implement the recommendations from the projects, where feasible, to create, restore and protect important habitats (e.g., breeding areas) and evaluate the effectiveness of actions that have been completed.	Improved strategic planning for restoration opportunities.	Directed	Throughout

CLOWHOLM 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	**COM.ALL.RI.02.01 Conduct a limiting factors analysis…-Lower Clowhom & estuary-P2**	2	Fish & Wildlife	Conduct a **limiting factors analysis** for priority fish and/or wildlife in the Clowhom 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 Clowhom and estuary (Priority 2), and Clowhom Lake and tributaries (Priority 1). Analyses should build upon previous and ongoing assessments, including the Water Use Plan studies (e.g., COMMON-2) and any existing restoration plans, in association with local agency, First Nation and BC Hydro staff, private 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.	To determine cost-benefit of potential FWCP actions and support prioritization of future projects. Leads to the creation of robust habitat or species-based restoration plans for the watershed or sub-basins.	Directed	Throughout
			COM.ALL.RI.02.02 Conduct a limiting factors analysis…-Clowhom Lake & tributaries-P1	1					
			COM.ALL.RI.02.03 Conduct a limiting factors analysis…-Clowholm Watershed-P2	2					
3	All	Research & Information Acquisition	**COM.ALL.RI.03.01 Develop a comprehensive restoration and protection plan-Lower Clowhom & estuary-P2**	2	Fish & Wildlife	**Develop a comprehensive restoration and protection plan for fish and/or wildlife** in the Clowhom 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;	To determine high priority, cost-effective habitat and/or species-based actions that can be supported by the FWCP.	Directed	Throughout

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			COM.ALL.RI.03.01 Develop a comprehensive restoration and protection plan-Clowhom Lake & tributaries-P1	**1**		• Clear goals and objectives based on a desired future condition; • 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 Kokanee, Rainbow Trout, Cutthroat Trout, and Pacific Herring. High priority wildlife include bats, amphibians, and riparian-associated mammals and birds. Note that all estuary, riparian and wetland projects should include inventory of rare plants and invertebrates to prevent the destruction of at-risk habitats while carrying out other projects. Plans should be developed in association with local agency, First Nation and BC Hydro staff, landowners and other land managers. Project 16.W.COM.01 identified priority sites for wetland restoration and enhancement, undertook detailed ecological assessments at these candidate sites, and developed restoration plans. Next steps should be to monitor known breeding sites, implement the recommendations from the projects, where feasible, to create, restore and protect important habitats (e.g., breeding areas) and evaluate the effectiveness of actions that have been completed. Sub-basins for fish plans include the Lower Clowhom and estuary (Priority 2), and Clowhom Lake and tributaries (Priority 1). Restoration plans are best developed as 'living documents' so that they can be updated over time. Restoration plans should also build upon previous work in the watershed such as in BCRP Project# 05.CL.01. 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.			
			COM.ALL.RI.03.01 Develop a comprehensive restoration and protection plan-Clowholm Watershed-P2	**2**					

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4	All	Habitat-based Actions	**COM.ALL.HB.04.01 Implement high priority habitat-based actions-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 12**), 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 development of restoration actions would be beneficial.	Implement high priority, cost-effective habitat and/or species-based actions that can be supported by the FWCP.	Open	Throughout
		Species-based Actions	**COM.ALL.SB.04.02 Implement high priority species-based actions-P1**	**1**					
5	All	Monitoring & Evaluation	**COM.ALL.ME.05.01 Develop and implement an integrated monitoring plan-P2**	**2**	Fish & Wildlife	Develop and implement an **integrated monitoring plan** for fish and/or wildlife in the Clowhom 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 undertaken 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
6	All	Monitoring & Evaluation	**COM.ALL.ME.06.01 Assess success of habitat-based actions supported by FWCP-P2**	**2**	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. High priority for assessments: 1) evaluate the success of past wetland restoration activities (project COA-F17-W-1181 Clowhom Watershed Species at Risk and Habitat Surveys Year 4) in the watershed by tracking wildlife use, plant growth, water levels, etc. in the newly created wetland ponds. Priority area: lower Clowhom Lake. 2) Evaluate the effectiveness of the nest box program for Western Screech-Owls. 20+ nest boxes have been installed throughout the watershed with FWCP Coastal funding 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.	Assess success of habitat-based actions and support future planning and prioritization.	Open	Throughout

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7	All	Monitoring & Evaluation	**COM.ALL.ME.07.01 Conduct condition assessments and/or maintenance on habitat enhancements-P2**	2	Fish & Wildlife	**Conduct condition assessments and/or maintenance on habitat enhancements** once they are supported by the FWCP. This could include the development of an inspection and maintenance schedule if required.	Maintain functioning of habitat enhancements supported by the FWCP.	Open	Throughout
8	Rivers, Lakes and Reservoirs	Research & Information Acquisition	**COM.RLR.RI.08.01 Determine feasibility of improving habitat in the Clowhom estuary-P1**	1	Fish & Wildlife	**Determine feasibility of improving habitat in the Clowhom estuary** (e.g., improved connectivity, complexity, eelgrass, herring spawn, etc.).	Sustain and restore habitat capacity and population viability of Pacific Herring.	Open	Lower Clowhom and estuary
9	Rivers, Lakes and Reservoirs	Research & Information Acquisition	**COM.RLR.RI.09.01 Conduct research to determine if the Clowhom lakes used to support anadromous salmon...P2**	2	Anadromous & Resident Salmonids	Conduct research to **determine if the Clowhom lakes used to support anadromous salmon** prior to dam construction. Work could include a review of historic information and core sediment sampling to determine the historic fish use of Clowhom Lake.	Determine historic anadromy and inform development of fish passage plan, if required.	Open	Throughout
10	Rivers, Lakes and Reservoirs	Research & Information Acquisition	**COM.RLR.RI.10.01 Assess possibilities for fish passage up to and beyond Clowhom dam-P3**	3	Anadromous & Resident Salmonids	**Assess possibilities for fish passage up to and beyond Clowhom dam.** This work would be contingent on the outcome of an assessment of historical anadromous fish passage **(Action 9)** and review of productive capacity of Clowhom Lake and tributaries.	Develop fish passage plan beyond Clowhom Dam.	Open	Lower Clowhom and estuary
11	Rivers, Lakes and Reservoirs	Habitat-based Actions	**COM.RLR.HB.11.01 Implement habitat restoration, enhancement...-Lower Clowhom & estuary-P2** **COM.RLR.HB.11.02 Implement habitat restoration, enhancement...-Clowhom Lake & tributaries-P1**	2 1	Anadromous & Resident Salmonids, Pacific Herring	**Implement habitat restoration, enhancement and/or protective measures within sub-basins of the Clowhom watershed** (refer to priorities of sub-basins above) to improve salmonid migration, spawning, incubation or rearing habitat. 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	Throughout

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			COM.RLR.HB.11.03 Implement habitat restoration, enhancement...-Clowholm Watershed-P2	**2**					
12	Wetland & Riparian	Research & Information Acquisition	**COM.WAR.RI.12.01 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. Species of interest reflect engagement from FWCP partners and include, but are not limited to: • Wolverine. Inventory is needed to determine if conservation actions might be appropriate. There is a poor understanding of distribution within coastal watersheds that hampers conservation of the species in multi-use landscapes. • Mesocarnivores (i.e., Ermine, Pacific Marten). Conduct risk assessment and evaluate population sustainability through a monitoring program. If necessary, implement enhancement strategies to maintain sustainable populations. If part of a multi-year study, provide information about future objectives and actions. • Peregrine Falcon (probably anatum subspecies). Collect DNA to determine which subspecies occurs in the watershed. • Sharp-tailed Snake. Inventory required. Install Artificial Cover Objects,	Maintain or, where feasible, increase the abundance of species of interest.	Open	Throughout
	Upland & Dryland	Research & Information Acquisition	**COM.UAD.RI.12.02 Inventory for species of interest that are likely in the watershed-P2**	**2**					

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						could do hand surveys of suitable microhabitat. If present, refer to the Recovery Strategy for the Sharp-tailed Snake (Contia tenuis) in British Columbia (Sharp-tailed Snake Recovery Team 2008) for conservation actions.			
13	Wetland & Riparian	Habitat-based Actions	**COM.WAR.HB.13.01 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 Pacific Water Shrew (*Sorex bendirii*) in Canada (Environment Canada 2014). • Management Plan for Roosevelt Elk in British Columbia (Ministry of Forests, Lands and Natural Resource Operations 2015). • Recovery plan for the Western Screech-Owl, kennicottii subspecies (Megascops kennicottii kennicottii) in British Columbia (Ministry of	Stable or increasing population of at-risk species. Habitat enhancement opportunities.	Open	Throughout

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	Upland & Dryland	Habitat-based Actions	**COM.UAD.HB.13.01 Implement priority species- and habitat-related conservation actions…P1**	**1**		Environment 2013). Extensive Western Screech-Owl inventories have been completed. Project 14.W.COM.01 found 4 Western Screech-owl territories, pinpointed one nest cavity, and confirmed successful fledging in at least one territory. Next priorities are to monitor the known territories, seek to determine if any other territories exist, and seek to protect the known territories. • Management Plan for the Northern Goshawk, *laingi* subspecies (*Accipiter gentilis laingi*) in British Columbia (Ministry of Forests, Lands, and Natural Resource Operations and Ministry of Environment 2013). Work collaboratively with the province and build upon previous surveys (e.g., project 14.W.COM.01). Any occupied breeding territories, with sufficient suitable habitat, can be forwarded to federal government to inform the Recovery Strategy and to provincial government for consideration of Wildlife Habitat Area establishment. As well, at any nest sites confirmed as occupied, DNA should be collected (e.g., cast goshawk feathers) and provided to UBC in support of the goshawk genetic differentiation study. • Management Plan for the Coastal Tailed Frog (*Ascaphus truei)* in British Columbia (B.C. Ministry of Environment 2015). • Management Plan for the Western Toad (*Anaxyrus boreas*) in British Columbia (Provincial Western Toad Working Group 2014). • Management Plan for the Northern Red-legged Frog (Rana aurora) in Canada [Proposed] (Environment Canada 2016).			
14	Upland & Dryland	Research & Information Acquisition	**COM.UAD.RI.14.01 Verify critical Elk habitat models and maps -P2**	**2**	Roosevelt Elk	**Verify critical Elk habitat models and maps** (16.W.COM.02 Development of a Roosevelt Elk Habitat Model for the South Coast) through monitoring. Habitats need to be identified to determine best actions for protection and restoration of critical ranges. Of greatest concern is protection, maintenance and enhancement of winter ranges for cover and food.	Maintain or, where feasible, increase the abundance of species of interest.	Open	Throughout

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15	Upland & Dryland	Habitat-based Actions	**COM.UAD.HB.15.01 Implement ungulate winter range enhancement or restoration for both Roosevelt Elk and Deer-P3**	**3**	Roosevelt Elk & Deer	**Implement ungulate winter range enhancement or restoration** for both Roosevelt Elk and Deer. Explore opportunities for thinning and pruning of second-growth forest stands to improve forage production. These restoration activities could also improve the habitat for other wildlife species (e.g., Goshawks).	Protect and/or restore rare and ecologically significant upland/dryland habitat. Sustain and increase the food, social, ceremonial, recreational and/or commercial use of fish and wildlife resources.	Open	Throughout
16	Upland & Dryland	Habitat-based Actions	**COM.UAD.HB.16.01 Determine presence, identify/protect bat Maternity roosts & winter hibernacula-P1**	**1**	Bats	1) **Monitor known bat roosts for White Nose Syndrome**; 2) Through acoustic monitoring or other methods (e.g., radio-tracking, DNA), **identify bat maternity roosts and winter hibernacula; 3) Pursue protection of hibernacula and maternity roosts** (e.g., critical habitat, WHAs or wildlife habitat feature designations). Over 100 bat mist net hours and 10 hours of acoustic bat surveys were completed by project "14.W.COM.01 Surveys of Species at Risk and their Associated Habitats in the Clowhom Watershed – Year 2" which confirmed the occurrence of a diverse bat community composed of at least 8 species, including federally endangered Little Brown Bats.	Maintain or, where feasible, increase the abundance of species of interest.	Open	Throughout
17	Wetland & Riparian	Habitat-based Actions	**COM.WAR.HB.17.01 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	Varied types of species and habitat conservation, protection and enhancement	Open	Throughout

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	Upland & Dryland	Habitat-based Actions	**COM.UAD.HB.17.02 Conserve or enhance important habitats or mitigate habitat threats for priority bird species-P2**	2		recommended conservation actions/guidance in the implementation plans (http://www.pacificbirds.org/science-and-planning/state-or-regional-plans/).	opportunities. Maintain or, where feasible, increase the abundance of species of interest.		
18	Wetland & Riparian	Habitat-based Actions	**COM.WAR.HB.18.01 Identify, monitor and protect Barn Swallow nesting sites-P2**	2	Barn Swallow	**Identify, monitor and protect Barn Swallow nesting sites**. Project 16.W.COM.01 conducted enhancement and monitoring of Barn Swallow nesting activity at 5 anthropogenic sites.	Maintain or, where feasible, increase the abundance of species of interest. Encourage swallows away from BC Hydro infrastructure.	Open	On the Clowhom dam hoist tower, and in human structures near the dam
	Upland & Dryland	Habitat-based Actions	**COM.UAD.HB.18.02 Identify, monitor and protect Barn Swallow nesting sites-P2**	2					
19	Wetland & Riparian	Habitat-based Actions	**COM.WAR.HB.19.01 Restore and enhance the supply of cavities in trees for large cavity users-P2**	2	Multiple Species	**Restore and enhance the supply of cavities in trees** for large cavity users (e.g., Northern Flying Squirrels, Pacific Marten, Flying Squirrels).	Protect and/or restore rare and ecologically significant upland/dryland habitat.	Open	Throughout
	Upland & Dryland	Habitat-based Actions	**COM.UAD.HB.19.02 Restore and enhance the supply of cavities in trees for large cavity users-P2**	2					
20	Wetland & Riparian	Habitat-based Actions	**COM.WAR.HB.20.01 Implement wetland and riparian restoration projects-P1**	1	Wildlife	**Implement wetland and riparian restoration projects that are identified as high priorities through inventory, mapping or assessment in the Clowhom 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 (see areas identified in 16.W.COM.01 Surveys of Species at Risk and their Associated Habitats in the Clowhom Watershed - year 3).	Protect, restore and/or create new wetland and riparian habitat.	Open	Throughout

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21	Upland & Dryland	Monitoring & Evaluation	**COM.UAD.ME.21.01 Assess effectiveness of bat enhancement and mitigation efforts-P1**	**1**	Bats	**Assess effectiveness of bat enhancement and mitigation efforts** (i.e., bat boxes) through collaboration with BC Hydro. This could be a good area for monitoring effectiveness of bat houses because 15+ bat houses have been installed in Clowhom by researchers and BC Hydro. Use has been confirmed.	Maintain or, where feasible, increase the abundance of species of interest.	Open	Throughout

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