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FISH AND WILDLIFE COMPENSATION PROGRAM

COLUMBIA BASIN

RIPARIAN AND WETLANDS ACTION PLAN

DRAFT

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BChydro 
FOR GENERATIONS



Fisheries and Oceans
Canada

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Glossary

Action Plan: the Fish and Wildlife Compensation Program (FWCP) has identified conservation priorities for fish and wildlife in each of its three regions and these are reflected in a series of Action Plans. The priorities and plans vary by region.

Basin Plan: these plans set forth the strategic direction for the Fish and Wildlife Compensation Program (FWCP) in the Columbia Region.

Blank Ownership (unknown ownership): there are large areas within the basin where there is no information on ownership in the mapping databases. The category of “unknown ownership” is not large; however large areas are identified as “ownership blank”. This is the result of a systemic error in the databases that has been identified by government. For the purposes of this document “no ownership” and “ownership blank” are considered the same, although they are identified separately in the mapping data sets.

Conservation Properties: all lands purchased for conservation.

Conservation Reserves: crown lands such as Wildlife Sanctuaries and ecological reserves that have been dedicated to conservation purposes.

Creston Valley Wildlife Management Area: a 7,000-hectare (17,000-acre) area of provincial Crown land located along the Kootenay River system.

Crown Land: includes all federal and provincial land not in direct conservation designations as described above (e.g. conservation properties, Conservation Reserves, etc.).

First Nations Reserve Lands: federal crown land held in trust for individual First Nations.

Fish and Wildlife Compensation Program (FWCP): The FWCP is partnership between BC Hydro, Fisheries and Oceans Canada, the Province of BC, First Nations and public stakeholders to conserve and enhance fish and wildlife impacted by the construction of BC Hydro dams.

Focal Areas: six priority riparian and wetland areas addressed in this riparian and wetland action plan are referred to as focal areas and include: Creston Valley; Duncan, Lardeau and Revelstoke Valleys; Elk Valley; Robson Valley; Slocan Valley; and the Upper Columbia Valley.

Private Land: this includes all land divested from the crown. Mining leases are included in this category.

Protected Areas: protected areas were used in the Robson Valley as a form of protection developed in the land use planning process for that area and other areas in the north. They are equivalent to provincial park status in other parts of the province.

Provincial Parks: for the purposes of this document Provincial Parks are included as conservation lands. National park lands occur in only one focal area and are a very minor portion of the entire area.

Riparian Habitat: is defined as an area adjacent to a river or stream that differs from the surrounding uplands in the diversity of plant and animals found and in the overall productivity of the site.

Wetland: an area of land where the soil is saturated with moisture either permanently or seasonally and where water occurs on the surface e.g. in marshes, bogs and swamps.

Wildlife Management Area (WMA): is an area of land designated under section 4(2) of the *Wildlife Act* for the benefit of regionally to internationally significant fish and wildlife species or their habitats. Conservation and management of fish, wildlife and their habitats is the priority in a WMA but other compatible land uses may be accommodated.

Notice to Readers

2014 Riparian and Wetlands Action Plan

This Fish and Wildlife Compensation Program (FWCP) Riparian and Wetlands Action Plan, September 2014 replaces the June 2012 Riparian and Wetlands Action Plan. The 2014 version addresses input received from stakeholders to strengthen the plan. It contains updated analysis of land ownership status, more comprehensive mapping of wetlands and riparian areas, and detailed information on ecological process for each of the six focal areas addressed in this plan.

This Action Plan has been developed with input from First Nations, public stakeholders, the Province of BC, BC Hydro and the FWCP-Columbia fish and wildlife Technical Committees. This plan has been reviewed by the FWCP-Columbia Board.

First Nation References in the Action Plan

Portions of this plan are subject to a further review by First Nations to ensure the plan is comprehensive and inclusive. The FWCP does not anticipate changes to the Action Tables as a result of this review; however, references to First Nations' land uses, etc. may be updated.

Implementing the Action Plan

This Action Plan includes Action Tables for each of the six focal areas. The priority actions recommended in each Action Table will guide the FWCP's investments in wetland and riparian areas.

Proponents interested in applying for FWCP funds for fish and wildlife projects, should review the Action Tables and align their funding applications with the Actions recommended. Learn more at www.fwcp.ca.

Columbia Riparian and Wetlands Action Plan

1. Introduction to FWCP

The Fish and Wildlife Compensation Program (FWCP or Program) was established to compensate for impacts to fish, wildlife and their supporting habitat resulting from the construction of BC Hydro generation facilities. The FWCP operates in three regions of British Columbia: Coastal, Columbia and Peace. In the Peace and Columbia regions, the Program is in place to meet conditions related to the protection or enhancement of fish and wildlife and their habitat in BC Hydro's Water Licences¹ issued under the provincial Water Act; the Program is voluntary in the Coastal region.

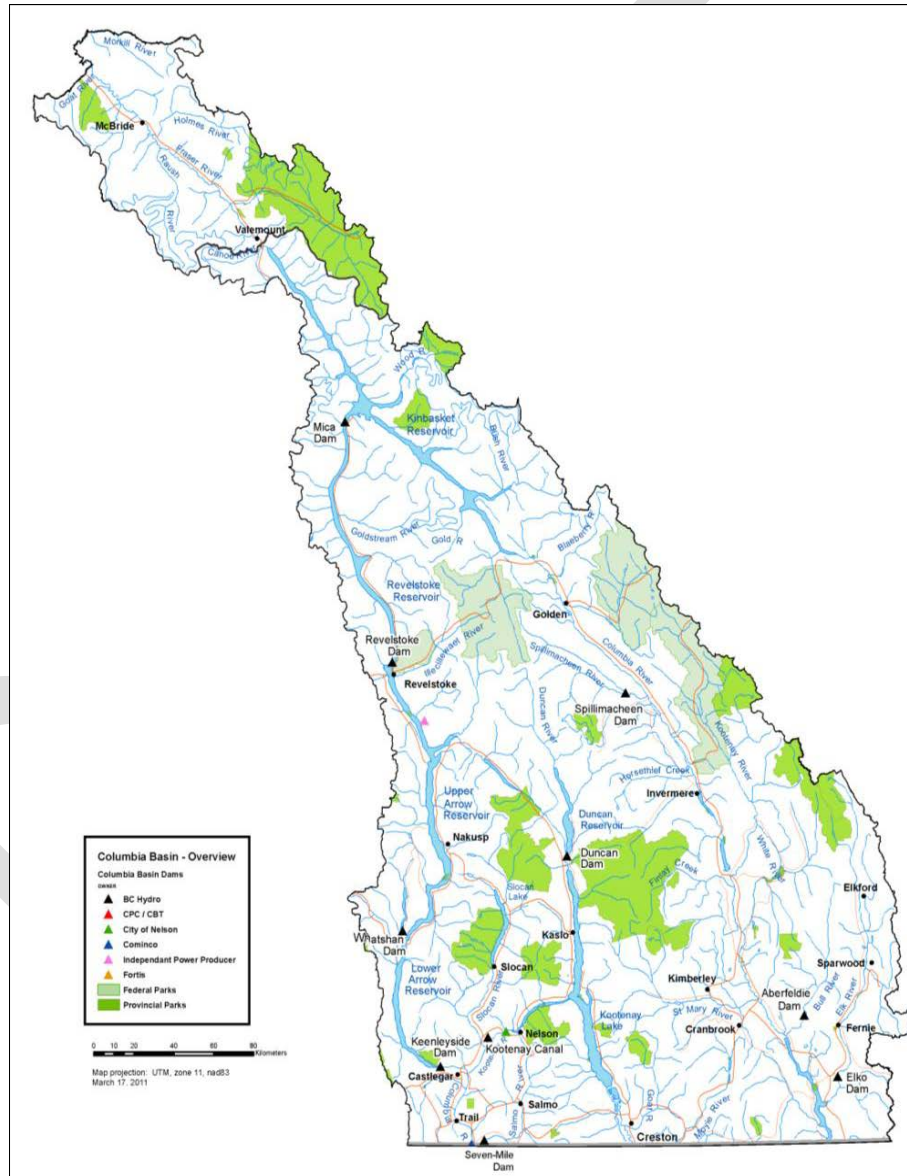


Figure 1: The Columbia Basin generation system, indicating the region's major dams and reservoirs.

¹ Section 2.1., Legal Platform, describes the water licence conditions related to the FWCP.

The FWCP-Columbia was created in 1995 to coordinate efforts in the Columbia Basin to compensate for fish and wildlife losses associated with BC Hydro projects in the region (Figure 1). An Administrative Agreement was signed in 1999 between the BC Ministry of Environment and BC Hydro to formalize the management of the program, which was developed to satisfy the obligations regarding fish and wildlife attached to the Arrow, Duncan, Mica, Seven Mile and Revelstoke project water licenses. The program is delivered as a partnership between BC Hydro, the BC Provincial Government, Fisheries and Oceans Canada, First Nations and public stakeholders.

Until 2008, the three regions operated independently, essentially as separate programs. Each of these programs had similar objectives but operated under varying administrative and delivery mechanisms. A comprehensive and independent program evaluation completed in 2008 recommended a more coordinated approach including a harmonized governance and consistent delivery structure as outlined in the 2014 FWCP Governance Manual.

The FWCP developed a strategic framework that guides overall planning for compensation investments (MacDonald 2009). The framework has guided the development of strategic plans for each basin within the FWCP program area, which are in turn informing action plans that focus on specific priorities within each basin (Figure 2).

Riparian areas and wetlands provide habitat for a disproportionately large number of species. Because they are usually associated with bottomlands, impacts from dam construction and operations have resulted in significant losses. This Riparian and Wetlands Action Plan sets out priorities and guides projects within the FWCP- Columbia program area. The plan builds on the FWCP's strategic objectives as outlined in the FWCP Columbia Basin and Action Plans.

Conservation

- Maintain or improve the status of species or ecosystems of concern.
- Maintain or improve the integrity and productivity of ecosystems and habitats.

Sustainable Use

- Maintain or improve opportunities for sustainable use, including harvesting and other uses.

Community Engagement

- Build and maintain relationships with stakeholders and aboriginal communities.

Action Plans have also been developed for small lakes, large lakes, streams, upland and dryland areas, and species of interest² The FWCP-Columbia, in partnership with Columbia Basin Trust, developed the Upper Kootenay Ecosystem Enhancement Plan (UKEEP) for the upper Kootenay River watershed including Koocanusa Reservoir. Some actions recommended in the Action Plans, including the UKEEP, may be complementary.

This Action Plan has been developed with input from First Nations, public stakeholders, the Province of BC, BC Hydro and the FWCP-Columbia fish and wildlife Technical Committees. This plan has been reviewed by the FWCP-Columbia Board.

² All FWCP Action Plans are available at www.fwcp.ca.

Strategic Framework

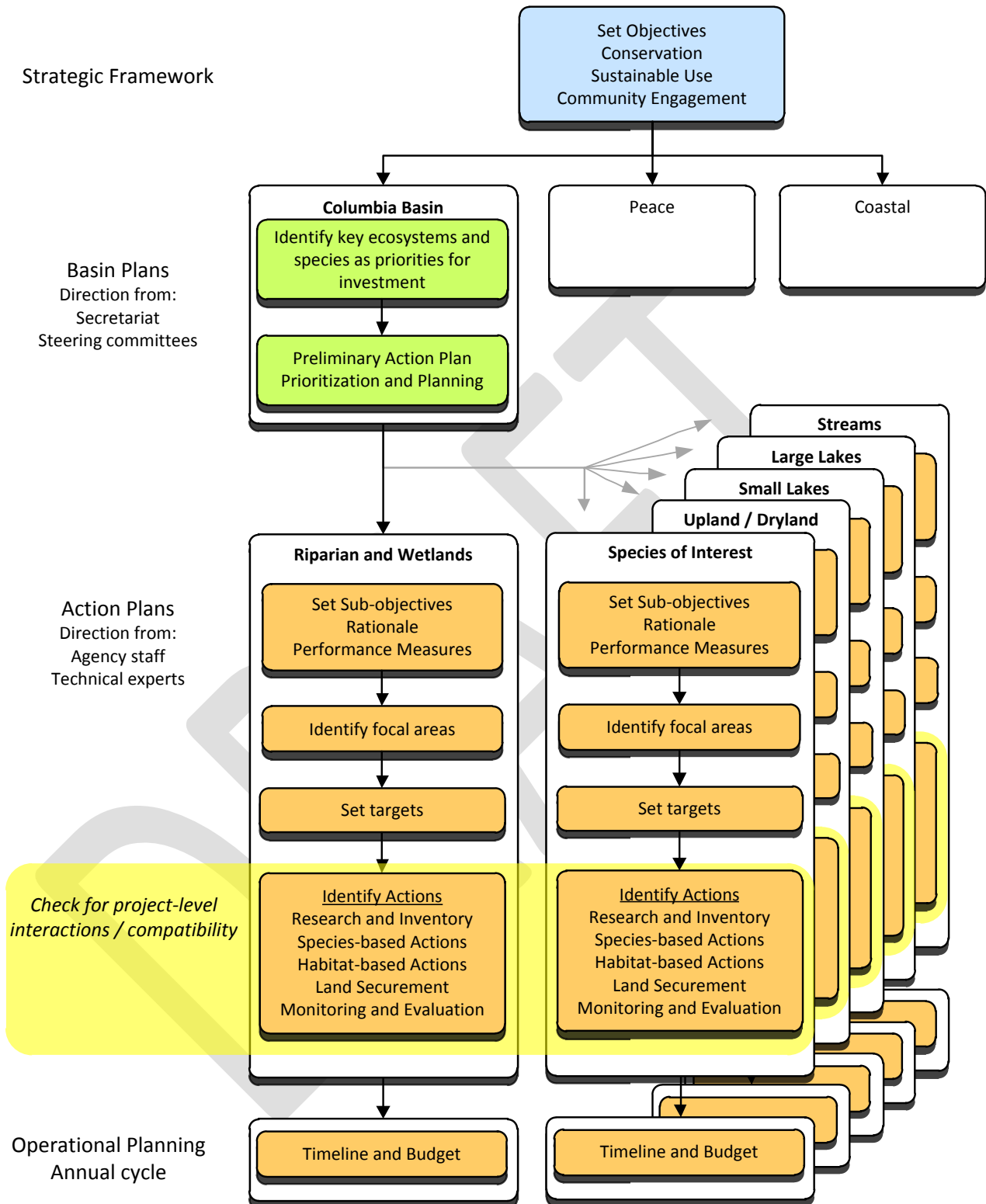


Figure 2: Relationship between the Riparian and Wetland Action Plan and higher level planning and objectives.

2. Overview and Context

A wetland is an area of land where the soil is saturated with moisture either permanently or seasonally. Where water occurs on the surface, marshes, bogs and swamps occur. In the Columbia Basin, there are: large numbers of small wetlands, bogs and ponds in the alpine and at higher elevations (Machmer et al. 2004); lesser numbers at mid elevations; and high numbers at low elevations, on the benches in the major valleys and on the floodplains of major rivers. Most bench wetlands are found in the Rocky Mountain Trench in the East Kootenay. Wetlands in the West Kootenay are very rare due to the lack of extensive bench lands in the valleys. There are floodplain wetlands along mid-elevation tributaries in each of the focal areas addressed in this plan (See [Figure 3](#) for focal areas). At low elevations throughout the Basin there are extensive wetlands on the floodplains of the major rivers throughout the Basin. These were the largest and most productive wetlands pre-settlement and have been most affected by hydro-electric developments and other human activities. They are the focus of this Action Plan.

Riparian habitat is defined as an area adjacent to a river or stream that differs from the surrounding uplands in the diversity of plant and animals found and in the overall productivity of the site. This occurs as a result of groundwater exchange, shading by trees and other proximity- related riparian habitat elements. Riparian areas occur in two forms in the Basin: riparian zones and floodplain riparian zones.

Where mountain slopes decline steeply into water bodies there is a narrow riparian zone of vegetation that is affected by the nearby presence of water bodies. These zones occur along the edge of all major lakes, reservoirs, rivers and streams, but in most areas form a very narrow zone. There are floodplain areas throughout the Basin where flat areas occur along major rivers and streams. The floodplain riparian zone in such areas can be kilometres wide. These systems support three major riparian habitats. Wetlands occur on these floodplains where the water table is close to the surface and are generally classified as shallow water, marsh, swamps, bogs and fens. At slightly higher elevations, where the groundwater level is lower, wet meadow systems develop, dominated by sedges and grasses, interspersed with an over-story of shrub species. Higher still, where the ground is less saturated with water, riparian forests develop. Cottonwood stands dominate in many areas, although in some areas the final seral stage is conifer dominated. Along rivers the annual spring freshet and major flood events create conditions where cottonwood stands can dominate these stands for long periods. Together, these three major types form floodplain complexes where habitat types can change based on very minor changes in elevation.

The ecological processes that drive each of these wetland types are different in each of the focal areas and these in turn, provide different options for conservation and enhancement. All of these systems provide important values to human society, including seasonal water storage, flood abatement, and, in some systems, net carbon storage. This plan targets six priority riparian and wetland habitat focal areas (see [Figure 3](#)):

1. Creston Valley;
2. Duncan, Lardeau and Revelstoke Valleys;
3. Elk Valley;
4. Robson Valley;
5. Slocan Valley; and
6. Upper Columbia Valley.

These are areas where most remaining riparian and wetland habitat occurs, where significant investments have been made by FWCP, or where significant, known opportunities for investment occur. An overview of each of these focal areas is provided below along with recommended actions.

The focal areas discussed here vary greatly in terms of both the functional processes that drive these systems and the impacts of human activity on these systems.

This Wetland and Riparian Action Plan focuses on the securement, creation and restoration of wetlands and riparian areas. Inventory, monitoring and the development of management plans are a lower priority but are often required before actions on these three priority actions can proceed effectively.

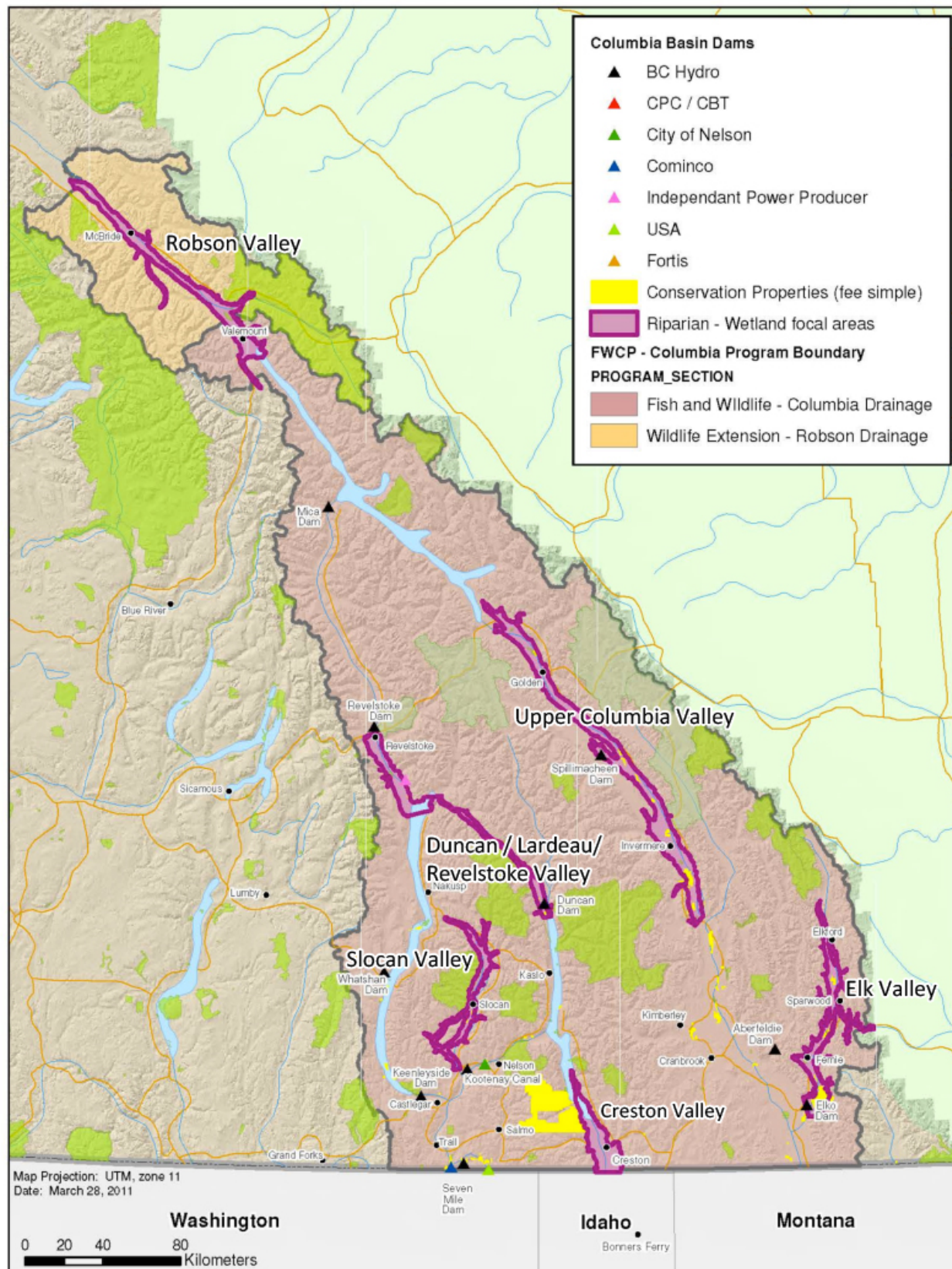


Figure 3: This Plan focuses on six focal areas in the Columbia Basin for riparian and wetland habitat securement, management, and project implementation.

2.1. Land Ownership Status

An analysis of land ownership in each focal area was completed during development of this Action Plan. The analysis was carried out at three levels: 1) ownership in the entire area of each focal area was assessed to provide a sense of land ownership at lower elevations in each focal area; 2) the TRIM data for swamp and marsh was used to provide an estimate of the presence of these categories in each focal area; and 3) floodplain risk mapping was then used to define the area of the floodplain along the major rivers in each focal area. These areas contain substantial areas of both riparian and wetland habitats.

The following section outlines land ownership status for each focal area. This baseline information has been considered in the development of objectives, targets and actions. In the future, these data will allow the FWCP to measure changes in land securement status.

1. Ownership of all low elevation habitats in each focal area.

This analysis provides data on the ownership of all low elevation habitats in each focal area. It is a measure of the degree of securement of low elevation habitats in each valley. Figure 4 indicates the relative level of securement across the six focal areas. Unknown ownership is low (7%) in the Elk Valley, and higher (20-60%) in the other focal areas.

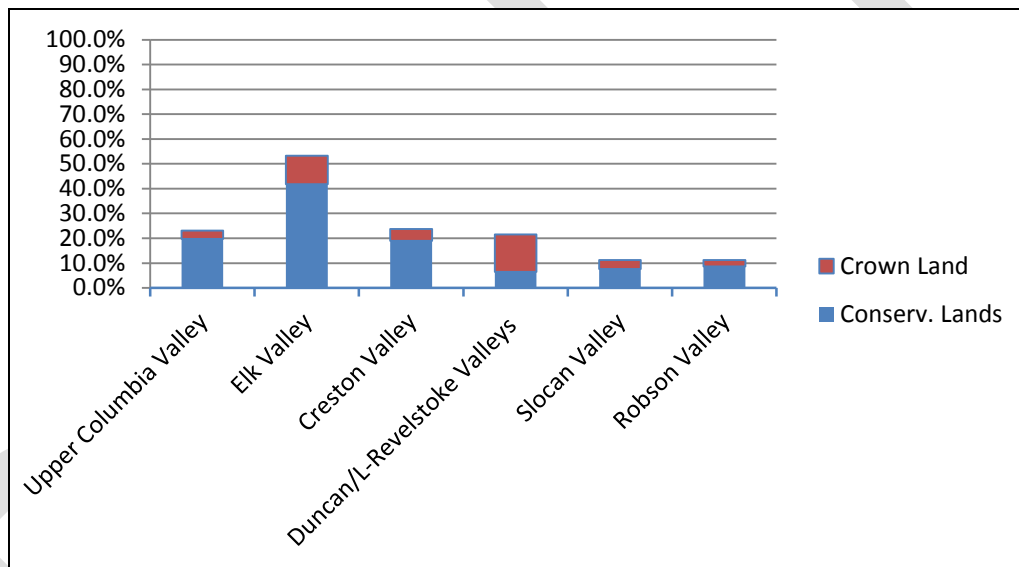


Figure 4: The proportion of low elevation habitats secured in conservation lands and crown land status in each focal area.

2. Ownership of marsh and swamp TRIM categories in each focal area.

TRIM data for the areas classified as marsh and swamp secured in each focal area is provided in Figure 5. Unknown ownership³ is a major issue in this analysis also, with >1% ownership blank in the Creston Valley and 8-32% in the other focal areas.

³ Unknown ownership includes an ownership category referred to as “blank ownership” in the government databases referenced for this analysis.

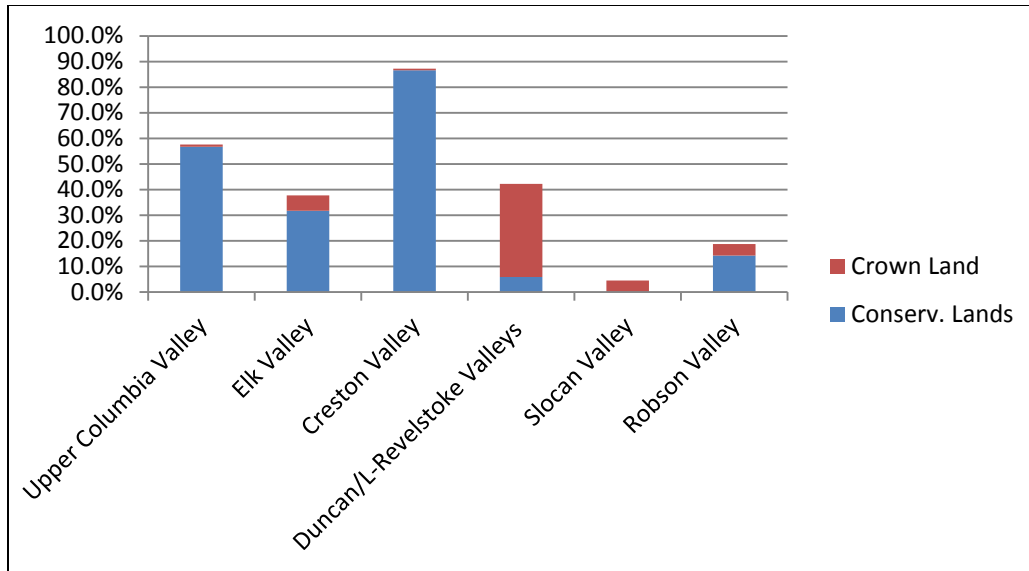


Figure 5: The proportion of TRIM swamp and marsh categories secured in conservation lands and crown land status in each focal area.

These data indicate that securement of wetland and swamp categories (TRIM) is very high in the Creston Valley (>85%). Almost all of this securement is in the form of conservation lands. In the Upper Columbia Valley, 57% of the wetlands are secured. Again, almost all of this securement is in the form of conservation lands.

The Creston Valley and Upper Columbia Valley contain the majority of wetlands in the Basin (11,773 ha, 77% of all wetlands in the six focal areas). There are relatively few wetlands in the Elk Valley (248 ha), of which approximately a third are secured. There are extensive wetland habitat areas in Duncan/Lardeau and Revelstoke valleys (1016 ha). Of these, approximately 40% are secured. In the Slokan Valley there are 313 ha of wetland. A very small proportion of these are secured (5%), none of which are located on conservation lands. In the Robson Valley there are 1018 ha of wetlands of which <20% are secured. Taken collectively, these data suggest that 56% of wetlands, as defined in TRIM as swamp or marsh, are secured across the six focal areas. There are no similar data available for riparian habitats, so it was not possible to calculate the proportion of both riparian and wetland habitats that are secured.

3. Ownership of riparian and wetland habitat in the major floodplains in each focal area.

Data is available on wetland and riparian habitats for the floodplain portions for five of the six focal areas addressed in this plan. All of the floodplains were (pre-settlement), or are, wetland habitats, riparian habitats or rivers and bars. This analysis (Figure 6) indicates the proportion of conservation and crown land on the major floodplains in each focal area. Unknown ownership is <10% for the Upper Columbia, Elk and Creston Valleys, while >30% in the other focal areas.

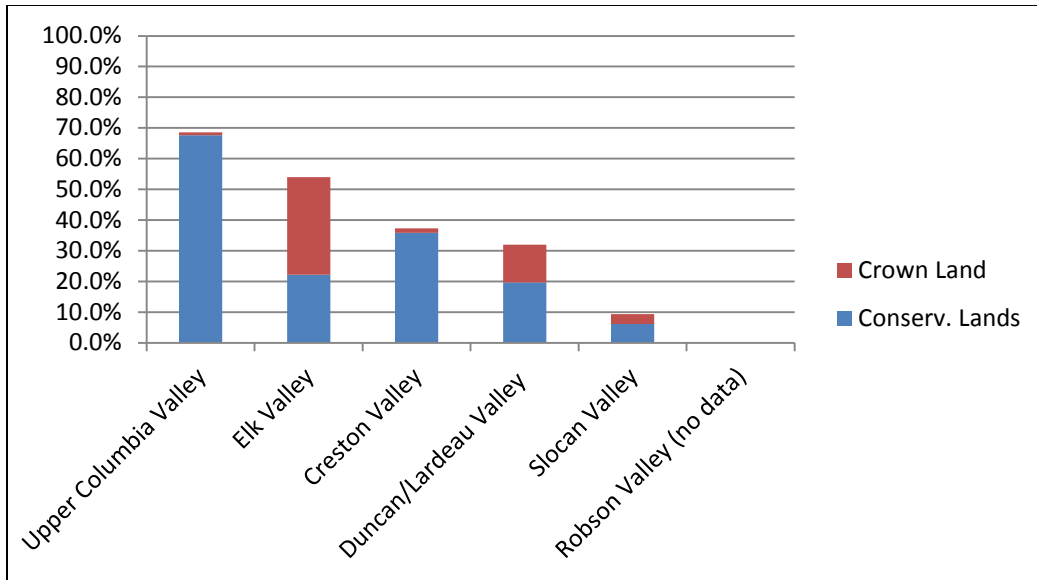


Figure 6: The proportion of secured lands in conservation lands and crown land status on the major floodplains in each focal area.

On the floodplain of the Upper Columbia Valley, the level of securement is high (68%). Most of this secured land is provided by conservation lands (i.e. the Columbia Wetlands Wildlife Management Area). The level of securement is also high in the Elk Valley (54%), a large portion of which is owned by the Nature Conservancy of Canada. The crown land portion (32%) is mostly land below the high water mark (water and river bars) along the Elk River. Of the remaining riparian and wetland habitats on this floodplain, 84% are secured, based on data in Jamieson et al. 1998.

The proportion secured on the Creston Valley floodplain is lower (37%), since much of the floodplain has been converted to agricultural use. However, the proportion of remaining wetland and riparian areas on the Creston Valley floodplain is very high. Only 19 ha of wetlands (from the TRIM data) in the Creston Valley remain in private ownership. There are larger unsecured areas of riparian habitat. On the Duncan/Lardeau floodplain, about one-third (32%) of the floodplain is secured, made up of conservation lands and crown land below the high water mark. On the floodplain in the Revelstoke area (not documented), almost all of the floodplain is in crown or BC Hydro ownership. There are few options for securement in the Revelstoke Valley.

In contrast, on the floodplain of the main Slocan River, a very low proportion (9%) of the floodplain is secured. No data exists for the floodplains in the Robson Valley, but the proportion there is also likely to be relatively low. For the five focal area floodplain areas assessed, 46% of the total floodplain area is secured, made up of very high levels of securement in the Upper Columbia, Elk and Creston valleys and low levels in the Slocan, Robson and Duncan/Lardeau valleys.

Based on the combined mapping analyses, the Slocan, Robson and Duncan/Lardeau, valleys should be considered as priority areas for wetland and riparian securement in the future.

Options for securement exist on the floodplain of the Slocan River and in the Little Slocan Valley. Other securement options exist along the Fraser, Rausch and Canoe rivers in the Robson Valley. Substantial areas of wetland and riparian habitat are privately owned on the Duncan/Lardeau floodplain, and at higher elevations between Trout Lake and Staubert Lake and west of the Arrow Reservoir.

3. Action Plan Objectives, Measures and Targets

Clear and realistic management objectives are necessary to guide information acquisition and to 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 FWCP partners.

3.1. Defining Objectives, Measures and Targets

The following definitions are used for setting objectives in this report:

Objectives:	Objectives are high-level statements of desired future conditions (outcomes), consistent with FWCP partner mandates and policies.
Sub-objectives:	Sub-objectives are detailed statements of desired future conditions within objectives, from which performance measures can be derived and alternative management actions evaluated. They may be arranged hierarchically within objectives, and usually indicate conditions necessary to attain the objective to which they refer.
Performance Measures:	Measures are specific metrics that indicate the degree to which desired future conditions have been achieved.
Targets:	Targets are the value of the performance measure that indicates the attainment of a desired condition.
Actions:	Actions are management activities, plans or policies for achieving the objectives.

Objectives are the ends or the outcomes we ultimately care about. Actions are 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.

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

Category 1 Natural riparian or wetland habitat	Largely intact and functioning ecosystems with natural disturbances sufficient to maintain sub-climax communities and processes characteristic of wetlands and riparian ecosystems, (e.g. the wetland floodplain complex in the Columbia wetland).
Category 2 Managed 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.
Category 3 Dis-climax or degraded wetland or riparian habitat	Formerly natural wetland or riparian ecosystems that have lost most of their natural disturbance regime and are no longer functioning effectively as wetland or riparian habitat. These areas are candidates for restoration to Category 1 or 2 habitats.

3.2. Objectives, Measures and Targets

The entire Columbia Basin shares common objectives, sub-objectives and performance measures; however, targets may differ for each focal area.

The following four objectives (and corresponding sub-objectives, if applicable) guide the Actions recommended in this plan and are explained in detail in the sections that follow.

Objective 1 – Maintain Productive and Diverse Ecosystems.

- Sub-objective 1: Secure remaining Category 1 riparian and wetland habitat within the FWCP-Columbia program area:
- Sub-objective 2: Restore degraded or create new riparian and wetland habitat (Category 2).
- Sub-objective 3: Maintain the productivity of Category 2 (created) riparian and wetland habitat.
- Sub-objective 4: Reduce threats to Category 1 riparian and wetland habitat.

Objective 2 – Maintain or Improve the Status of Habitat Important to Recovery and Focal Species.

Objective 3 – Maintain or Improve Opportunities for Sustainable Use.

Objective 4 – Maintain or Improve Opportunities for Community Engagement.

The Action Plan outlines prioritized actions for each focal area. Some actions support multiple sub-objectives, which in turn support multiple objectives.

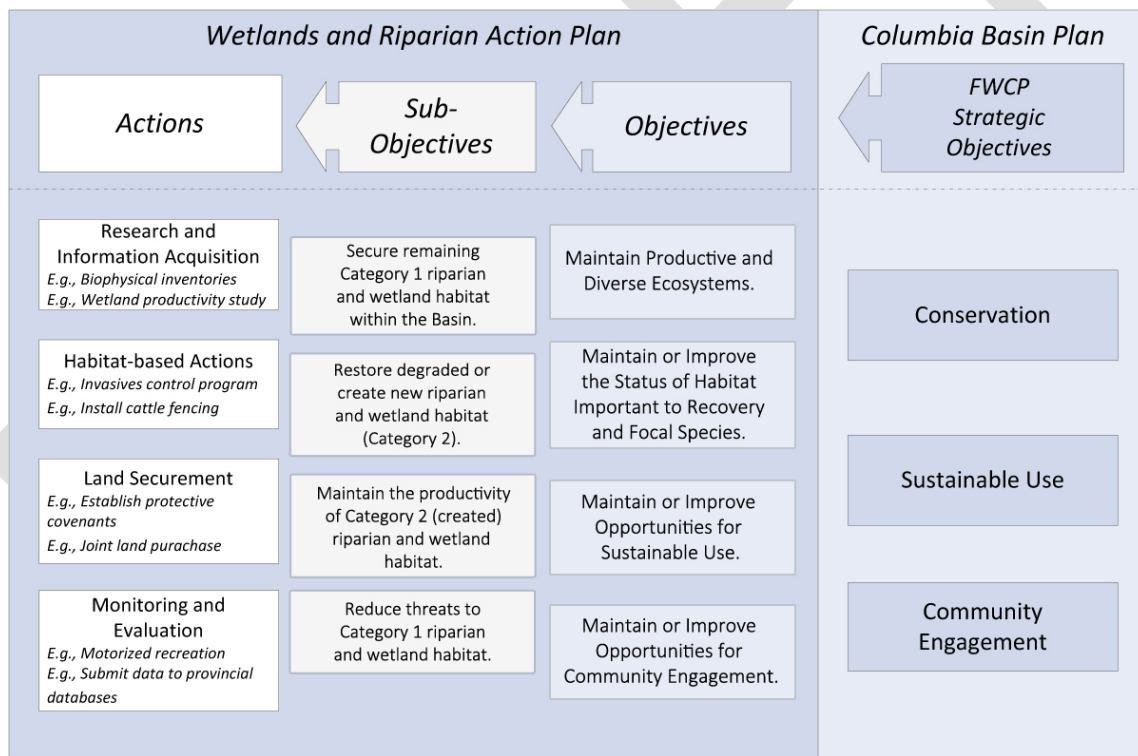


Figure 7: Relationship between actions, sub-objectives and objectives in this Riparian and Wetlands Action Plan and the FWCP strategic objectives in the Columbia Basin Plan.

Objective 1 – Maintain Productive and Diverse Ecosystems.

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

Rationale: Conversion to other land uses is an ongoing threat to riparian and wetland habitat. Securing remaining habitat is a high priority. Habitat is considered secure if it is protected from conversion to other land uses (e.g. by purchasing the land or negotiating a covenant or stewardship agreement, or through conversion to status as a Wildlife Management Area (WMA), provincial park, or other protected designation). Other crown lands have been secured to some degree through other legislation. The issue around the degree to which riparian and wetland habitats on crown lands are secure is complex and is discussed in Appendix 1. For this Action Plan both conservation lands and crown lands are considered secure.

Performance Measure: Proportion of riparian and wetland habitat secured in the next 20 years.

Targets: Secure 80% of the remaining low and mid-elevation wetland and riparian habitats in the Basin (including at least 60% of wetland and riparian habitat in each focal area) in the next 20 years.

Estimating the proportion of remaining wetland and riparian habitats from the available mapping is difficult since wetland and riparian habitats are poorly mapped in the TRIM database or in other map sets (PEM, TEM, etc.). In addition, there is a large proportion of the land base for which there is no ownership data. As a result, the numbers presented in Figure 4, Figure 5, and Figure 6 are only credible if one assumes that the unknown ownership area is distributed proportionally across all of the various land categories. This may be a poor assumption. However, the proportion of secured lands presented fit with a general understanding of the situation in each valley and with the mapping provided in the appendices.

Three measures of the level of secured land ownership were developed to indicate the degree to which this target has been achieved to date.

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

Rationale: In the past, large stable water wetlands have been created using extensive dike systems in the Creston area, at Bummer's Flats near Cranbrook, at Bergenham Flats near Golden and at the Cranberry Marsh near Valemont. Experience to date would suggest that new, large scale wetland creation projects on floodplains are unlikely, given their initial capital costs and long term maintenance costs. Other smaller projects, generally in bench land areas, where wetland habitats can be created at lower costs may be a viable option where fisheries issues are minimal. Extensive wetlands have been created in several areas, using short dikes on watercourses (e.g. Dunbar Lakes, Ta Ta Creek, and Wolf Creek). There is some experience in other areas with creating wetland systems that include small dams/structures that allow for fish passage while creating small wetlands and recharging floodplain groundwater flows. Other strategies such as re-meandering creek channels to improve stream conditions for fish, and increase the area of riparian habitat, also provide options that may be viable in some situations (i.e. where focal species are involved). Close to communities, projects that use wetlands to remove nutrients from municipal sewage may be an option. Such a project is underway near Cranbrook. In some bench land areas, cattle grazing could be managed along the shoreline of wetlands and small lakes to improve vegetative growth.

Performance measure: Hectares of Category 2 riparian and wetland habitat restored or created annually.

Targets: Targets for focal areas to be determined when more data is available. Potential projects of this kind are identified below for each focal area.

Sub-objective 3: Maintain the productivity of Category 2 (created) riparian and wetland habitat.

Rationale: Managed wetlands with good growing conditions evolve toward dense stands of emergent vegetation over time. These areas may require periodic disturbances to return the site to early seral conditions and maintain areas of open water in the wetland.

Performance Measure: Proportion of Category 2 riparian and wetland habitat improved annually.

Targets: The amount of riparian and wetland habitat that is managed and monitored has increased.

Sub-objective 4: Reduce threats to Category 1 riparian and wetland habitat.

Rationale: Many naturally functioning riparian and wetland habitats (Category 1) can benefit from management actions that reduce specific threats (e.g. the treatment for invasive species and access management). Invasive plant management programs are in place in most focal areas. Motorized vehicles (snowmobiles and ATV's) can cause significant damage to emergent vegetation and stress wintering wildlife. These uses should be restricted in wetlands.

Performance Measure: Hectares of Category 1 riparian and wetland habitat improved annually.

Targets: Management Plans for addressing invasive aquatic species should be in place for all the major wetland/floodplain focal areas by 2020. Plans should also be developed to reduce the presence of terrestrial invasive weed stands on floodplains in each focal area.

Objective 2 – Maintain or Improve the Status of Habitat Important to Recovery and Focal Species.

Rationale: Although species will benefit from general improvements in riparian and wetland ecosystems, there are specific factors that might be limiting the abundance and distribution of priority species. Actions to address these factors are presented in the FWCP-Columbia Species of Interest Action Plan. Three of the seven species identified as recovery species in that Action Plan will be affected by actions in the Riparian and Wetlands Action Plan. The Northern Leopard Frog is directly dependent on wetland habitats and associated riparian habitats. It occurs in the Creston Valley and Upper Columbia Valley focal areas. The Western Screech Owl nests in riparian cottonwood and deciduous stands and feeds in riparian habitats (Creston and Slocan Valley focal areas), and the Yellow-breasted Chat uses riparian shrub communities and associated upland shrub areas (Creston Valley focal area). White Sturgeon use wetlands connected to river systems (e.g. Creston Valley). A wide range of focal species also depend on these habitats. Other species that are directly dependent on wetlands and riparian habitats are identified in Appendix 8.

Performance Measure: Hectares of riparian and wetland habitat available to recovery and focal species.

Targets: Viable populations of the three priority species directly dependent on riparian and wetland habitats are present in at least two focal areas within the Basin by 2020.

Objective 3 – Maintain or Improve Opportunities for Sustainable Use.

Rationale: Many wetland and riparian species are the focus of sustainable use activities by First Nations and the public. The creation and protection of habitat areas such as the Creston Valley Wildlife Management Area (CVWMA) and the Columbia Wetlands has created opportunities for recreational and traditional use.

Performance Measure: the maintenance of viable populations of a range of species that will support hunting, fishing, trapping, wildlife viewing and gathering by First Nations.

Targets: Maintain opportunities for hunting, fishing, trapping fishing and wildlife viewing and gathering for First Nations, residents of the Basin, BC residents and other visitors.

Objective 4 – Maintain or Improve Opportunities for Community Engagement.

Rationale: The FWCP has developed interpretation and engagement opportunities for specific projects it supports (e.g. Summit Lake ToadFest, Meadow Creek Spawning Channel Open House). In addition, a variety of stewardship groups have evolved to help address issues related to wetland and riparian management in many of the focal areas.

Performance Measure: The presence of community support and local stewardship groups, in all focal areas addressing issues related to wetland and riparian management.

Targets: Effective community engagement and stewardship on issues related to wetland and riparian management in each of the focal areas by 2020.

DRAFT

4. Conclusions

This Wetland and Riparian Action Plan focuses on the securement, creation and restoration of wetlands and riparian areas. Inventory, monitoring and the development of management plans are a lower priority but are often required before actions on these three priority actions can proceed effectively.

The focal areas discussed here vary greatly in terms of both the functional processes that drive these systems and the impacts of human activity on these systems. Extensive areas have been secured in the past (1960s to the 1970s in the Upper Columbia and Creston valleys), in the form of Wildlife Management Areas. In recent years securement in the form of private land acquisition has occurred in the Elk River and Duncan/Lardeau valleys. Other focal areas have seen few securement actions to date (the Slocan, Revelstoke and Robson valleys).

Based on the combined mapping analyses, the Slocan, Robson and Duncan/Lardeau, valleys should be considered priority areas for wetland and riparian securement in the future.

Analysis undertaken to complete this Action Plan suggests that very few options for habitat creation on a large scale exist, due to technical, logistical, cost and capacity constraints. The creation of new wetlands in the future will need to focus on new and novel approaches to wetland restoration that are cost effective. Restoration of degraded wetlands may provide a cheaper and more effective strategy.

An overall strategy for monitoring the vast range of organisms that occur in wetland and floodplain systems will need to be developed over time. This will be a very complex undertaking and will need to be spaced over decades.

The wetland and riparian systems in the Basin are unique in the degree to which stewardship groups have evolved to address issues in these systems. Stewardship groups of one sort or another have developed independently in five of the six focal areas. Funding small-scale riparian/wetland projects from groups, communities and individuals will likely be an important approach for meeting riparian habitat goals.

Four of the seven recovery species are strongly associated with riparian and wetland habitats (Fish and Wildlife Compensation Program 2011b). Habitat actions directed at recovery or focal species will also support general riparian and wetland goals/targets.

Fisheries issues (rearing habitat in wetlands and side channels) need to be considered in this plan and in the Small Lakes and Streams Action Plans. Capturing the linkage between these Action Plans is vital to assess progress on Riparian and Wetland action Plan goals.

5. Action Plans

5.1. Introduction to Action Plans and Action Tables

This Riparian and Wetland Action Plan address six focal areas (see Figure 1):

1. Creston Valley;
2. Duncan, Lardeau and Revelstoke Valleys;
3. Elk Valley;
4. Robson Valley;
5. Slocan Valley; and
6. Upper Columbia Valley.

5.1.1. Action Categories

For each focal area, an Action Table has been prepared that outlines the prioritized actions recommended for: information acquisition, habitat-based actions, land securement and monitoring and evaluation.

1. **Research and Information Acquisition:** actions to inventory resources or research critical effect pathways and relationships; these projects are typically funded as priority actions to gather information that is needed to support a future habitat enhancement or restoration projects, or species-based actions.
2. **Habitat-based Actions:** activities focused on improving general habitat conditions or ecosystem function.
3. **Land Securement:** contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes.
4. **Monitoring and Evaluation:** activities conducted following a habitat-based or species-based action that are focused on assessing the outcomes of that habitat- or species-based action.

Some of the actions recommended are unique to each focal area and appear in their respective focal area Action Table. Other recommended actions apply equally to all focal areas. These so-called cross-cutting issues and actions are shown in Table 1 below (See Section 5.2). Readers should review individual focal area Action Tables (See Sections 6 to 11) as well as Table 1 for a comprehensive understanding of all actions recommended for each focal area. In all cases a rationale provides local context and a statement regarding the desired outcome helps define the intent of each action. Each action supports an overall FWCP-Columbia objective (see Section 3).

5.1.2. Setting Priorities

Through a series of workshops, FWCP-Columbia representatives, including members of the FWCP-Columbia fish and wildlife technical committees, set priorities for the recommended actions in each focal area. Priorities were determined based on professional opinion and consideration of the following:

- the level of perceived threat (e.g. urgent, less urgent or possible threat);
- technical feasibility of the action;
- the feasibility of achieving the expected outcome given finite resources; and
- the scale and timing of the resulting conservation benefit.

Projects ranked #1 are viewed by the FWCP-Columbia as the most urgent and therefore the highest priority. Projects ranked #2 and #3 are considered to be lower priorities, respectively.

Limited program funding requires that priority-setting has to 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.

5.2. Actions for All Focal Areas

This Action Table presents the prioritized actions that apply equally to all six focal areas. The priority ranking (1 to 3) is shown by focal area in columns on right side of table. These actions are not repeated in the Action Tables for individual focal areas that follow. Readers should review individual focal area Action Tables (See Sections 6 to 11) as well as this table for a comprehensive understanding of all actions recommended for each focal area.

Table 1: Recommended actions that apply to all six focal areas.

Action No.	Objective	Action	Rationale	Desired Outcome	Upper Columbia Valley	Elk River Valley	Creston Valley	Duncan/Lardeau & Revelstoke Valleys	Slocan Valley	Robson Valley
Research and Information Acquisition										
1	1	Inventory, map and monitor the seral stage distribution of riparian habitat (including but not limited to cottonwood, aspen and cedar).	Establishing a baseline and monitoring habitats for changes in seral stage will help inform potential conservation actions, recruitment knowledge and identify threats.	This information will inform conservation actions to protect unique and high value habitats.	1	1	1	1	2	2
2	1	Monitor wildlife species presence and abundance in wetland and riparian areas in each focal area.	Information needs about species will vary by region. Inventory data on several wetland and floodplain species have been collected but information for many species groups and guilds is not available.	Changes to species presence are monitored and inform conservation actions.	2	2	2	2	2	3
3	1	Map the abundance and distribution of riparian habitats by focal area.	Riparian habitat types are poorly mapped throughout the Basin. Improving spatial data would further inform conservation planning. (New Predictive Ecosystem Mapping (PEM) data has been developed	Comprehensive mapping information on riparian values by focal area.	1	1	1	1	1	1

Action No.	Objective	Action	Rationale	Desired Outcome	Upper Columbia Valley	Elk River Valley	Creston Valley	Duncan/Lardeau & Revelstoke Valleys	Slocan Valley	Robson Valley
			recently for the Arrow Lakes, Kootenay Lake, Rocky Mountain and Invermere areas).							
4	1	Map the abundance and distribution, of wetlands in each focal area.	Information gaps may exist regarding the abundance and distribution of wetlands.	Conservation planning and actions are informed by comprehensive data.	2	1	2	2	2	2
5	1	Establish a reference condition for wetland and riparian areas in each focal area.	Expected local impacts of climate change and other influences will impact wetland and riparian areas in each focal area. Establishing a reference condition will provide an ecological baseline understanding that can be used to guide conservation planning in the future.	Conservation and management planning is based on understanding of best-case scenario reference condition.	1	1	1	1	1	2
6	1	Collaborate and share information with organizations and agencies in this focal area to monitor and assess the functional processes and basic ecological parameters of wetlands and riparian areas.	Improved information sharing will reduce the potential of duplicating efforts and leverage the multi-agency efforts.	A more systematic approach to monitoring flow and water quality parameters in wetland and riparian areas in this focal area will inform conservation actions.	2	3	1	3	3	3
7	1	Monitor status of introduced species (e.g. wild rice) to determine impact on wetland and	Introduced species may have benefits for specific species or habitats but there has been little or no monitoring conducted.	Monitoring will improve awareness; identify changes to habitats; and identify potential conservation actions.	3	3	3	3	3	3

Action No.	Objective	Action	Rationale	Desired Outcome	Upper Columbia Valley	Elk River Valley	Creston Valley	Duncan/Lardeau & Revelstoke Valleys	Slocan Valley	Robson Valley
		riparian areas.								
8	1	Conduct an information review on fish presence and abundance in wetland and riparian areas within the focal area.	Information on species' presence and abundance is limited resulting in information gaps. This review should include information within the Provincial Data warehouses.	A review, as defined will increase understanding of distribution, identify data gaps and potential conservation actions.	3	2	2	3	3	3
9	1	Review available species' inventories in order to identify changes, trends and information gaps.	Reviewing the available data will help inform conservation actions and further inventory actions to monitor species.	Desired outcome: determine if there are data gaps, and potential conservation actions	3	3	2	3	2	3
Habitat-based Actions										
10	1	Monitor and treat aquatic invasive species in wetland and riparian areas.	Invasive plants (including but not limited to Purple Loosestrife, Japanese Knotweed, Eurasian Milfoil, Yellow-flag Iris) threaten the productivity of native wetland and riparian area ecosystems. Projects should be supported by local Invasive Management Plans (E.g. http://www.ckipc.ca/resources/publications) Treatment is the priority over monitoring.	Improved conservation planning that impedes the further spread of invasive species.	2	2	1	2	2	1
11	1	Monitor and treat terrestrial invasive species in wetland and riparian areas.	Terrestrial invasive species (including but not limited to Reed canary grass) exist in wetland and riparian areas. Implications for long-term wetland and riparian health	Improved conservation planning that impedes the further spread of invasive species.	2	2	2	2	2	2

Action No.	Objective	Action	Rationale	Desired Outcome	Upper Columbia Valley	Elk River Valley	Creston Valley	Duncan/Lardeau & Revelstoke Valleys	Slocan Valley	Robson Valley
			and function are not well understood. Projects should be supported by local Invasive Management Plans (E.g. http://www.ckipc.ca/resources/publications) Treatment is the priority over monitoring.							
12	1	Restore and create wetland and riparian area habitat in this focal area, where feasible to address impacted, degraded or lost habitat (including but not limited to gravel pits where they exist on the floodplain, oxbows and side channels).	Opportunities exist to increase the availability of lost or impacted wetland and riparian area habitat using a variety of approaches.	Increased availability of wetland and riparian area habitat in this focal area. Restoring riparian vegetation will improve shoreline habitat for a variety of species.	1	1	1	1	1	1
13	4	Explore options to collaborate with partners, in order to conserve and enhance wetland and riparian areas.	A collaborative and multi-agency approach will leverage collective efforts and strengthen conservation outcomes.	Strengthened and expanded partnerships and collaborations and enhanced wetland and riparian areas.	2	2	2	2	2	2
Land Securement										
9	1	Identify threats to habitat connectivity and support opportunities, including but not limited to land securement, in order to	Conservation lands, especially with minimal development or human impacts, support important habitat values for a range of wetland and riparian species of interest. Conserving these lands will	Land securement increases the available wetland and riparian area habitat. Securing lands for conservation will support conservation objectives.	2	2	2	2	1	2

Action No.	Objective	Action	Rationale	Desired Outcome	Upper Columbia Valley	Elk River Valley	Creston Valley	Duncan/Lardeau & Revelstoke Valleys	Slocan Valley	Robson Valley
		secure and steward lands with high conservation values for wetland and riparian areas.	ensure they remain available for species of interest.							
Monitoring and Evaluation										
11	1	Compile, assess and document the effectiveness of completed wetland and riparian restoration projects.	Documenting past restoration actions will strengthen knowledge management. Assessing the effectiveness of past conservation actions will ensure the most effective actions are implemented in the future. Ducks Unlimited Canada and other organizations have created wetlands in the Columbia and Upper Kootenay River watersheds. The long term effectiveness of these projects is not known.	Future actions are effective and documented.	1	2	1	1	1	1
12	1	Monitor species use of habitat created or restored with support from the FWCP (i.e. past projects).	This action will help inform future conservation actions and ensure the most effective restoration actions are implemented. For monitoring, recovery species will be the highest priority followed by focal species.	Improved awareness of species use of and effectiveness of restoration actions.	2	2	2	2	2	2

6. Upper Columbia Valley

6.1. Overview

There are five wetland and riparian systems in this focal area including:

- the floodplain complex along the Columbia River, including marshes, sedge meadow/shrub complexes and riparian cottonwood and spruce systems;
- riparian cottonwood and conifer systems along the levees of the main river and the alluvial fans that protrude into the wetlands;
- marshes, fens and bogs on the benches west and north of the main river floodplain;
- Ducks Unlimited Canada wetland projects with stable water levels, (two on the Columbia River floodplain, and four on the west benches); and
- Mid-elevation riparian zones along the various stream courses joining the Columbia River.

The low-elevation systems along the major rivers, i.e. floodplain systems, have been the systems most impacted by hydro development. Mapping of this valley is provided in Appendix 2. The ecological processes that drive these systems, and other background information, are provided in Appendix 3.

6.1.1. Impacts and Threats

Hydro-related Impacts: Significant wetland and riparian habitat impacts occurred as a result of the construction of the Mica Dam and associated Kinbasket Reservoir located downstream from this focal area (Utzig and Schmidt 2011). A total of 7,859 ha (5,653 ha of wetland, 1,651 ha of cottonwood and 555 ha of shallow water) were flooded as a result of dam construction (Utzig and Schmidt 2011). The impacts from hydro development are minimal within the actual focal area.

The Spillimacheen Dam is a run-of-the-river dam with little storage capacity and the hydrograph below the dam is close to natural. One important species, kokanee salmon (*Oncorhynchus nerka*), have expanded substantially in the system following the development of the Mica Dam (Oliver 1995). It is likely that the entire range of species that prey on kokanee as a food source have increased over time. It is important to remember that there have been significant changes in the fisheries and nutrient flows in the Upper Columbia River since the construction of Grand Coulee Dam in 1942. Prior to that date, salmon spawned at several sites in the Upper Columbia. These impacts will not be addressed in this document.

Non-hydro related Impacts: The marsh, levee and water portion of the Columbia Wetlands system has seen relatively few impacts from human use and remain in a close to natural condition that is maintained by a natural river hydrograph, except where the grade of the Canadian Pacific Railway bisects the floodplain. There are four bridges with elevated roadways which restrict the downstream flood waters between Invermere and Golden; however there does not seem to be a significant alteration in the wetland communities downstream of roadways (Carli, 2011). Several of the alluvial fans portions of the system have been developed for agriculture, industrial use and human settlement. Human communities have expanded substantially since the 1970s in the Golden and Invermere areas, but less development has occurred along the wetlands between these two communities. Agriculture is small scale through most of this area with only a few larger ranches. Cattle grazing is present in a few areas on the floodplain and some portions of the west bench. The major impacts to the wetlands on the west bench have been in the form of logging, with settlement around some lakes and ponds near Invermere.

6.1.2. Limiting Factors

Natural factors: The productivity of the wetlands in the Upper Columbia Valley is driven by the annual spring freshet, variation in flood intensity, and wetland depth and duration across the flood plain, the turbidity of the water during such events, and the temperature and nutrient status of the sediment and water that flows into the wetlands during such events. This system is at higher elevation (770 m) relative to the similar wetlands at Creston and the Lardeau Valley (530 m), which may reduce overall productivity. Marshes that are more isolated from the flooding contain different communities than those more frequently exposed to the scouring action and sediments associated with the flood pulse. The annual spring freshet occurs during the middle of the waterfowl nesting season (early July) and may have an impact on duck recruitment in all of the wetlands that are subject to annual flooding (Jamieson and Hennen 1998). Perched wetlands (defined as wetlands that are not directly connected to the river and are flooded only during major flood events) are less affected. It is not known what impact this freshet timing issue has on amphibians and other wildlife. The bench wetlands occur at slightly higher elevation (1000-1200 m) and are not subject to flooding and are more productive for waterfowl.

Human driven factors: A management plan for the Columbia Wetlands was developed, based on significant public input, in 1998 (Jamieson and Hennen 1998). At that time, there was no public support for the development of diked wetlands in the Columbia Wetlands area. This lack of public support seriously limits options for such activities in this system. On the alluvial fan portions of the floodplain area, private land ownership is a major limiting factor. To date, aquatic invasive species have not had a major impact on ecological process in the wetlands (R. Darvill, pers. comm.). Terrestrial invasive plants are a concern in many adjacent areas. Wild rice (*Zizania* sp.) is present in at least one marsh in the wetlands. It does not appear to be invasive, to date, and is heavily used by waterfowl. There is minimal data on the presence of reed canary grass or other invasive grass/reed species that may have an impact on wetland and riparian function. The impact of road and railway culverts on fish movement is not known.

Climate Change implications: Regional scale data suggest that climate change in this area may have some benefit via increased heat units in low elevation systems such as the Columbia wetlands (Hamlet et al. 2010). Booth et al. 2012 suggests that significant changes in growing season length have occurred in southern BC since 1950. Water temperature may also increase during the growing season as the various glacial sources of melt water decline over time. The altered timing of high water and low water levels in late fall may have other unanticipated impacts. The increase in major storm events, as occurred in the Rockies and southern Purcell mountains in July of 2013, could have much larger impacts. Major stream bed alterations on alluvial fans should be expected in the future in this system. Enhancement projects on these fans will need to be designed with this potential issue in mind.

6.1.3. Trends and Knowledge Status

Land Ownership: An analysis of land ownership in each focal area was completed in 2013/14. This was meant to provide an overview of land ownership in each area and guidance for future land securement. The analysis was carried out at three levels, as below. Ownership in each was classified as conservation lands, crown land, First Nations lands and private lands. Conservation lands included all private lands purchased for conservation, Wildlife Management Areas, ecological reserves, wildlife sanctuaries, provincial parks and protected areas. The precision of this analysis was limited by the presence of large areas identified as ownership unknown or ownership blank within the existing provincial data sets. In this document, blank and unknown mapping designations are synonymous. Details on the mapping process and the categories used are provided in Appendix 1. Detailed mapping of this focal area is provided in Appendix 2.

- a. **Focal Area analysis.** This focal area includes all lands below 1052 m in elevation. There are two large Wildlife Management Areas (WMAs) in this valley, along with several conservation properties. WMA's and the conservation properties make up 20% of the land base, with another 3% in crown ownership. There was no ownership data for 42% of the land base.
- b. **Wetland habitats in the focal area.** An assessment using the Terrestrial Resource Inventory Mapping (TRIM) categories for swamp and marsh indicate that 57% of these habitat types are in conservation status, with only 1% in

crown status. Most are located on the Columbia River floodplain (7819 ha), with significant areas on the nearby benches (1329 ha).

- c. **Wetland and riparian habitats on the Columbia River floodplain.** The floodplain portion of the focal area contains a mix of riparian and wetland habitats. Most of this system is secured with Wildlife Management Area status (60%). The total area in conservation lands status is 67%, with another 2% in crown ownership. Most of the private land in the floodplain area (19%) is located on the alluvial fans that intrude out into the floodplain wetlands. There are 371 ha of wetland and riparian habitats on the Akisqnuq First Nation Reserve (Columbia Lake Band). Unknown ownership is 10%.

Details on the land ownership analysis for this focal area are provided in Appendix 3.

Habitat Status: In general, wetland habitats in this focal area are in good condition, supported by a natural hydrograph.

Habitat Trends: The floodplain wetlands along the Columbia River are in close to natural condition. Diking for agriculture is very limited in this system. A photo comparison of historic to recent photographs for the Columbia Wetlands shows little apparent change for the period 1883 to 2011 (Jamieson 2011) in the marsh and river portion of the system. There has been significant natural fluctuations in marsh types and other wetland landforms from the 1940s to present, most showing a loss of emergent marsh and an increase in open water (Carli 2010; Rooney et al. 2013); due to natural processes in this kind of system. Large areas on the alluvial fans that intrude into the wetlands were developed for agriculture and residential development in the early part of the last century. Ecological processes have been compromised by settlement, hay field development and by cattle grazing on these sites. There are no data on habitat changes over time in the higher elevation wetlands.

Habitat Connectivity: Development along the two major lakes in the systems compromise the ability of species such as painted turtles (*Chrysemys picta*) to move between habitat patches. Habitat mapping and shoreline management processes are being developed for both lakes. There are potential barriers to movement in the communities of Athlmer and Golden, where the aquatic system is restricted to the width of the river by human settlement.

Species Status: The area supports almost the entire range of wetland and riparian species that occurred pre-settlement. Only two species are known to have been extirpated: the Columbia River variant of Chinook salmon (*Oncorhynchus tshawytscha*) and the Northern Leopard frog (*Lithobates pipiens*). White Sturgeon likely used the system pre-settlement but recent surveys have not located any sturgeon in the Kinbasket River or Upper Columbia River (M. Thomas, pers.comm.). Leopard frogs were re-introduced into the system in 2013 (P. Ohanjanian, pers. comm.).

Species Trends: There is some historic Canadian Wildlife Service data for migratory waterfowl, both nesting surveys and fall migration counts; however data collection methodology has not been consistent (B. Harrison, pers. comm.). It would appear that ducks nesting in the north are no longer using the Columbia Wetlands and the Trench as a flyway (B. Harrison, pers. comm.). Osprey and Great blue heron numbers have been monitored in the system for several years (Machmer 2007). Amphibians and reptiles were surveyed in a recent basin wide survey (Dulisse and Hausleitner 2010). There are no data on shorebirds and several other guilds and species groups.

6.1.4. Knowledge Gaps

There is little long term monitoring of ecological processes in this area. There is one long term water flow and water quality monitoring station at Nicholson (south of Golden). In addition there is flow monitoring at the Spillimacheen Dam and lower in the system at Donald. There are no water monitoring stations in the portion of the system upstream of Nicholson, though several existed in the past. Some monitoring of basic wetland parameters has occurred recently related to the Northern Leopard frog and other projects in the wetlands (Ohanjanian P. and C. Carli. 2010, Carli 2011). There is very little information on fish and wildlife numbers and status in this system, especially for songbirds and other migrants. Monitoring of waterfowl use during migration no longer occurs and there is minimal data on use during the breeding season (some CWS surveys are carried out annually).

6.2. Upper Columbia Valley Action Plan

The individual actions for the Upper Columbia Valley focal area are outlined in Table 2 below. The actions are numbered for easy reference. No ranking is implied by the action number. Each recommended action is tied to a specific objective outlined in Section 3.0 of this Wetland and Riparian Area Action Plan. The conservation actions are broken into four categories, or types of actions:

1. **Research and information acquisition** – actions to inventory resources or research critical effect pathways and relationships;
2. **Habitat-based actions** – activities focused on improving general habitat conditions or ecosystem function;
3. **Land securement** – contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes; or
4. **Monitoring and evaluation** – activities focused on assessing the outcomes of habitat- or species-based actions.

Each action has been assigned a priority ranking using the ranking approach outlined in Section 5.0 of this Action Plan. Priority #1 is the highest priority action, while actions with priority #2 or #3 are lower priority respectively. Some recommended actions apply equally to each focal area. These cross-cutting issues and actions are shown in Actions for All Focal Areas Table 1 in Section 5.2. Readers should review individual focal area Action Tables as well as Actions for all Focal Areas (Table 1) for a comprehensive understanding of all actions recommended for each focal area.

Table 2: Action Priorities for the Upper Columbia Valley (see Figure 3 and Map in Appendix 2 for focal area boundaries).

Action No.	Objective	Action	Rationale	Desired Outcome	Priority
Research and Information Acquisition					
See Table 1 for research and information acquisition actions that apply to all focal areas					
Habitat-based Actions					
1	1	Restore and create wetland and riparian area habitat in this focal area, where feasible to address impacted, degraded or lost habitat (including but not limited to gravel pits where they exist on the floodplain, oxbows and side channels).	Opportunities exist to increase the availability of lost or impacted wetland and riparian area habitat using a variety of approaches. Areas of interest include but are not limited to, the West Bench, Blaeberry Bench, Blackwater Lakes, and Sinclair Creek.	Increased availability of wetland and riparian area habitat in this focal area. Restoring riparian vegetation will improve shoreline habitat for a variety of species.	1
2	1	Restore wetland and riparian areas impacted by livestock use.	Work is required to identify the best site-specific action to reduce livestock impacts on wetland and riparian areas in order to conserve and	Improved management of livestock to reduce impacts and restore wetland and riparian area values.	2

Action No.	Objective	Action	Rationale	Desired Outcome	Priority
			enhance those habitat types for species of interest.		
3	2	Support actions developed by the Northern Leopard Frog (NLF) recovery team for the Upper Columbia Valley NLF population.	Implementing and supporting recommended recovery actions for this population of endangered Northern Leopard Frogs will contribute to the species recovery and is consistent with the intent and objectives in the FWCP-Columbia Species of Interest Action Plan.		1
Land Securement⁴					
See Table 1 for land securement actions that apply to all focal areas					
Monitoring and Evaluation					
4	2	Monitor and assess the effectiveness of FWCP's efforts to re-introduce Northern Leopard Frogs into this focal area.	Monitoring effectiveness is critical to the species recovery and defining FWCP's continued and future involvement in the re-introduction of Northern Leopard Frogs.		1
5	1	Implement program to monitor population trends of species in wetland and riparian areas including but not limited to amphibians.	Previous work has documented amphibian presence and occupancy in this focal area (Dulisse et al. 2010, Ohanjanian 2006, etc.). Additional surveys are required to monitor population trends. Surveys for osprey, bittern, eagles and herons have been completed.	New data will inform conservation actions including identification of potential Wildlife Management Areas.	2

⁴ **Land securement** - contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes.

7. Elk Valley

7.1. Overview

There are three wetland and riparian systems in this focal area, including:

- The floodplain wetlands that have developed in the side channels and oxbows along the Elk River;
- Riparian cottonwood and conifer systems on the floodplain of the main Elk River; and
- Low elevation riparian zones along the various tributaries.

The floodplain system between the communities of Elko and Elkford is the most important riparian system within the focal area. There are few cottonwood dominated floodplain systems with an unaltered hydrograph and natural cottonwood recruitment remaining in BC, western Canada or the Columbia Basin (J. Stanford, pers. comm.). Background information on this focal area is provided in Appendix 4.

7.1.1. Impacts and Threats

Hydro related Impacts: The impacts from hydro development are minimal in this focal area. The Elko Dam is a run-of-the-river dam with little storage capacity and is located below the major floodplain area in the Fernie area. The Elk River floodplain system does provide options for enhancement that are relatively close (10 km) to the Koocanusa reservoir. Losses of wetland and riparian cottonwood habitats in the Koocanusa reservoir were 108 ha of wetland, 655 ha of cottonwood stands and 211 ha of shallow water, a total of 974 ha (Utzig and Schmidt, 2011).

Non-hydro related Impacts: In the lower portion of the system (south of the community of Elkford), the major impacts on the floodplain are settlement, agriculture, gravel mining and transportation corridors. Increased tourism development in the last two decades has resulted in more human settlement in the area, some of which has occurred on or adjacent to the floodplain. In the upper portion of the watershed, coal mining is the dominant impact on the landscape. Floodplain habitats on the Fording River have been lost, but this area is outside of the Elk Valley focal area boundary. In recent years concerns have arisen with selenium and other heavy metals entering the water courses in the upper Elk River from mining operations. There are indications that this may have implications for wetlands and side channel habitats (Appendix 4). New mines are proposed in portions of the upper drainage.

7.1.2. Limiting Factors

Natural factors: This floodplain system is at a relatively high elevation and is likely less productive, in terms of overall photosynthetic production/ha, than similar systems at lower elevations. Heat units over the growing season and the frost free period in the Elk Valley are much less than that found in the Creston Valley [98 frost free days at Fernie versus 132 days at Creston (Ministry of Environment 1981)]. The parent material in the Elk Valley is based on softer sedimentary rocks found along the continental divide, including coal and phosphate bearing rocks. Carbon and phosphorus levels in the soils in this area are likely higher than those found in other floodplains. Precipitation is relatively high during the growing season in the lower portion of the floodplain and groundwater flows maintain high soil moisture levels. These factors are expressed in the development of floodplain forests made up of multiple tree species and complex shrub and grass/forb communities. Mature timber stands on this floodplain contain very large trees in some areas.

Human driven factors: The extent of the floodplain in this valley is limited in some areas by linear developments e.g. rail lines and highways. There is more recent diking for flood protection along the Elk River in the Fernie and Sparwood areas. Human settlement has occurred on the floodplain in several areas. Further development is limited to some degree by regional

district regulations. There are no known aquatic invasive species in the river, though knapweed and other terrestrial invasive plants are present on the floodplain. Reed canary grass is a growing issue in this system (S. Rood, pers. comm.). Other land uses and the presence of extensive areas of private land are other major limiting factors in this system. Direct mining impacts in this watershed, though extensive, are outside the focal area boundary.

Climate Change implications: Regional climate modeling suggest that this area may have some benefit via increased heat units. It would also appear that peak flows will occur earlier, which will have impacts that are difficult to predict. Water temperature will likely increase during the second half of the growing season as the various glacial sources of melt water decline over time. This will likely be accompanied by lower flows. There are three glacier complexes at the headwaters of this system, but they make a relatively minor contribution to flows except in late summer. Glacial sediment flows are mediated by lakes and high elevation floodplain systems below each of these glacier complexes. An increase in major storm events, as occurred in this watershed in July of 2013, could have much larger impacts. Major stream bed alterations on alluvial fans and along stream channels occurred throughout the Elk River system. Enhancement projects on the floodplain here will need to be designed with this in mind. An additional factor affecting enhancement options will be the human response to this problem (e.g. dikes, dams, etc.) that may alter conservation options in the future. Actions to protect infrastructure along the transportation corridors through the valley and around the various communities should be expected.

7.1.3. Trends and Knowledge Status

Land Ownership: This focal area includes all lands below 1400 m in elevation. (Detailed mapping of this focal area is provided in Appendix 2). The entire Mt. Broadwood property [owned by the Nature Conservancy of Canada (NCC)] and a portion of the lower Wigwam River, is included in the focal area. This property includes some lands above 1400m in elevation.

- a. **Focal Area analysis.** In this focal area 42% of the land base is in conservation land ownership and 11% in crown land status. There was no ownership data for 7% of the land base.
- b. **Wetland habitats in the focal area.** TRIM data on swamp and marsh habitats in the focal area indicate that 32% are in conservation land status and 6% in crown status. There are relatively few wetlands (248 ha) in the Elk Valley. Most are located on the Elk River floodplain. The majority of privately held wetlands are owned by TECK and exist on the floodplain of the Elk River in the form of oxbows and side channels.
- c. **Wetland and riparian habitats on the Elk River floodplain.** The floodplain portion of the main Elk River extends from Elko to just north of Elkford along the Elk River. Land ownership in the area from Elko to Elkford was assessed previously (Jamieson et al. 1997). Land ownership data from that work, and estimates of the area of recent acquisitions by NCC in this floodplain area, were used to estimate land ownership for this floodplain. Within this floodplain area 22% is now in conservation land status and 32% is in crown ownership.

Details on the land ownership analysis for this focal area are provided in Appendix 4.

Habitat Status: In general, the remaining wetland and riparian habitats in this focal area are in good condition, supported by a natural hydrograph.

Habitat Trends: There have been extensive losses over time of floodplain habitats to settlement and agriculture, primarily in the Fernie and Sparwood areas. However, a healthy natural recruitment process continues in the remaining natural portion of the system (Polzin and Rood 2006) and multiple age stands of cottonwood occur throughout. The upstream riparian systems on the Elk River are crown land and are in a natural state, with extensive logging in many adjacent areas.

Habitat Connectivity: Movement for wildlife species up and down the river system is restricted to some degree at each of the three major communities, Fernie, Sparwood and Elkford. The Elko Dam and the canyon below the dam constitute a major impediment to movement through that area, but that same constriction (a waterfall and canyon) existed before the dam was built. Recent securement by the NCC have contributed to long term habitat connectivity along several parts of the river and floodplain, both for riparian species moving up and downstream and for larger mammals moving across the valley (Appendix 4).

Species Status: There is little information on actual species use of these habitats in this focal area. The use by wildlife of such gravel based systems is reviewed by Jamieson et al 2001. None of the species identified as recovery species in the Species of Interest Action Plan occur in this focal area (Fish and Wildlife Compensation Program. 2011b). Some focal species identified in that plan do occur. Great blue herons are monitored at one site in this valley (Machmer 2007).

Species Trends: There are no data on population trends for floodplain riparian and wetland species for this focal area. Extensive monitoring is occurring in a similar gravel based braided system just above Bonner's Ferry, as part of the floodplain restoration project there (S. Soult, pers. comm.).

7.1.4. Knowledge Gaps

The impact of nutrients flows and heavy metal flows on this floodplain system is poorly understood at present. A cumulative effects study to look at these and other issues is presently underway. The role of side channels for fish rearing is not well understood in this system, and there are little data on migratory bird use of riparian floodplain cottonwood/spruce stands. The area is surveyed on an irregular basis to document large ungulate numbers by the Wildlife Section of the Ministry of Forests, Lands and Natural Resource Operations (FLNRO). There are little data on the Elk River fishery, despite its importance to the local fish guiding community and the tourism sector. Wetlands associated with the lower Elk River floodplain have not been monitored.

7.2. Elk Valley Action Plan

The individual actions for the Elk Valley focal area are outlined in the Table 3 below. The actions are numbered for easy reference. No ranking is implied by the action number. Each recommended action is tied to a specific objective outlined in Section 3.0 of this Wetland and Riparian Area Action Plan. The conservation actions are broken into four categories, or types of actions:

1. **Research and information acquisition** – actions to inventory resources or research critical effect pathways and relationships;
2. **Habitat-based actions** – activities focused on improving general habitat conditions or ecosystem function;
3. **Land securement** – contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes; or
4. **Monitoring and evaluation** – activities focused on assessing the outcomes of habitat- or species-based actions.

Each action has been assigned a priority ranking using the ranking approach outlined in Section 5.0 of this Action Plan. Priority #1 is the highest priority action, while actions with priority #2 or #3 are lower priority respectively. Some recommended actions apply equally to each focal area. These cross-cutting issues and actions are shown in Table 1, Actions for All Focal Areas, in Section 5.2. Readers should review individual focal area Action Tables as well as Actions for all Focal Areas (Table 1) for a comprehensive understanding of all actions recommended for each focal area.

Table 3: Action priorities for the Elk Valley (see Figure 3 and Map in Appendix 2 for focal area boundaries).

Action No.	Objective a	Action	Rationale	Desired Outcome	Priority
Research and Information Acquisition					
1	2	Monitor riparian vegetation areas (e.g. including but not limited to the Big Ranch area).	The valley bench lands are important ungulate winter range. Long-term monitoring will contribute to the sustainable management of the riparian vegetation and support elk populations in this focal area including but not limited to the Big Ranch/Grave Creek area.		3
2	2	Inventory and prioritize old growth stands in wetland and riparian areas for conservation action.	A stand of very old and large cottonwood have been identified and protected in the Morrissey area. Some cedar stands are protected in Lizard Creek Provincial Park. No work has been done to look at older age class spruce and cedar stands.	Inventorying old growth stands in wetland and riparian areas and prioritizing stands will inform conservation planning.	1
3	1	Further investigate available Predictive Ecosystem Mapping (PEM) data to identify	The unique hydrology in this focal area creates forested wetland and riparian areas not necessarily	Comprehensive inventory of wetland and riparian area habitat in this focal area. This	2

Action No.	Objective a	Action	Rationale	Desired Outcome	Priority
		wetland and riparian habitat in this focal area.	captured in the available data. PEM data could potentially be used to more comprehensively document the wetland and riparian area in this focal area.	would provide a more precise estimate of crown and conservation land for this floodplain.	
Habitat-based Actions					
4	4	Work with regional organizations to conserve and enhance riparian areas in and adjacent to communities within this focal area.	Wetland and riparian areas exist within or adjacent to urban areas within this focal area and may be threatened by human actions and impacts. Conserving and enhancing urban wetland and riparian areas, including but not limited to those in Fernie and Sparwood, would provide community-level stewardship opportunity and increase the available habitat.	Increased available wetland and riparian habitat and community involvement in stewardship activities.	2
Land Securement⁵					
See Table 1 for land securement actions that apply to all focal areas.					
Monitoring and Evaluation					
See Table 1 for monitoring and evaluation actions that apply to all focal areas.					

⁵ **Land securement** - contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes.

8. Creston Valley

8.1. Overview

There are four wetland and riparian systems in this focal area including:

- Diked wetlands in the Creston Valley Wildlife Management Area (CVWMA) and on the Yaqaan Nukiy (also known as the Lower Kootenay Band) lands (the Yaqaan Nuki wetlands project);
- Floodplain wetland systems along the Kootenay and Goat rivers that flood during high water events;
- Floodplain cottonwood systems on portions of the floodplain and the alluvial fans of Summit Creek and the Goat River; and
- Cottonwood dominated systems along the dikes and levees of the Kootenay River.

There are two small pothole wetlands in the Canyon / Lister area on the elevated benches on the east side of the valley south of Creston. Background data on this system is provided in Appendix 5.

8.1.1. Impacts and Threats

Hydro related Impacts: There have been large impacts on both the Kootenay River and the floodplain as a result of flow regulation through Libby Dam, Duncan Dam, Corra Linn Dam, etc. Nutrient and sediment flows in this portion of the river and floodplain have been altered substantially since the construction of the Libby Dam in 1975. Nutrient addition programs a) in the South arm of Kootenay Lake (Funded by: Kootenai Tribe of Idaho, implemented by: Ministry of Forests, Lands, and Natural Resource Operations (FLNRO), and supported by: FWCP) and b) in the Idaho portion of the Kootenay River upstream of Bonner's Ferry are in currently being implemented. The impact of these programs on wetlands and riparian habitats is poorly known, however, the loss of sediment is expected to be important. Most of the wetlands in the Creston portion of this focal area are diked and therefore are independent of river flow dynamics in all but major flood years. During major flood events, water levels are increased to reduce the differential between river levels and wetland levels to ensure that dike breaches do not occur (M. Beaucher, pers. comm.). Portions of the CVWMA and other areas are not diked and the ecological dynamics of these areas are driven by flow management at Libby Dam, regulated levels in Kootenay Lake, and the unregulated flows from the Goat River.

Non-hydro related Impacts: The major impact on the pre-settlement wetlands was the diking of the Kootenay River and the development of agriculture across much of the floodplain. Nutrient flows from croplands and cattle operations likely contribute phosphorous and nitrogen to the river and some wetlands areas but there are no data at this time. A Canadian Pacific Rail line is routed across the wetlands near Kootenay Lake, effectively acting as a dike for some of the wetlands. Industrial sites include a mine above Duck Lake and a logging mill at Wyndell. There have been ongoing river channel alterations for flood control on the lower Goat River that have had an impact on fisheries and floodplain habitats in that area.

8.1.2. Limiting Factors

Natural factors: The wetlands in this area are likely the most productive in the Canadian portion of the Columbia Basin, due to low elevation, high heat units and stable water levels in the diked wetlands. For example Northern Leopard frog tadpole development, occurs two to three weeks earlier at Creston than it does at Bummer's Flats (a wetland area North of Cranbrook near Fort Steele). For both the wetland areas outside the dikes and in the diked wetlands, flow regulation and major storm events can result in the flooding of nests and lost recruitment. There is also a long term shift from meadow

systems to deciduous trees and shrubs occurring. Many former sedge dominated areas are now occupied by Goldenrod (*Solidago canadensis*) on the CVWMA.

Human driven factors: A major limiting factor for creating diked wetlands in the future is the cost of constructing such systems and maintaining them over time. In addition there are costs associated with maintaining open water habitat in such marshes when emergent macrophytes take over the entire area of the marsh. Human settlement and agriculture now limit wetland and floodplain systems to the CVWMA and the Yaqan Nukiy lands.

These wetland and floodplain systems have several invasive species issues. Plains cottonwood (*Populus deltoides*) was introduced at Bonner's Ferry several decades ago and is now a significant component of cottonwood stands along the Kootenay River. There are no data on the degree to which this species competes with or replaces the native black cottonwood (*Populus trichocarpa*). It would appear that plains cottonwood is functionally similar to black cottonwood, in terms of nesting habitat for songbirds and other values, but this supposition has not been tested. Reed canary grass (*Phalaris arundinacea*) and common reed grass (*Phragmites australis* subsp. *australis*) present a similar problem. Both are large grass species that occur on floodplains and in wetlands. It would appear that in both cases, the native species have hybridized with the Eurasian species and have become more invasive as a result. Work in other systems has indicated that the presence of these grasses on point bars is limiting cottonwood recruitment. Their value as nesting habitat for ducks, compared to native sedge and other plant communities is not known. Wild rice is present in the Corn Creek marsh and one other compartment (introduced by CVWMA staff in earlier decades). Wild rice is extensive in these marshes and is a preferred species for waterfowl. It is reseeded annually and can be controlled by manipulating water levels during its' seeding phase. Terrestrial invasive weeds are endemic in the Creston Valley, especially knapweed. Yellow Flag Iris is a problem on the CWMWA. Eurasian watermilfoil (*Myriophyllum spicatum*) is an aquatic plant species which displaces native aquatic plant communities. It has been documented in the Kootenai River but not on the Kootenai National Wildlife Refuge or the CVWMA.

Climate Change implications: The management plan for the Kootenai National Wildlife Refuge (US Fish and Wildlife Service, 2011) provides an in depth analysis of climate change issues for diked wetland systems in the Creston/Bonner's Ferry valley. The implications for the Canadian portion of the system include increased heat units and increased water temperature and potentially, inherent productivity, shifts to warm water fish in the wetlands, the altering of fundamental climatic and hydrologic processes and the impacts and major flood and drought events. Flows in Summit, Corn and Boundary Creeks may also be affected over the long term. These tributaries provide sources of water for some of the wetlands in the CVWMA.

8.1.3. Trends and Knowledge Status

Land Ownership: This focal area includes all lands in the ICHxw Biogeoclimatic unit. The boundary for this unit varies from 825m on the west side of the valley, to 1050m on the east side of the valley.

- a. **Focal area analysis.** 19% of the focal area is in conservation status and 5% is in crown status. There was no ownership data for 22% of the land base.
- b. **Wetland habitats in the focal area.** Of the lands identified as swamp and marsh in the TRIM database, some 86.6% is in conservation land status (86.6%), with only 0.4% in crown status. A further 11.4% (300ha) are diked wetlands on First Nations Reserve lands. Only 19 ha of wetland are privately owned in the focal area.
- c. **Wetland and riparian habitats on the floodplain of the Kootenay and Goat rivers.** On the floodplain, 36% is in conservation land status and 1.5% is crown land. For the entire international floodplain, from Bonner's Ferry to Kootenay Lake, approximately 33% of the original floodplain is in crown, public and conservation status.

Habitat Status: In general, the remaining wetland and floodplain habitats in this focal area are in good condition. However, significant changes have occurred as areas have been shifted from a natural floodplain hydrologic regime to a system of managed marshes and riparian habitats.

Habitat Trends: Wilson 1992 provides some data on habitat trends for the CVWMA. Jamieson and Braatne 2001 provide a comparison of habitat types in 1947, 1974 and 1998 for three areas on the US side of the system and on the delta of the Kootenay River where it enters Kootenay Lake. Cottonwood recruitment is also occurring in several other areas in the CVWMA and along the lower portions of the Goat River.

Habitat Connectivity: In this focal area, habitat connectivity issues need to be considered in the context of the entire floodplain system on both sides of the Canada / USA border. The various wetland elements in this system are reasonably well connected by the river (Kootenay River) and narrow strips of habitat along the river edge. The entire system is isolated from other floodplain wetland complexes by the surrounding mountains and Kootenay Lake.

Species Status: The CVWMA management plan (Wilson et al. 2004) provides an overview of species status for many wetland species in the CVWMA. Three recovery species identified in the FWCP-Columbia's Species of Interest Action Plan occur in this focal area (Northern Leopard frog, Yellow-breasted Chat and White Sturgeon). Several focal species also occur.

Species Trends: There has been a major increase in the diversity of wetland species since the area was established as a wildlife management area (WMA) (Wilson et al. 2004). Migratory waterfowl numbers were very large in the 1970s (40-60,000 in some years with one year at 120,000), but numbers have declined in recent decades as farmland in the valley converted from cereal grains to hay production. Wilson and Stushnoff 1992 and Wilson 1992 provide details on the waterfowl and habitat surveys that were completed in the CVWMA up until 1998. Annual brood counts and counts of migratory waterfowl were discontinued in the 1990s at the CVWMA. Waterfowl numbers from the Kootenai National Wildlife Refuge just to the south indicate an overall pattern similar to the CVWMA data (US Fish and Wildlife Service 2011).

8.1.4. Knowledge Gaps

Much more research and monitoring has been done in this area relative to the other focal areas. Work being done just to the south on the same floodplain, in the Bonner's Ferry area (www.restoringthekootenai.org) provides further information on this system, especially relative to the functional processes that drive the productivity of these systems. On the Canadian side, there are little data on basic ecological conditions and processes in the managed wetlands, (water pH, temperature, etc.) or for the other habitat elements in these systems. There are also little data on songbird use of systems in this area. Some data on songbirds are available for similar areas to the south in the Bonner's Ferry area, collected as part of the floodplain project there.

8.2. Creston Valley Action Plan

The individual actions for the Creston Valley focal area are outlined in the Table 4 below. The actions are numbered for easy reference. No ranking is implied by the action number. Each recommended action is tied to a specific objective outlined in Section 3.0 of this Wetland and Riparian Area Action Plan. The conservation actions are broken into four categories, or types of actions:

1. **Research and information acquisition** – actions to inventory resources or research critical effect pathways and relationships;
2. **Habitat-based actions** – activities focused on improving general habitat conditions or ecosystem function;
3. **Land securement** – contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes; or
4. **Monitoring and evaluation** – activities focused on assessing the outcomes of habitat- or species-based actions.

Each action has been assigned a priority ranking using the ranking approach outlined in Section 5.0 of this Action Plan. Priority #1 is the highest priority action, while actions with priority #2 or #3 are lower priority respectively. Some recommended actions apply equally to each focal area. These cross-cutting issues and actions are shown in Table 1, Actions for All Focal Areas, in Section 5.2. Readers should review individual focal area Action Tables as well as Actions for all Focal Areas (Table 1) for a comprehensive understanding of all actions recommended for each focal area.

Table 4: Action priorities for the Creston Valley (see Figure 3 and Map in Appendix 2 for focal area boundaries).

Action No.	Objective	Action	Rationale	Desired Outcome	Priority
<i>Research and Information Acquisition</i>					
1	1	Document and monitor changes in wetland and riparian vegetation and habitat in this focal area (e.g. including but not limited to the Creston Valley Wildlife Management Area).	Major changes in vegetation have been observed anecdotally in this focal area however there is little data available to document these observed changes.	Identify changes to wetland and riparian area vegetation.	3
2	1	Monitor nutrient flows and water quality in wetland and riparian areas in this focal area including but not limited to Duck Lake and the Duck Creek drainage ditch.	Duck Lake is a shallow eutrophic lake with high productivity for waterfowl. There is very limited information on the change in nutrient status or water quality over time for this water body.	Monitoring nutrient flows and water quality will inform management options to protect wetland and riparian values.	2
3	1	Document and monitor cottonwood stands in order to determine, among other values, the presence and abundance of Black and Plains Cottonwood in wetland and riparian areas in	Plains cottonwood was introduced at Bonner's Ferry decades ago and is now a significant component of cottonwood stands along the river. It would appear that Plains Cottonwood is functionally similar to		3

Action No.	Objective	Action	Rationale	Desired Outcome	Priority
		this focal area.	Black Cottonwood, in terms of nesting habitat for songbirds and other values, but this supposition has not been tested. A survey of the presence of cottonwood stands will improve knowledge, answer questions including the presence and role of Plains cottonwoods, hybridization.		
4	1	Determine baseline fisheries values in wetland and riparian areas within this focal area to further inform future management actions.	Both game and non-game fish in wetlands are prey for various wildlife species.	Baseline information will fill information gap and inform conservation actions and management.	2
5	1	Monitor abundance of migratory birds and nesting success.	Monitoring abundance and nesting success of waterfowl and other migratory bird species will identify trends and help inform potential conservation actions and increase local knowledge. This work could be undertaken in cooperation with the Kootenai National Wildlife Refuge staff at Bonner's Ferry.		2
Habitat-based Actions					
6	2	Improve connectivity between wetlands and rivers in this focal area with an emphasis on the Kootenay River.	There may be options to develop access to compartments in the Six Mile slough and allow annual flooding. A portion of the slough is 10 m deep and could provide overwintering habitat for fish species.	Improving wetland and river ecosystem connectivity will increase the availability and diversity of fish habitat.	2
7	4	Support the development of management plans for wetlands in this focal area, including but not limited to the Yaqaan Nuki wetlands.	Management plans for wetlands in this focal area will identify management objectives and strengthen conservation planning and actions.		1
9	1	Collaborate with CVWMA to identify options for maintaining early seral vegetation types on the CVWMA.	Regulated flows and dike construction have removed flood events and other forms of disturbance. Investigate options to reverse the lack of early seral plant communities.		2

Action No.	Objective	Action	Rationale	Desired Outcome	Priority
Land Securement					
10	1	Collaborate with the Lower Kootenay Band and others in this focal area to identify potential stewardship opportunities to address threats to wetland and riparian areas.	Stewardship and outreach actions involving landowners and others will strengthen community engagement and contribute to conservation objectives.	Increased involvement of private landowners in the stewardship of lands with high wetland and riparian area values.	1
Monitoring and Evaluation					
11	2	Monitor wetland and riparian area focal, inventory and recovery species including but not limited to the Yellow-Breasted Chat.	Work has been completed at a provincial scale. If justified in terms of the overall range of species, a more detailed survey could be completed for the Creston area. This species has a large range in the USA.	Improving the knowledge about bird species, including but not limited to the Yellow-Breasted Chat will inform conservation actions.	2
12	1	Inventory and monitor available wetland and riparian area habitat and presence of species using those habitats.	Data has been collected on several species over the last several decades. These inventories should continue.		2

9. Duncan/Lardeau and Revelstoke Valleys

9.1. Overview

There are four wetland and riparian systems in the Duncan/Lardeau Valley portion of the focal area including:

- The floodplain/wetland complex along the lower Lardeau River;
- Riparian spruce systems on the floodplain of the Lardeau River from the town sites of Marblehead /Howser to Trout Lake;
- Mid-elevation floodplain wetland complexes at the upper end of the Lardeau system, above Trout Lake and adjacent to Staubert and Armstrong lakes in the nearby watershed that flows into the Arrow Lakes watershed;
- Wetlands on the west bench above Arrow Lakes Reservoir; and
- Low elevation riparian zones along the various tributaries in the focal area.

There are three wetland and floodplain systems in the Revelstoke Valley portion of the focal area including:

- Wetlands that have developed in the drawdown zone of the Arrow Lakes Reservoir, just south of Revelstoke;
- Riparian cottonwood systems on the floodplain of the Illecillewaet River where it flows through Revelstoke; and
- Riparian areas along the mainstem of the Columbia River.

The extensive wetlands that have developed in the drawdown zone of the Arrow Reservoir just south of Revelstoke and are a component of the ongoing work through the Columbia Water Use Plan. These wetland areas were not mapped or included in the calculation of secured lands. Extensive work has been accomplished through the Water Use Planning process, including songbird inventory and wetland mapping (BC Hydro 2014). Background information on these systems is provided in Appendix 6.

9.1.1. Impacts and Threats

Hydro related Impacts: The impacts from hydro development in the Duncan/Lardeau Valley portion of the focal area relate to habitat losses in the storage reservoir and the altered hydrograph below the Duncan Dam. Losses of wetland and riparian cottonwood habitats in this reservoir (Utzig and Schmidt, 2011) were 1007 ha of wetland, 1426 ha of cottonwood stands and 172 ha of shallow water, a total of 2605 ha. The degree to which the partial control of flows in this system, (below the inflow of the Duncan River) has altered the lower floodplain system is not well understood and is the subject of several studies being carried out as part of the Duncan Dam Water Use Plan. The role of water level regulation in Kootenay Lake is also a factor in the lower portion of the floodplain, but has not been studied extensively. In the Revelstoke portion of the focal area, flow regulation below Revelstoke Dam and the flooding of the main valley below Revelstoke by the Arrow Lakes Reservoir have had major impacts. A total of 2,291 ha (479 ha of wetland, 1,709 ha of cottonwood and 103 ha of shallow water were inundated by this reservoir (Utzig and Schmidt 2011).

Non-hydro related Impacts: In the lower portion of the Duncan/Lardeau system (south of Howser), the major impacts on the floodplain are settlement, agriculture, mill site development and transportation corridors. The decline in logging in this area in recent decades has resulted in the closure of mills in this valley and a major decline in the human population in this valley. Agriculture is small scale. Mining was a major industry here in the 1800s but there are no active mines at present. In the Revelstoke Valley portion of the focal area, most of the floodplain and adjacent bench lands are now part of the community of Revelstoke. A portion of the floodplain of the lower Illecillewaet River is diked.

9.1.2. Limiting Factors

Natural factors: The Duncan/Lardeau and Revelstoke floodplain system is at relatively low elevation and is likely very productive relative to other systems at higher elevations. The wetland systems between Trout Lake and Armstrong Lake are at higher elevation.

Human driven factors: The altered hydrograph and loss of nutrients and sediment from the Duncan system have had some unknown effect on the lower floodplain. There are no known aquatic invasive species in the river, though Knapweed species and other terrestrial invasives are present on the floodplain. Reed canary grass is present on at least one site (M. Polzin, pers. comm.). Russian thistle is a concern in the old field portions of some of the conservation properties (G. Trower, pers. comm.). In the Revelstoke Valley, management options are limited by human settlement adjacent to the rivers and floodplains there. Management options are also limited by the extreme water level fluctuations of Arrow Lakes Reservoir.

Climate Change implications: Climate change in this area may have some benefit via increased heat units. It would also appear that peak flows will occur earlier, which will have impacts that are difficult to predict. A major storm event in June 2013 resulted in major impacts on lower Hamill Creek. Such events may limit enhancement options in some areas. Water temperature during the growing season may increase as the various glacial sources of melt water decline over time. There are several glacier complexes at the headwaters of this system, primarily in the Duncan River system. In the Revelstoke Valley, climate impacts on the upstream portion of the Columbia River will be mediated by flow control at the Revelstoke and Mica dams. Major storm events could have much larger impacts on the Illecillewaet River fan.

9.1.3. Trends and Knowledge Status

Land Ownership: This focal area includes all lands below 877 m in elevation, across an extended area from Kootenay Lake to Revelstoke. A large portion of this focal area is the water surface of Trout Lake and the Arrow Lakes Reservoir.

- a. **Focal Area analysis.** With these large water areas removed, 6% of the focal area is in conservation land status and 15% in crown ownership. There was no ownership data for 60% of the land base.
- b. **Wetland habitats in the focal area.** The TRIM data for this focal area identifies 1016 ha of wetlands. Of this area, 6% is in conservation land status, 36% is crown, and 19% is unknown ownership. Some wetlands occur in this focal area on the Duncan/Lardeau floodplain. There are also substantial areas of wetlands between Trout Lake and Stauber Lake and on the west side of Arrow Lakes that are in private status.
- c. **Wetland and riparian habitats on the floodplain of the Duncan/Lardeau River.** On the floodplain of the Duncan/Lardeau, 20% of the land is in conservation lands with a further 12% in crown land. There was no ownership data for 35% of the land base.
- d. **Wetland and riparian habitats on the floodplain of the Columbia and Illecillewaet rivers.** The floodplain area in the Revelstoke area, above the high water level of the Arrow Reservoir, is limited by dikes along the channels of the Columbia and Illecillewaet rivers. Almost all of this floodplain area is in crown or BC Hydro ownership. No assessment was done for that floodplain area.

The third major floodplain, along the Lardeau River upstream of Howser is critical to maintaining fisheries values; however, no floodplain mapping was available for this area. It is almost entirely crown, with two blocks of private land at Poplar Creek and below Cascade Creek. The floodplain above Poplar Creek is within the Goat Range Provincial Park.

Details on the land ownership analysis for this focal area are provided in Appendix 6.

Habitat Status: In general, the remaining wetland and floodplain habitats in the Duncan/Lardeau portion of the focal area are in good condition. However, subtle changes have occurred in the floodplain below the confluence of the Duncan and Lardeau rivers due to the altered flow regime below Duncan Dam. The riparian zone along the Columbia River in the Revelstoke Valley

has been changed significantly by the altered flow regime below Revelstoke Dam. The Illecillewaet River has a natural hydrograph and floodplain vegetation system in the remaining portion of the floodplain.

Habitat Trends: There have been extensive losses over time of floodplain habitats to settlement and agriculture in the lower floodplain of the Duncan/Lardeau River. Krebs et al. 2012 provides an analysis of major habitat types at present versus those found in 1963. Cleared land has increased and shrub communities have declined over that period. On the delta, the interplay of hydrologic effects from the river and lake has created conditions that have led to the development of extensive stands of willow along the lake edge. This habitat type was less extensive prior to the development of Duncan Dam and the control of levels on Kootenay Lake. Limited natural recruitment of cottonwood is occurring along the main river channels and multiple age stands of cottonwood occur. The upper Lardeau floodplain is occupied by older age conifer forests with little recent logging. There are cottonwood stands on several point bars and in braided portions of the river. The mid elevation wetlands and fens between Trout Lake and Armstrong Lake appear to be in natural condition. There are no data on trends in the floodplain vegetation along the Columbia and Illecillewaet rivers where they flow through the Revelstoke Valley.

Habitat Connectivity: The floodplain complexes in this focal area are isolated from other similar habitats by the surrounding mountains and Kootenay Lake. Habitat mapping and shoreline management processes are being considered for the lake. The Arrow Lakes Reservoir, Revelstoke reservoir and steep mountain slopes isolate the Revelstoke floodplain area from other similar systems.

Species Status: There is good information on the Gerrard rainbow, bull trout and kokanee populations in the Duncan/Lardeau system, and extensive work on riparian habitat, but little information on the use of the floodplain habitats by wildlife species. Issac and Pomeroy (2009) looked at songbird status and recorded the presence of other species. There are no recovery species in this system. Several focal species are present. The lower floodplain is likely very important as nesting habitat and stop-over sites for migrating songbirds and other migrants. There has been research and monitoring on fisheries, songbirds, water birds, shorebirds and painted turtles in the Revelstoke area (Appendix 6).

Species Trends: There is minimal data on population trends for floodplain riparian and wetland species for the south portion of the focal area, but some good data for specific species (herons, songbirds, in the Revelstoke area).

9.1.4. Knowledge Gaps

Extensive work on cottonwood and other riparian habitat elements has recently been completed for the Duncan/Lardeau floodplain. We have a poor understanding of how floodplain systems respond where controlled water levels in the lake/reservoir contribute to the complexity of the hydrology of the system. This system shares attributes with three similar systems in northern Idaho where rivers flow into Pend Oreille and Cour d'Alene Lakes.

9.2. Duncan/Lardeau and Revelstoke Valleys Action Plan

The individual actions for the Duncan/Lardeau and Revelstoke Valleys focal area are outlined in the Table 5 below. The actions are numbered for easy reference. No ranking is implied by the action number. Each recommended action is tied to a specific objective outlined in Section 3.0 of this Wetland and Riparian Area Action Plan. The conservation actions are broken into four categories, or types of actions:

1. **Research and information acquisition** – actions to inventory resources or research critical effect pathways and relationships;
2. **Habitat-based actions** – activities focused on improving general habitat conditions or ecosystem function;
3. **Land securement** – contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes; or
4. **Monitoring and evaluation** – activities focused on assessing the outcomes of habitat- or species-based actions.

Each action has been assigned a priority ranking using the ranking approach outlined in Section 5.0 of this Action Plan. Priority #1 is the highest priority action, while actions with priority #2 or #3 are lower priority respectively. Some recommended actions apply equally to each focal area. These cross-cutting issues and actions are shown in Table 1, Actions for All Focal Areas, in Section 5.2. Readers should review individual focal area Action Tables as well as Actions for all Focal Areas (Table 1) for a comprehensive understanding of all actions recommended for each focal area.

Table 5: Action priorities for the Duncan/Lardeau and Revelstoke Valleys (see Figure 3 and Map in Appendix 2 for focal area boundaries).

Action No.	Objective	Action	Rationale	Desired Outcome	Priority
Research and Information Acquisition					
See Table 1 for research and information acquisition actions that apply to all focal areas.					
Habitat-based Actions					
1	1	Explore options to create floating wetlands in draw down zone where feasible.	Wetlands have been lost or impacted due to human activity, including hydro operations, particularly in the Duncan-Lardeau area. Floating loon nesting platforms have been utilized successfully in the basin.	Increasing available habitat will support conservation objectives for wetlands, riparian areas and species of interest.	1
2	1	Restore and maintain riparian vegetation; priority locations are those that have already been degraded or impacted including but not limited to erosion).	The shoreline of Kootenay Lake on the delta of the Duncan/Lardeau River system is a very complex site that is affected by both riverine and lake process (water level change and erosion caused by wave action). The net result over time	The site should be managed to optimize the area for wildlife values maintaining a mix of early seral and later vegetation communities.	1

Action No.	Objective	Action	Rationale	Desired Outcome	Priority
			has been a major shift in the land forms and vegetation on this site.		
Land Securement⁶					
See Table 1 for land Securement actions that apply to all focal areas.					
Monitoring and Evaluation					
4	4	Share monitoring and other data related to priority wetland & riparian species generated by BC Hydro under the Columbia River Water Use Plan (i.e., Water Licence Requirements) and other processes to improve information sharing and leverage collaboration.	Integrating species science and data compiled through various agencies and processes will leverage synergies and knowledge transfer.	Improved info sharing and strengthened collaboration.	1

⁶ **Land securement** - contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes.

10. Slocan Valley

10.1. Overview

Riparian and wetland habitat in the Slocan Valley are among the few low elevation floodplain systems remaining in the West Kootenay. This system supported salmon spawning runs prior to the 1942 construction of Grand Coulee Dam in Washington State (Oliver 1998).

There are five wetland and riparian systems in this focal area including:

- Floodplain wetlands along the lower Slocan River;
- Riparian cottonwood/spruce/cedar systems on portions of the lower Slocan floodplain;
- Two small bench wetlands on the slopes above the Little Slocan Valley;
- Alluvial fans on the shores of Slocan Lake;
- Low elevation floodplain systems in the Little Slocan Lakes area and other small wetlands at slightly higher elevation above Slocan Lake in the upper watershed; and
- Mid elevation riparian zones along all the various stream courses in the area and surrounding lakes and wetlands.

Appendix 2 provides mapping of this focal area. Background information on these systems is provided in Appendix 7.

10.1.1. Impacts and Threats

Hydro related Impacts: The impacts from hydro development are minimal in this focal area other than the historic loss of salmon due to the construction of Grand Coulee Dam.

Non-hydro related Impacts: Pre-settlement this system supported stands of very large western red cedar, with cottonwood and other species. Today, it is a mix of small farm holding and many small natural areas along the river, including several side channels and oxbows. There are several small human communities on or adjacent to the lower floodplain. The floodplain wetland complexes in the Little Slocan have seen few impacts from human use and remain in a close to natural condition. The alluvial fans of the creeks coming into Slocan Lake are occupied by human communities. Logging occurs in many areas in the watershed; however there are also two major park areas. Mining has had major impacts in the past.

10.1.2. Limiting Factors

Natural factors: The lower Slocan floodplain wetlands are potentially very productive, given the elevation and heat units in the valley. However, the river is nutrient poor and groundwater flows into the floodplain wetlands are likely to be nutrient poor, in contrast to their historic condition when salmon spawned in the system.

Human driven factors: Human settlement and small scale agriculture on the various floodplains is the dominant land use in this system. The lower floodplain is almost entirely private land. Stream temperature appears to be limiting for salmonids (Corbett 2006). Nutrient levels and river temperature may have some impact on wetlands adjacent to the river. Terrestrial invasive plants are a concern. For example, reed canary grass is significant factor limiting restoration options along the river. Japanese knotweed is also a concern.

Climate change implications: Climate change may have some benefit via increased heat units in low elevation systems such as the Slocan Valley. Water temperature may increase; which will have an impact on fish and floodplain. Glacial sources of melt water are declining over time. The impacts in this valley will be modulated by Slocan Lake, which will mediate stream flows and the impact of large storm events in the upper watershed. The increase in major storm events could have large impacts in the area below Lemon Creek and the Little Slocan system. The communities and natural communities on the alluvial fans along Slocan Lake are at high risk. Major stream bed alterations on alluvial fans should be expected in the future in this system.

10.1.3. Trends and Knowledge Status

Land Ownership: This focal area includes all lands below 877 m in elevation in the Slocan River watershed. Detailed mapping is provided in Appendix 2.

- a. **Focal Area analysis.** Only 8% of the focal area is in conservation land status and 3% in crown status. There was no ownership data for 61% of the land base.
- b. **Wetland habitats in the focal area.** Most wetlands in this area occur in the form of oxbows and side channel habitats on the lower Slocan River floodplain. There are also areas of wetlands in the Little Slocan Lakes area, in the Bonanza Creek area at the upper end of Slocan Lake and at the lower end of Summit Lake (313 ha). Of these wetlands 5% are found on crown land, 0% in conservation land status and 25% with no ownership data.
- c. **Wetland and riparian habitats on the floodplain of the Slocan River.** On the floodplain of the Slocan River downstream of Slocan Lake, 6% of the land is in conservation land status, with a further 3% in crown land status. This level of securement is much lower than that found on the floodplain portion of the other focal areas. There was no ownership data for 36% of the land base.

Details on the land ownership analysis for this focal area are provided in Appendix 7.

Habitat Status: In general, the remaining wetland and floodplain habitats in this focal area are in fair condition, maintained by a natural hydrograph.

Habitat Trends: There have been extensive losses over time of floodplain habitats to settlement and agriculture in the lower Slocan floodplain. There are few sources of information on habitat change over time.

Habitat Connectivity: In this focal area, movement for wildlife species up and down the system is restricted to some degree at each of the various communities along the lower floodplain. The Little Slocan River provides a habitat corridor to the Little Slocan Lakes, but Slocan Lake is likely a significant barrier to movement to the wetlands in the upper watershed. The entire system is isolated from other floodplain wetland complexes by the surrounding mountains.

Species Status: The area supports wide range of wetland species but there are little data on actual numbers. Only one species is known to have been extirpated; i.e. the Columbia River variant of Chinook salmon (Oliver 1998). The lower floodplain is likely very important as nesting habitat and stop-over sites for migrating songbirds and other migrants. Two recovery species, Lewis' Woodpecker and Western Screech owl, are present. Several focal species are present.

Species Trends: There are no data on population trends for floodplain riparian and wetland species for this focal area. Machmer 2007 has monitored osprey and blue heron numbers in the system in recent years. Amphibians and reptiles were surveyed in a recent basin wide survey (Dulisse and Hausleitner 2010). There has been recent work on otter and western toad (I. Manley, pers. comm.).

10.1.4. Knowledge Gaps

There has been very little long term monitoring of ecological process in this area except for water flow and water quality monitoring, collected by a local watershed group. There are no data on songbirds, other migrants or waterfowl.

10.2. Slocan Valley Action Plan

The individual actions for the Slocan Valley focal area are outlined in the Table 6 below. The actions are numbered for easy reference. No ranking is implied by the action number. Each recommended action is tied to a specific objective outlined in Section 3.0 of this Wetland and Riparian Area Action Plan. The conservation actions are broken into four categories, or types of actions:

1. **Research and information acquisition** – actions to inventory resources or research critical effect pathways and relationships;
2. **Habitat-based actions** – activities focused on improving general habitat conditions or ecosystem function;
3. **Land securement** – contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes; or
4. **Monitoring and evaluation** – activities focused on assessing the outcomes of habitat- or species-based actions.

Each action has been assigned a priority ranking using the ranking approach outlined in Section 5.0 of this Action Plan. Priority #1 is the highest priority action, while actions with priority #2 or #3 are lower priority respectively. Some recommended actions apply equally to each focal area. These cross-cutting issues and actions are shown in Table 1, Actions for All Focal Areas, in Section 5.2. Readers should review individual focal area Action Tables as well as Actions for all Focal Areas (Table 1) for a comprehensive understanding of all actions recommended for each focal area.

Table 6: Action priorities for the Slocan Valley (see Figure 3 and Map in Appendix 2 for focal area boundaries).

Action No.	Objective	Action	Rationale	Desired Outcome	Priority
Research and Information Acquisition					
10	1	Further investigate available Predictive Ecosystem Mapping (PEM) data to identify wetland and riparian habitat in this focal area.	The unique hydrology in this focal area creates forested wetland and riparian areas not necessarily captured in the available data. PEM data could potentially be used to more comprehensively document the wetland and riparian area in this focal area.	Comprehensive inventory of wetland and riparian area habitat in this focal area. This would provide a more precise estimate of crown and conservation land for this floodplain.	2
11	1	Support the continued monitoring of ecological processes in the system (flow monitoring, nutrient levels, other water quality measures).	Local stewardships groups are now monitoring water quality which was done previously by the provincial government. A long-term commitment to monitoring will provide critical data.		2

<i>Habitat-based Actions</i>					
1	1	Strengthen available habitat by creating structures in this focal area including but not limited to nest boxes in wetland and riparian areas.	This project would be dependent on the outcome of project above.	Increased habitat structures in wetlands, riparian areas and species of interest.	2
<i>Land Securement⁷</i>					
See Table 1 for land securement actions that apply to all focal areas.					
<i>Monitoring and Evaluation</i>					
See Table 1 for monitoring and evaluation actions that apply to all focal areas					

⁷ **Land securement** - contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes.

11. Robson Valley

11.1. Overview

The Robson Valley focal area includes four separate watersheds:

1. lower Canoe River watershed;
2. McLennan Creek watershed (between Valemount and Tete Jaune Cache);
3. Swift Creek watershed; near Valemount and Tete Jaune Cache) and
4. the much larger floodplain system along the Fraser River from the Mt. Robson area downstream to Crescent Spur.

There are several wetland and floodplain systems in this focal area, including:

- two diked wetlands (Cranberry Marsh near Valemount and Horseshoe Lake near McBride);
- floodplain wetlands along the Fraser River (100 km+), McLennan Creek (20 km) and the Canoe River (8 km), mostly in the form of old oxbows;
- riparian spruce/aspen/cottonwood systems on the floodplains of each of these watersheds;
- several small wetlands on the benches above the Fraser River;
- a mid-elevation floodplain system on the Rausch River; and
- mid-elevation riparian zones along all the various stream courses in the area.

This focal area is unique in that the Fraser River portion of this system presently supports salmon species. Appendix 2 provides mapping for this area. Background information on these systems is provided in Appendix 8.

11.1.1. Impacts and Threats

Hydro related Impacts: The impacts from hydro development are minimal in the Fraser River portion of this focal area. However, major portions of the Canoe River system were inundated when the Mica Dam was constructed. A total of 7859 ha (5,653 ha of wetland, 1,651 ha of cottonwood and 555 ha of shallow water) were inundated (Utzig and Schmidt 2011). This was the largest loss from any of the reservoirs in the Basin. One important species, kokanee, has expanded substantially in the Canoe River system following the development of the Mica Dam (Oliver 1995).

Non-hydro related Impacts: The Robson Valley supports small scale agriculture and tourism, but is primarily a forestry dependent valley. There is a combination of private land logging activities and agriculture fields on the Fraser River floodplain. Most of these activities occur on the first bench, some 10-30 m above the active floodplain and river. The McLennan Creek and Canoe floodplains have less of both activities. In general the railway and highways in this valley are on this first bench with minor impacts on the active floodplain except in the wetland area just downstream of Tete Jaune Cache.

11.1.2. Limiting Factors

Natural factors: The floodplain wetlands/marshes in this area are at higher elevation and far to the north of the wetlands in the remainder of the FWCP's program area. The valley is in the boreal zone. There are 76 frost free days at Valemont and 82 at McBride compared to 132 days at Creston and 98 frost free days at Fernie (Ministry of Environment 1981). This cooler climate results in more extensive fens and bog systems occurring compared to areas further south.

Human driven factors: Much of the Fraser River floodplain below Tete Jaune Cache is private land. There are little data on aquatic and terrestrial invasive species in this valley.

Climate Change implications: Climate change in this area may have some benefit via increased heat units. Water temperature may increase during the growing season as the various glacial sources of melt water decline over time. However, this altered timing of high water and low water levels may have other unanticipated impacts on natural systems and fish and wildlife populations. The increase in major storm events, as occurred in the Rockies and southern Purcells in July of 2013, could have major impacts on the various alluvial fans in the area.

11.1.3. Trends and Knowledge Status

Land Ownership: This focal area includes all lands in the SBSdh 1Biogeoclimatic unit. The boundary for this unit varies from 900 m on the south side of the valley, to 1500 m on the north side of the valley. Detailed mapping is provided in Appendix 2.

- a. **Focal Area analysis.** In this focal area, 9% of the focal area is in conservation land status and 3% is in crown status. There was no ownership data for 49% of the land base.
- b. **Wetland habitats in the focal area.** Most wetlands and riparian areas are on the lower floodplain of these rivers, but there are some wetlands on the benches along the Fraser River and throughout the valley. The TRIM data for wetlands suggests that some 14% of these wetlands are in conservation lands and 5% in crown ownership, but with 33% with unknown ownership.
- c. **Wetland and riparian habitats on the floodplains in the Robson Valley.** Floodplain mapping is not available for this focal area. The floodplains along the rivers in this system are relatively narrow compared to some of the other focal areas. A review of the mapping completed (Appendix 2) suggests that the proportion of the floodplains in secure status is low on the three rivers involved (Fraser, McLennan and Canoe rivers).

Habitat Status: In general, the remaining wetland and floodplain habitats in this focal area are in good condition, maintained by a natural hydrograph in each of the river systems. Some work has been accomplished through Water Licence Requirements, as outlined in the Columbia River Water Use Plan, on peat lands and other wetlands in the drawdown zone of Kinbasket Reservoir (BC Hydro 2014a).

Habitat Trends: There have been losses over time of floodplain habitats to settlement and agriculture in the lower floodplain of the Fraser River. There are few sources of information on habitat change over time. Few of the floodplains at the lower floodplain level have been altered, much larger changes have occurred on the adjacent benches and on some alluvial fans.

Habitat Connectivity: The various wetland elements in this focal area are connected by the three river systems. There are few bottlenecks for wildlife movement along the rivers, relative to the situation in the other focal areas in the basin.

Species Status: There is good information on the salmonid populations in this system, but little information on the use of the floodplain habitats by other fish and wildlife species. There are two recovery species in this focal area, (Mountain Caribou and White Sturgeon) and several focal species. Song birds populations were monitored through the FWCP two decades ago (Leung and Simpson 1993).

Species Trends: There are no data on population trends for floodplain riparian and wetland species for this focal area. There are some data for the fisheries that use the Fraser River.

11.1.4. Knowledge Gaps

There has been very little long term monitoring of ecological process in this area. There are flow monitoring stations at three sites (Mt. Robson Park, McBride and Dore River). Water quality is not monitored except at community effluent outfalls. This lack of data will limit options for some kinds of enhancement. In general there are very little data on wildlife in this area compared to the other focal areas.

11.2. Robson Valley Action Plan

The individual actions for the Robson Valley focal area are outlined in the Table 7 below. The actions are numbered for easy reference. No ranking is implied by the action number. Each recommended action is tied to a specific objective outlined in Section 3.0 of this Wetland and Riparian Area Action Plan. The conservation actions are broken into four categories, or types of actions:

1. **Research and information acquisition** – actions to inventory resources or research critical effect pathways and relationships;
2. **Habitat-based actions** – activities focused on improving general habitat conditions or ecosystem function;
3. **Land securement** – contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes; or
4. **Monitoring and evaluation** – activities focused on assessing the outcomes of habitat- or species-based actions.

Each action has been assigned a priority ranking using the ranking approach outlined in Section 5.0 of this Action Plan. Priority #1 is the highest priority action, while actions with priority #2 or #3 are lower priority respectively. Some recommended actions apply equally to each focal area. These cross-cutting issues and actions are shown in Table 1, Actions for All Focal Areas, in Section 5.2. Readers should review individual focal area Action Tables as well as Actions for all Focal Areas (Table 1) for a comprehensive understanding of all actions recommended for each focal area.

Table 7: Action priorities for the Robson Valley (see Figure 3 and Map in Appendix 2 for focal area boundaries).

Action No.	Objective	Action	Rationale	Desired Outcome	Priority
Research and Information Acquisition					
1	1	Conduct an information review to identify wetland and riparian restoration opportunities within this focal area.	There are several recent information sources including Water Licence Requirements related activities with Kinbasket.	A review of available data and information may identify new and or additional opportunities for wetland and riparian area restoration in this focal area.	1
Habitat-based Actions					
2	1	Improve connectivity between wetland and river ecosystems, including but not limited to high-value wetlands cut-off by transportation corridors.	Several wetlands, including historical wetlands below Tete Jaune Cache have been isolated from the Fraser River for decades.	Restoration of isolated wetlands and improved connectivity.	2

Action No.	Objective	Action	Rationale	Desired Outcome	Priority
3	4	Support the development of management plans for wetland and riparian areas in this focal area, including but not limited to the Cranberry Marsh, McLellan/Fraser confluence and Horseshoe Lake and associated Protected Areas.	Management plans for wetlands in this focal area will identify management objectives and strengthen conservation planning and actions.		2
Land Securement⁸					
See Table 1 for land securement actions that apply to all focal areas.					
Monitoring and Evaluation					
See Table 1 for monitoring and evaluation actions that apply to all focal areas.					

⁸ **Land securement** - contributing to the establishment of easements or covenants or the purchase of private land for conservation purposes.

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- BC Hydro 2014a. Kinbasket projects at canoe. A list of projects can be found at:
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13. Appendices

Appendix 1: Mapping Analysis Overview

Appendix 2: Land ownership maps

Appendix 3: Focal area analysis for the Upper Columbia Valley

Appendix 4: Focal area analysis for the Elk River Valley

Appendix 5: Focal area analysis for the Creston Valley

Appendix 6: Focal area analysis for the Duncan/Lardeau and Revelstoke Valleys

Appendix 7: Focal area analysis for the Slocan Valley

Appendix 8: Focal area analysis for the Robson Valley

Appendix 1: Mapping Analysis Overview

An analysis of land ownership in each focal area was completed during development of this Action Plan. The analysis was carried out at three levels: 1) ownership in the entire area of each focal area was assessed to provide a sense of land ownership at lower elevations in each focal area; 2) the TRIM data for swamp and marsh was used to provide an estimate of the presence of these categories in each focal area; and 3) floodplain risk mapping was then used to define the area of the floodplain along the major rivers in each focal area. These areas contain substantial areas of both riparian and wetland habitats.

Ownership in each was classified as:

1. **Conservation Properties:** All lands purchased for conservation, by groups such as the Nature Conservancy of Canada and the Nature Trust of B.C. In earlier decades some land was purchased directly by the federal and provincial governments (National Wildlife Areas, Second Century Fund purchases). These were included in this category. Conservation easements on private land were not included since many include such lands support other land uses. The location of such lands is not public information.
2. **Conservation Reserves:** Crown lands such as Wildlife Sanctuaries and ecological reserves that have been dedicated to conservation purposes.
3. **Wildlife Management Areas:** These areas, though technically a conservation reserve, were treated separately since they constitute large areas in two of the focal areas.
4. **Provincial Parks:** Parks are included as conservation lands. National park lands occur only in one focal area and are a very minor portion of the entire area.
5. **Protected areas:** Protected areas were used in the Robson Valley as a form of protection developed in the land use planning process for that area and other areas in the north. They are equivalent to provincial park status in other parts of the province.

These categories were summed to provide an estimate of Conservation Lands, representing the lands in each area dedicated to conservation and fish and wildlife management.

6. **Crown land.** This category includes all federal and provincial land not in direct conservation designations as described above. The degree of securement provided by crown land varies between the three assessments made.

Focal area analysis: This analysis documents land ownership at lower elevations in each focal area, not just riparian or wetland habitats. Large areas of higher elevation non-riparian crown land are included. Logging and mining can occur on these lands. Logging activities return the landscape to early seral conditions, which are required by some wildlife species. Mining areas are reclaimed and over time will return to some level of productivity for wildlife. These lands however, can potentially be sold to private interests by BC Lands. In practise only relatively small areas are being sold. However, in this element of the analysis, there is some question as to if crown land should be considered secure.

Analysis of TRIM wetland and riparian mapping: Wetlands and riparian areas on crown land are less likely to be subject to land uses such as mining and logging. Logging does not occur in wetland habitats. Riparian habitats can be logged, subject to a 5 m setback. In general such logging contributes to early seral conditions in such habitats. If these habitats are part of lands leased for mining, the Mines Act requires that wetlands are replaced. Riparian habitats are replaced or compensated for as a matter of practise in reclamation plans. Grazing has some impact on these same habitats. However, in the case of the hundreds of pothole wetlands in the East Kootenay, establishing each of them as a WMA, to provide a higher level of securement, seems unrealistic, especially since there is very little funding available to manage the present WMAs in the province.

Floodplain habitat analysis: Lands below the high water mark, which are federal crown, are an important component of land ownership in these systems. Mining is unlikely on such lands since it would require diverting rivers or streams. It does occur on the Fording River in the Elk Valley and has occurred historically in some other areas (Salmo and Wildhorse River areas). Gravel mining occurs on some floodplains (Elk Valley, Revelstoke areas). Again, Mines Act regulations will require reclamation and/or replacement. Logging does occur; as described above. The sale of crown lands on floodplains is now rare, given concerns over flood risk and related Regional District regulations.

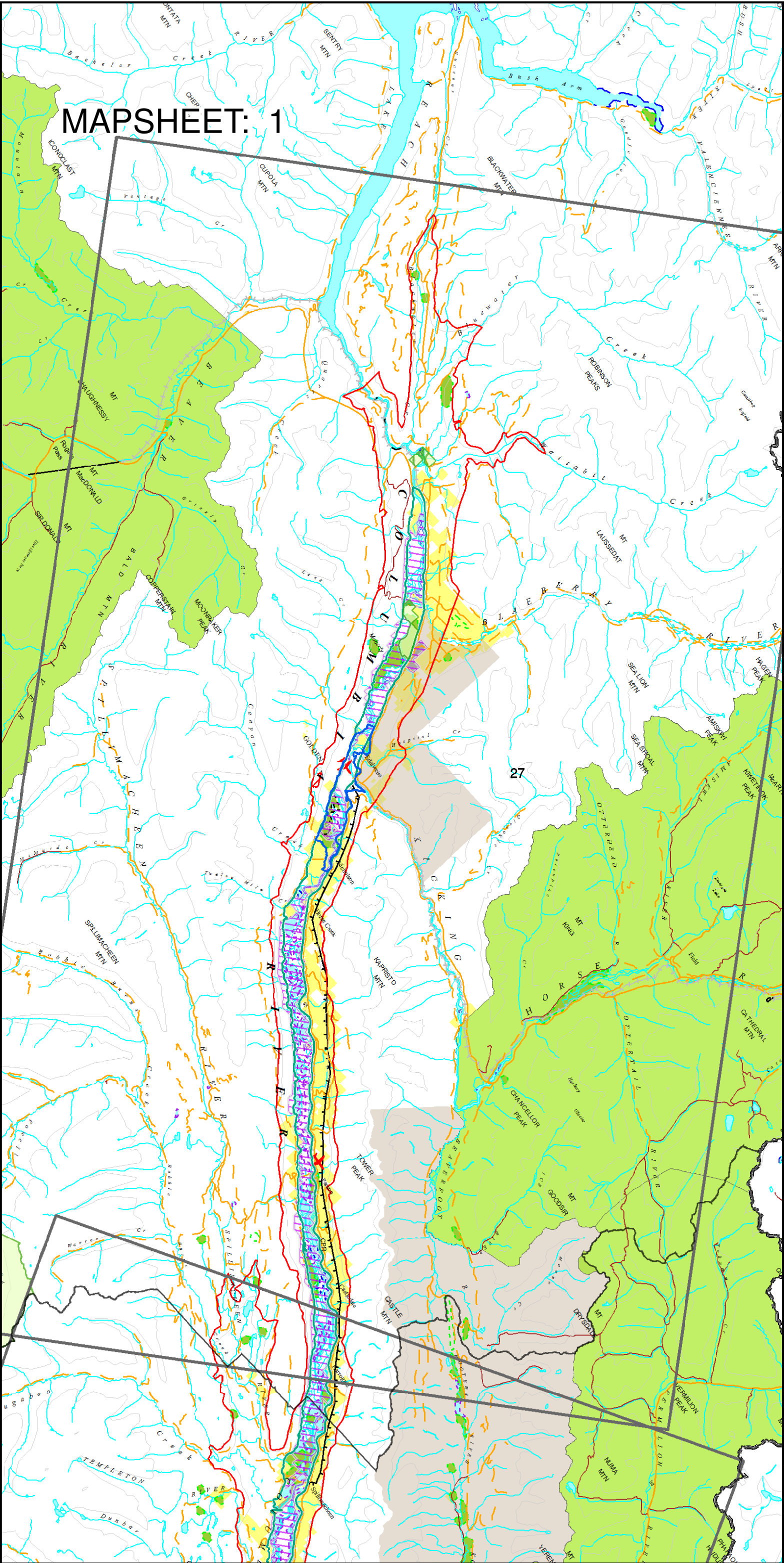
Conservation lands and crown land were considered secure for the purposes of this document, subject to the qualifications identified above. This may be a poor assumption for the focal area analyses but is a reasonable supposition for the TRIM data and floodplain analyses. The data is presented such that the securement target can be compared to both, or to conservation lands only.

7. **First Nation Reserve Lands:** This is federal crown land held in trust for individual First Nations. The major wetland areas on First Nation Reserve Lands occur in the form of natural wetlands on part of the Akisqnuk First Nation Reserve Lands and diked and managed wetlands on the Lower Kootenay First Nation Reserve Lands.
8. **Private land:** This included all land divested from the crown. Mining leases are included in this category.
9. **No ownership data (unknown ownership):** There are large areas in the areas looked at for which there is no information on ownership in the mapping databases. The category of unknown ownership is not large, but large areas are identified as ownership blank. This is the result of a systemic error in the databases that has been identified by government. For the purposes of this document no ownership and ownership blank are considered the same, although they are identified separately in the mapping data sets.

Large lakes and reservoirs occur in some of the focal areas and on the floodplain area for the Upper Columbia Valley. These were removed from the analysis. PEM and TEM did not provide useable information across all of the focal areas. The TRIM database was used as the best available mapping that covered all of the focal areas.

Appendix 2: Mapping of Ownership, All Focal Areas

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Columbia Valley Wetland and Riparian Ownership Overview

Land Ownership and Conservation

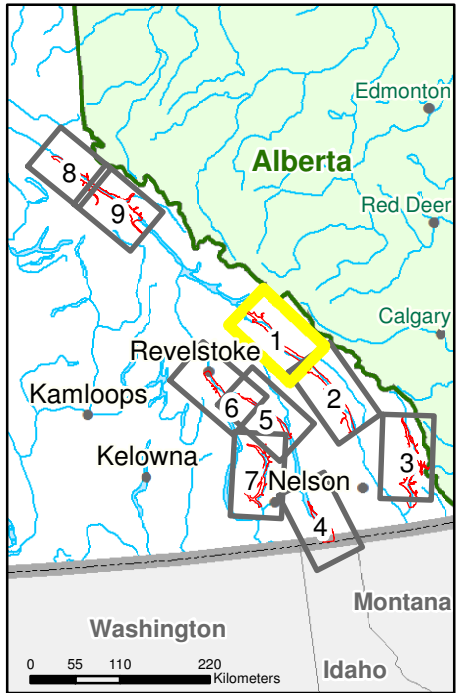
- Regional District
- Floodplains in British Columbia - Outlined
- Wetland and Riparian Focal Areas
- Provincial Parks
- Floodplain Boundary
- Wildlife Management Areas
- National Parks
- Conservation Properties - Columbia - Fee simple
- Conservation Lands
- ICIS Cadastre - Private

SCALE OF BASE
1:250,000 - Province of BC

Map Updated: 02/07/2014
Coordinate System: NAD 1983 Albers
Projection: Albers

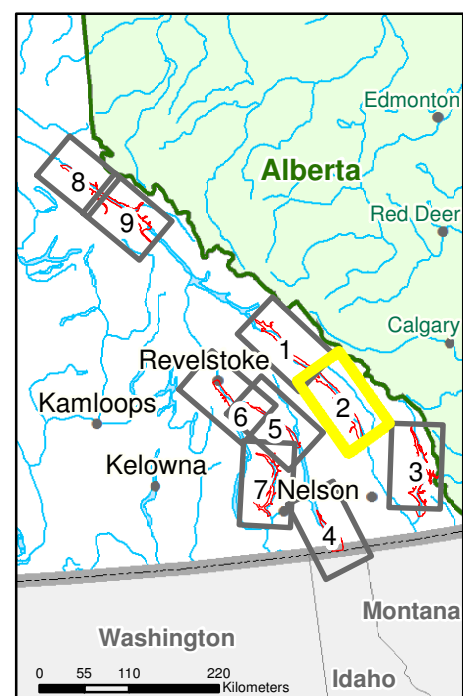
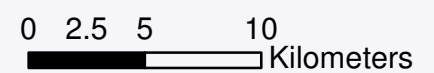
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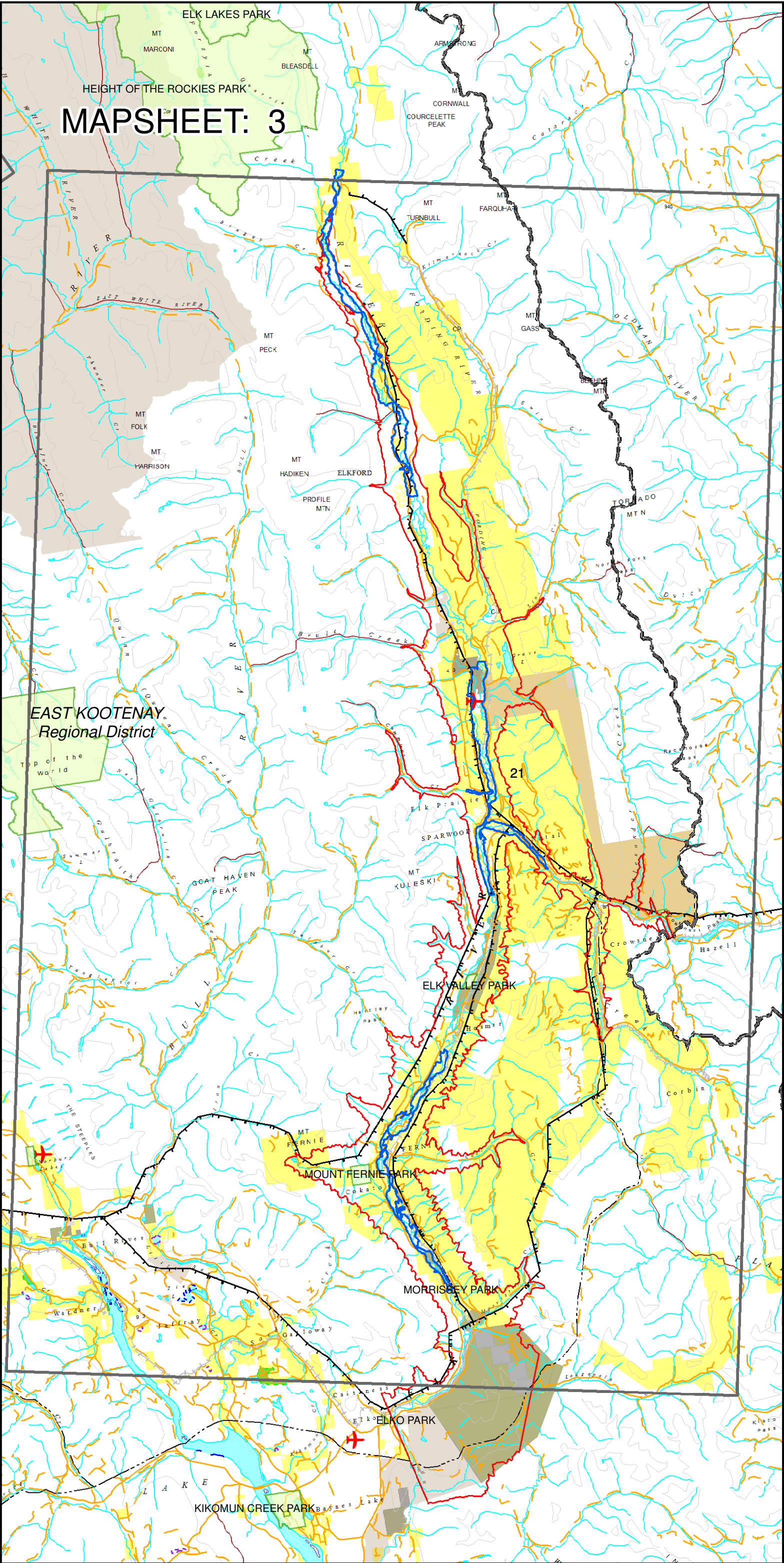
Index Map of Focal Areas



MAPSHEET: 2

The map displays the Lookout Mountain area, with the Lookout Pkwy corridor highlighted in yellow and purple. The corridor runs vertically through the center of the map. The area is characterized by numerous peaks and ridges, including Starbird Ridge, Steamboat Mountain, Lookout Mountain, and Lookout Pkwy. The map also shows various creeks and rivers, such as the Lookout River, Starbird Creek, and Steamboat Creek. The map is overlaid with a grid, and the title 'MAPSHEET: 2' is prominently displayed in the upper left corner.





Elk Valley Wetland and Riparian Ownership Overview

Land Ownership and Conservation

- Regional District
- Floodplains in British Columbia - Outlined
- Wetland and Riparian Focal Areas
- Provincial Parks
- Conservation Properties - Columbia - Fee simple
- Conservation Property - TECK
- Conservation Lands
- ICIS Cadastre - Private

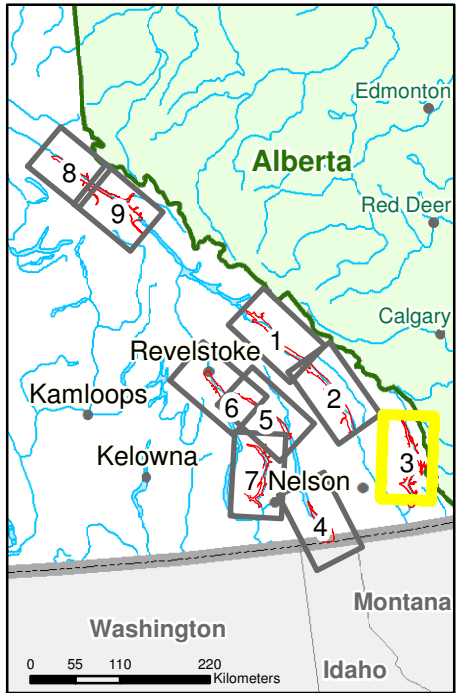
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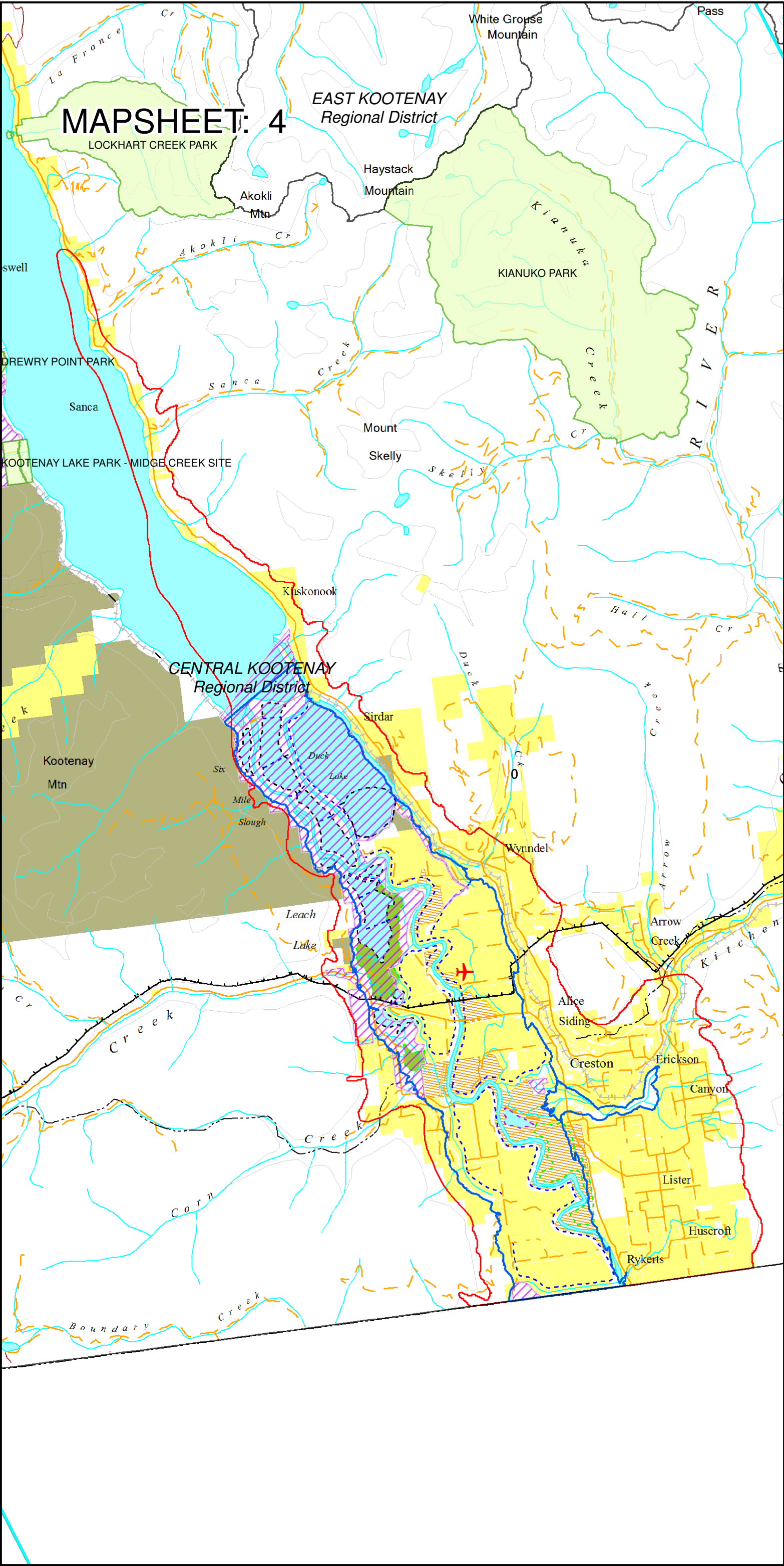
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Map Updated: 02/07/2014
Coordinate System: NAD 1983 Albers
Projection: Albers

0 2.5 5 10 Kilometers

Index Map of Focal Areas





Creston Valley Wetland and Riparian Ownership Overview

Land Ownership and Conservation

- Regional District
- Floodplains in British Columbia - Outlined
- Wetland and Riparian Focal Areas
- Provincial Parks
- Wildlife Management Areas
- Conservation Properties - Columbia - Fee simple
- ICIS Cadastre - Private
- Indian Reserves

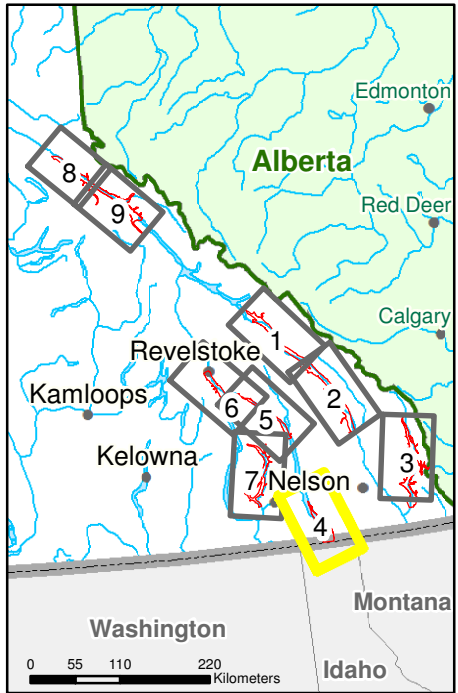
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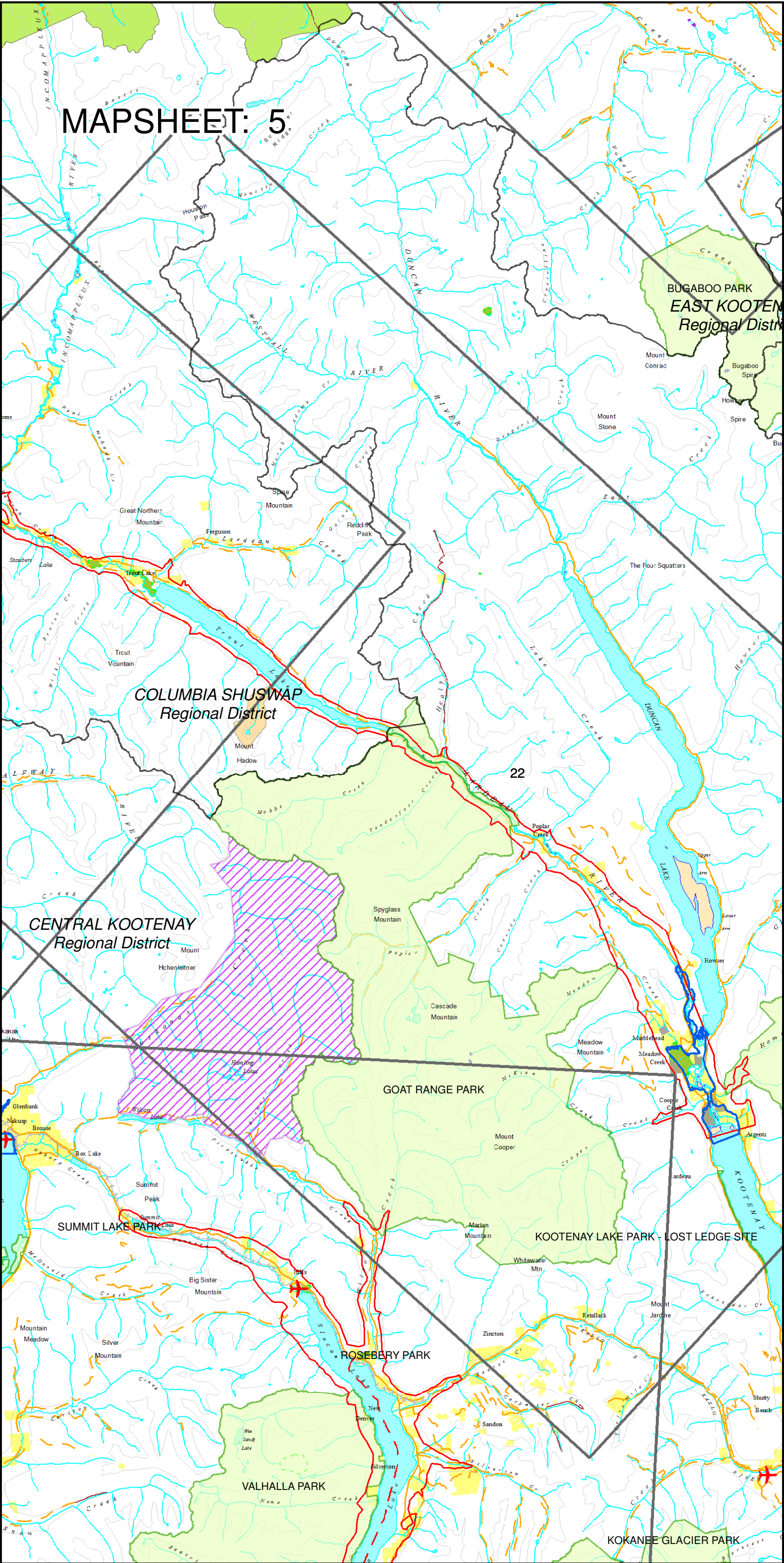
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Map Updated: 02/07/2014
Coordinate System: NAD 1983 Albers
Projection: Albers

0 1.25 2.5 5 Kilometers

Index Map of Focal Areas





Duncan - Revelstoke Wetland and Riparian Ownership Overview

Land Ownership and Conservation

- Regional District
- Floodplains in British Columbia - Outlined
- Wetland and Riparian Focal Areas
- Provincial Parks
- Wildlife Management Areas
- National Parks
- Conservation Properties - Columbia - Fee simple
- Conservation Lands
- ICIS Cadastre - Private
- Ecological Reserves

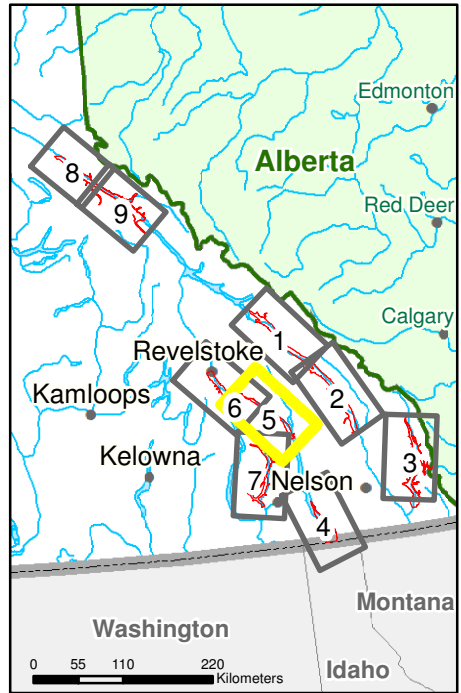
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1:250,000 - Province of BC

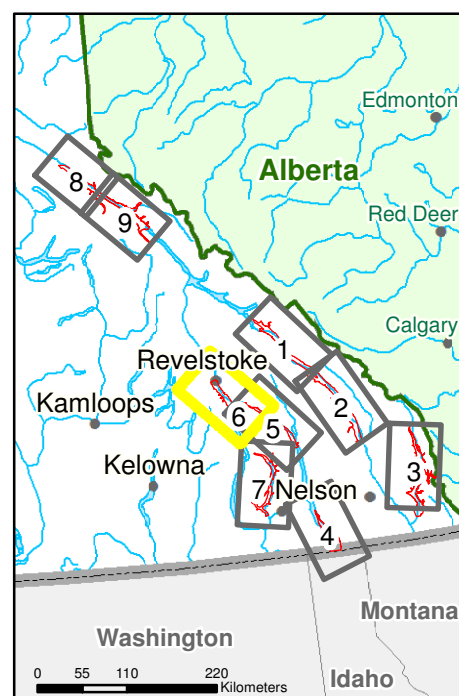
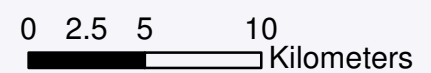
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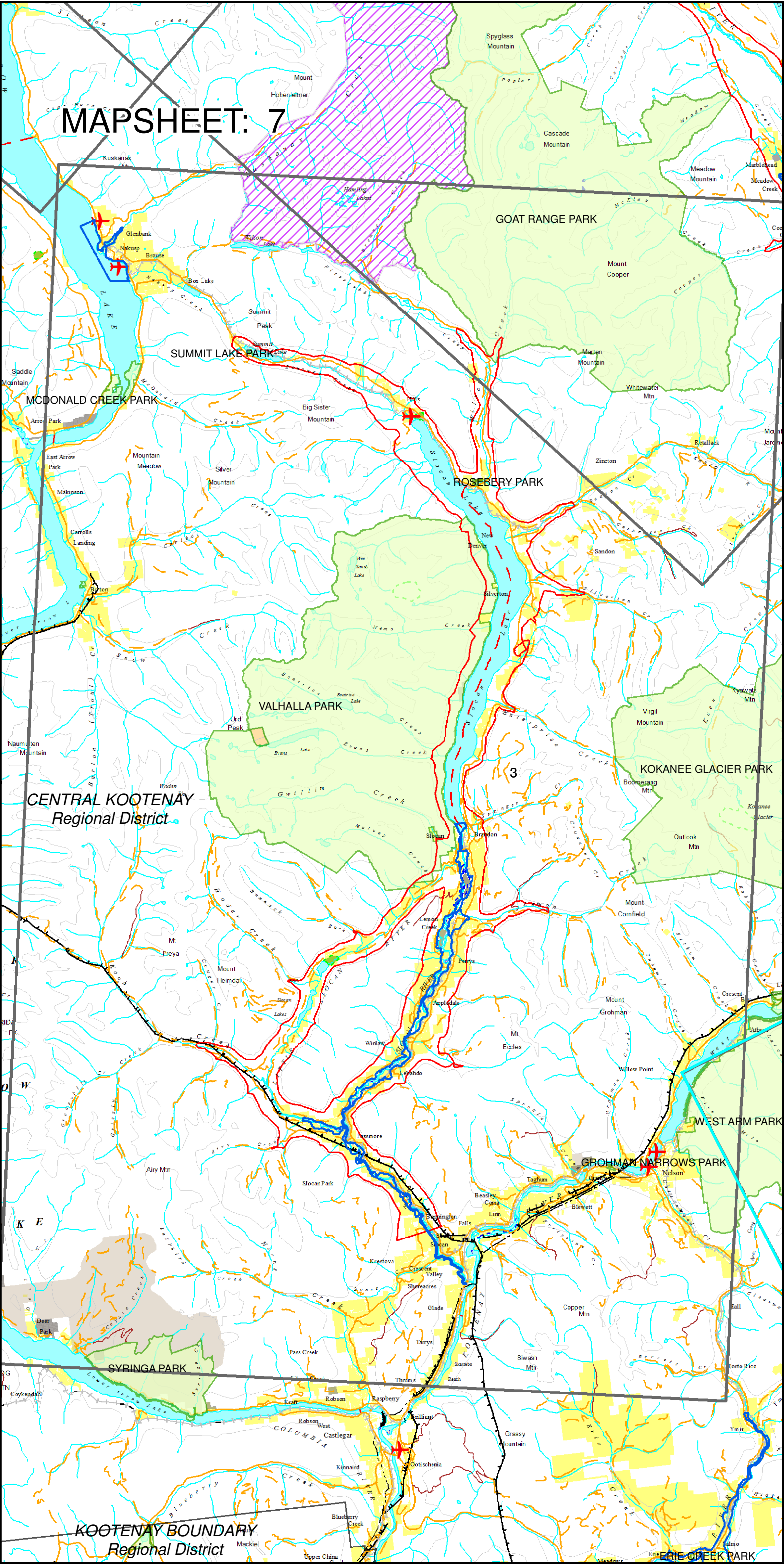
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Coordinate System: NAD 1983 Albers
Projection: Albers

0 2.5 5 10 Kilometers

Index Map of Focal Areas



[illegible]



Slocan Valley Wetland and Riparian Ownership Overview

Land Ownership and Conservation

- Regional District
- Floodplains in British Columbia - Outlined
- Wetland and Riparian Focal Areas
- Provincial Parks
- Wildlife Management Areas
- Conservation Properties - Columbia - Fee simple
- Conservation Lands
- ICIS Cadastre - Private
- Ecological Reserves

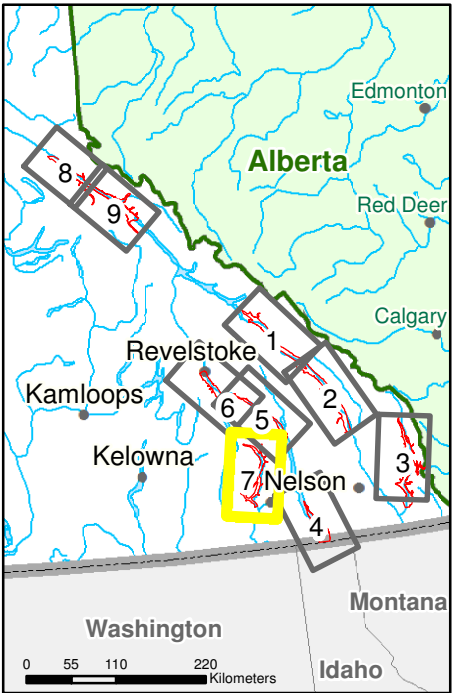
SCALE OF BASE
1:250,000 - Province of BC

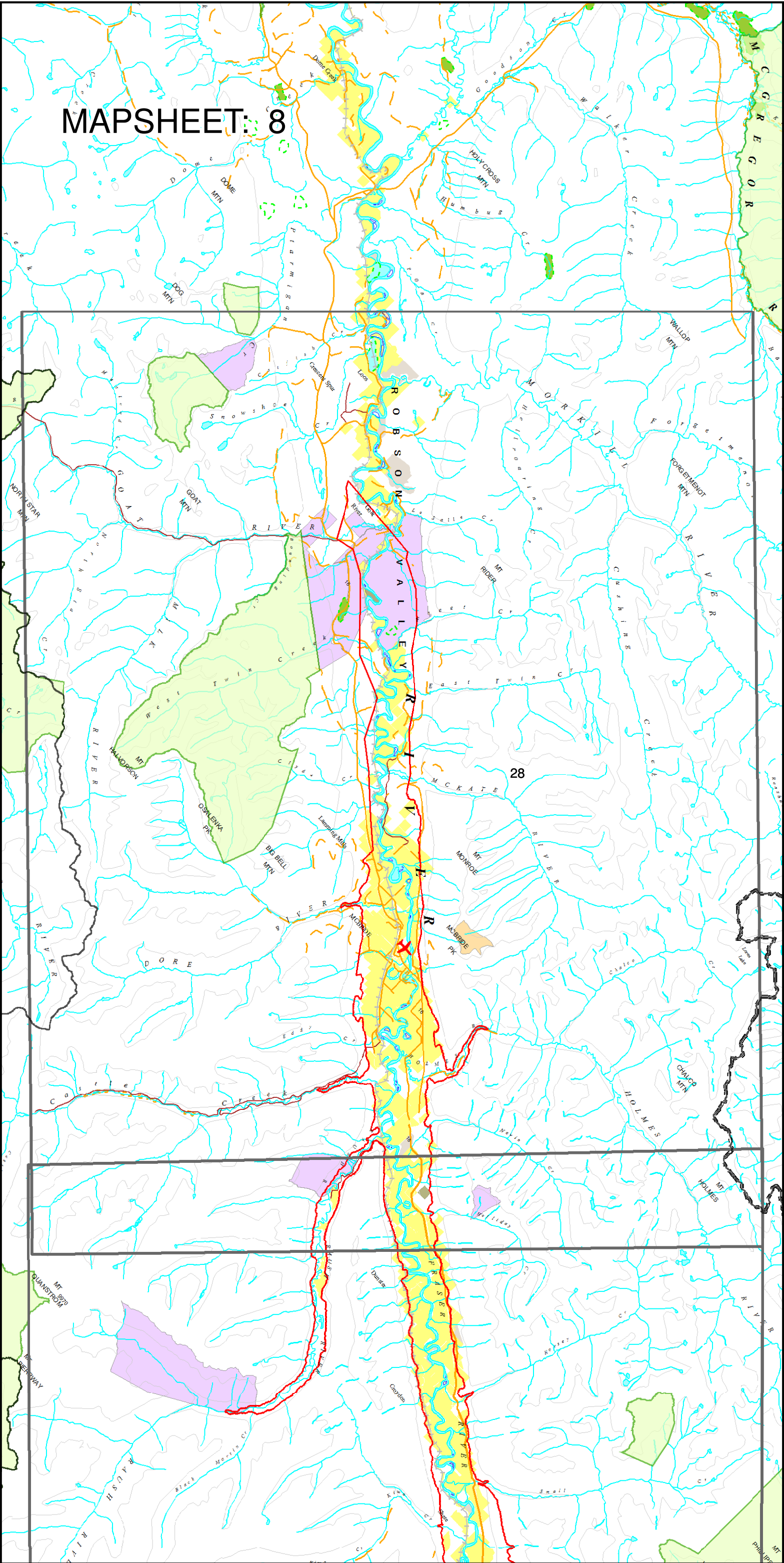
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Map Updated: 02/07/2014
Coordinate System: NAD 1983 Albers
Projection: Albers

0 2.5 5 10 Kilometers

Index Map of Focal Areas





Robson Valley Wetland and Riparian Ownership Overview

Land Ownership and Conservation

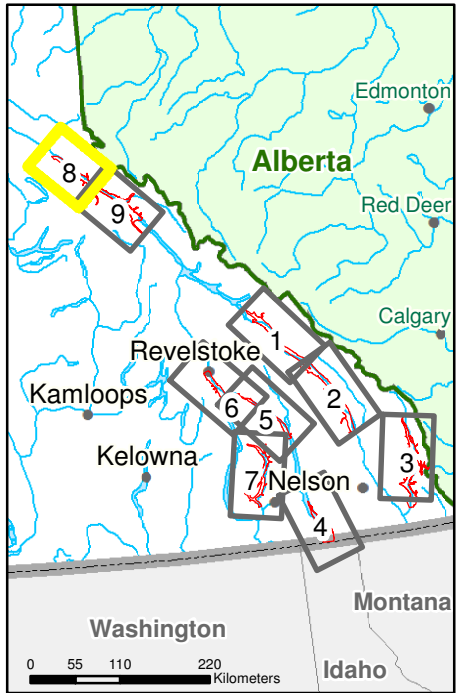
- Regional District
- Wetland and Riparian Focal Areas
- Provincial Parks
- Conservation Properties - Columbia - Fee simple
- Conservation Lands
- ICIS Cadastre - Private
- Ecological Reserves
- Protected Areas

SCALE OF BASE
1:250,000 - Province of BC

Map Updated: 02/07/2014
Coordinate System: NAD 1983 Albers
Projection: Albers

0 2.5 5 10
Kilometers

Index Map of Focal Areas



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Appendix 3: Focal Area Analysis for the Upper Columbia Valley

1. Introduction

The Upper Columbia Wetlands are one of the largest wetland systems in the province and in the Columbia Basin. It has RAMSAR status as a wetland system of international importance. Wildlife Management Area status provides protection for all of the crown land portion of the wetlands, a total of 16,969 ha.

2. Basic Ecological Processes

The productivity of the wetlands and floodplain areas in this focal area are dependent of the fundamental geological and ecological processes that have created the system and maintain its productivity. Ecological processes in wetland and floodplain riparian systems are complex, since both terrestrial and aquatic factors are at play. The basic processes driving the productivity of the systems in this focal area are described below.

Columbia River Floodplain complex: The Columbia Wetlands are a very long silt based floodplain wetland system interrupted by several gravel alluvial fans that protrude out into the floodplain at the mouth of each major tributary. The technical term for such systems is anastomosing system, which describes the way in which channels and habitats change over time in such systems. The Columbia Wetlands is one of very few such systems in the world that still operates as a natural system driven by natural hydrologic processes (Makaske 1998).

Wetlands in this system consist of three main types. Some wetlands are directly connected to the river channel and fill and drain from the river as the river rises and falls each spring. This results in an annual interchange of nutrients and sediment between the river and the connected wetlands. Other wetlands are perched slightly above the main floodplain, and flood from the river 40-60% of the years; these receive less sediment and nutrients from floodwaters. Some wetlands are perched well above the water levels of the annual floods and rarely receive sediment and nutrients. Nutrient levels and water temperature affect the productivity of the river for fish, but also have an effect in the adjacent wetlands.

There is a kokanee run of 700,000 to 1 million fish that migrate through the wetlands system (Oliver 1995). This upstream nutrient pump (provided by kokanee carcasses) contributes nutrients to the river and to the adjacent wetlands. Nutrients are also provided by natural flows off the landscape and from community sewage outflows along the river. Nutrient contributions from croplands and artificial fertilizer occur, but is likely a minor contributor since only a small portion of the watershed is cultivated. The only data on basic water quality parameters for the wetlands is from two recent reports on specific wetlands in the Columbia Wetlands (Ohanjanian and Carli 2010 and Rooney et al. 2013).

Some recent work has been completed that looks at changes in various habitat types over time in this system. Carli and Bayley (in review) found that habitats on the floodplain are changing over time. They found that the area of open water increased significantly (77%) from the 1940s to 2004, while the area of shrub/carr and vegetated marsh decreased 38.8% and 14.5% respectively.

Alluvial floodplain cottonwood stands: In the past, the alluvial fans portion of the main valley supported robust cottonwood stands that were critical songbird habitat and provided low elevation spawning sites for fish. Most of the remaining cottonwood stands in this focal area are found on these alluvial fans, in areas now dominated by agriculture or human settlement. Small, narrow stands of cottonwood occurred on the river levees of the Columbia River as a result of bare ground that provided a seed bed for cottonwood when the river was dredged in the early 1900s. These stands are now dying out and are being replaced by shrub communities.

Benchland wetlands: On the west benches of the Upper Columbia Valley there are 25+ small lakes and 200+ ponds and wetlands. They are more productive for nesting waterfowl since there is no spring freshet during the nesting season. In the area from Golden north to Aid Lake (Blackwater drainage) there is a large flat bench system. There are over 100 bogs, ponds, sedge meadows and other wetlands in this area. The focal area boundary (1052 m) includes about half of the wetlands in each of these areas. Sediment and nutrients flow into these systems are derived from their associated catchment basins, mediated by the vegetation in those basins. In the south portion (Invermere area) the basins are a mix of grassland, some human habitation and forest. In the north, the landscape is dominated by conifer forest.

Managed wetlands: There are eight projects in this focal area that provide stable water levels, with benefits to a range of wetland species. There are three projects in the Columbia Wetlands (Moberley Marsh; Reflection Lake at Golden; and Davidson Marsh at Parsons) and five projects on the west benches (Dunbar Creek Marsh; West side Km 43 marsh; Lake Enid near Invermere; Marion Creek benchlands; and Findlay Marsh, west of Canal Flats).

Mid-elevation floodplain complexes: There are several higher elevation floodplain systems in the tributary streams in this watershed; however all of these systems are outside the focal area boundary. The Grottos wetland on the Horsethief Creek is an example (1082 m/3550 ft) that is almost entirely privately owned and is of local concern. Such systems occur in almost all of the watersheds in this mountain range.

Mid-elevation riparian zones: There is a riparian zone of generally conifer forests (with shrub communities and deciduous trees in many areas) along tributaries through the focal area that are of value to wetland and riverine species.

3. Mapping of Wetland and Riparian Habitat and Ownership

Focal Area analysis: Table 1 provides data on land ownership in the Upper Columbia Valley focal area.

Table 1: Land Status in the Upper Columbia Valley Focal Area.

Conservation Lands & Crown Land	Hectares (ha)	Percent (%)
Conservation Property	5,714	4.5%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	18,026	14.3%
Provincial Park and Protected Areas	1,144	0.9%
Total Conservation Lands	24,884	19.7%
Crown Land (Federal and Provincial)	4,338	3.4%
Sub-total	29,222	23.1%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	4,349	3.4%
Private	40,142	31.8%
Sub-total	44,491	35.2%
No Ownership Data		
Blank (Ownership Uncertain) - excluding Lakes	47,491	38%
Unknown	5,042	4%
Sub-total	52,533	41.6%
Total Land Area (excluding large lakes and reservoirs)	126,246	100.0%

TRIM data analysis: Table 2 provides data on land ownership for the TRIM mapping for swamp and marsh the Upper Columbia focal area.

Table 2: The area of swamp and marsh TRIM categories for the Upper Columbia focal area.

Focal Area - Swamp and Marsh (Trim)	Hectares (ha)	Percent (%)
Conservation Properties and Reserves*	761	8.3%
Wildlife Management Area	4,180	45.7%
Provincial Park and Protected Areas	248	2.7%
Total Conservation Lands	5,189	56.7%
Crown Land (Federal and Provincial)	84	0.9%
Sub-total	5,273	57.7%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	335	3.7%
Private	1,887	20.6%
Sub-total	2,222	24.3%
No Ownership Data		
Blank (Lakes Removed)	1,549	16.9%
Unknown	102	1.1%
Sub-total	1,651	18.1%
Total Land Area (without large lakes and reservoirs)	9,146	100.0%

(* Conservation properties and reserves were summed for this analysis due to the complexity of ownerships in this area (National Parks, National Wildlife Areas, etc.).

Floodplain area analysis: Prior work, completed in the 1980s (Pedology Consultants et al. 1983) provides an analysis of habitat types, based on air photo interpretation. This work also provides a boundary for the Upper Columbia Wetlands floodplain. The study area boundary for that work was used in this project, with the land ownership layers to document ownership in the floodplain portion of the focal area, as indicated in Table 3. Most of the private land in the floodplain portion of the focal area is located on the alluvial fan portions of the floodplain.

Table 3: Land Status on the Upper Columbia River floodplain.

Floodplain Area - Land Status	Hectares (ha)	Percent (%)
Conservation Property	1267	5.6%
Conservation Property Within a Wma	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	13596	60.1%
Provincial Park and Protected Areas	425	1.9%
Total Conservation Lands	15288	67.6%
Crown Land (Federal and Provincial)	215	1.0%
Sub-total	15503	68.6%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	476	2.1%
Total Private	4316	19.1%
Sub-total	4792	21.2%
No Ownership Data		
Blank (Ownership Uncertain)-Without Lakes	1781	7.9%
Unknown	530	2.3%
Sub-total	2311	10.2%
Total Land Area (without large lakes and reservoirs)	22606	100.0%

4. Background Information

Recreational Use

The Columbia Wetlands are very important to several recreational interests, including fishing and hunting interests, boating interests and naturalists.

Stewardship Examples

The Columbia Wetlands Stewardship Partners is a group focused on floodplain and wetland systems stewardship in this valley. The Windermere Lake Ambassadors deals with shoreline management issues on Windermere Lake. A similar group is evolving for Columbia Lake. Wildsight, a local environmental group has played a long term role in advocating for the Columbia Wetlands and maintaining public interest in the area.

Public Education Examples

Friends of the Columbia Wetlands have established kiosks describing the wetlands at several locations along the Columbia Wetlands. The Columbia Wetlands Stewardship Partners website provides an overview of the natural history of the Columbia Wetlands.

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There are a variety of other reports implemented or collected by the Columbia Wetlands Stewardship Partners that are also available.

Mapping Data Resources

Predictive Ecosystem Mapping (PEM) mapping is available for the entire focal area. Parts of the focal area were mapped using Terrestrial Ecosystem Mapping (TEM). Carli and Bayley 2010 mapped eight landforms in approximately 3,000 ha of the Columbia Wetlands in 40 different areas. Machmer et al. 2001 did detailed wetland mapping based on air photo interpretation in three small areas in this focal area, including wetland mapping. Bayley et al. 2004 provides mapping of wetlands based on federal wetland data sets. Both reports cover the entire focal area. Shoreline Habitat Inventory Mapping (SHIM) is available for Windermere and Columbia Lakes (McPherson and Hlushak 2008).

Appendix 4: Focal Area Analysis for the Elk Valley

1. Introduction

The Elk River and its floodplain are very important amenities for the communities in the Elk Valley. The basic processes driving the productivity of each of these types are described below.

2. Basic Ecological Processes

Elk River floodplain complex: The Elk Valley floodplain is a gravel based system (versus the silt based system in the Columbia Wetlands). The river is braided in many areas and much of the floodplain is dominated by cottonwood stands. Groundwater flows plays a major role in such systems. Rivers represent only the surface water flows in such gravel systems. Water is flowing underground across the floodplain, bringing moisture, oxygen and nutrients to the plant communities, side channels and wetlands on the floodplain. The productivity of fish and wildlife populations on floodplains is directly connected to river conditions and nutrient levels.

Spawning areas in such systems are often associated with sites where groundwater flows into side channels, providing oxygenated water that provides near perfect conditions for spawning and hatching. Cottonwood stands develop in such systems through a process that is tied to the annual hydrograph. Deciduous trees in general and cottonwood stands in particular provide a range of values for wildlife species (Jamieson et al. 2001a). Where these sites are at low elevation, they provide critical stopover sites for migrating birds, since insects and forage are available in such sites when many other areas have been hit by frost and are less productive. Until recent decades there was very little understanding of how floodplain systems operate. The Flathead Lake Biological Station and others have carried out extensive research on how gravel based floodplain systems operate, based on work on the Flathead River in Montana (www.flbs.mt.edu). The processes that drive cottonwood recruitment in such systems have been the subject of extensive work in the Columbia Basin (Jamieson and Braatne 2001, others), and on many nearby rivers in the US and Canada.

Floodplain Wetlands: Wetland values develop in gravel based systems along secondary channels and in oxbows. Beaver play a major role maintaining these systems by slowing down flows and creating still water habitats. The productivity of the wetlands in the side channels of the Elk River is dependent on beaver dams in these channels, which increase water depth and water temperature. The old channel complex just downstream of the Elk Valley Provincial Park has multiple dams that maintain still water habitats there. These dams create wetland habitats, but limit options for use of the side channels as rearing habitat for fish. Nutrient flows in these side channels are directly connected to nutrient levels in the river, since these side channel wetlands are fed by groundwater flows from the river. The Elk River is relatively nutrient rich as a result of high natural phosphorus levels from the base rock in this watershed (Butrenchuk 1987), and nitrogen levels contributed by mine, agriculture and community effluents. There are several studies by TECK and others (Hauer and Sexton 2013) related to the selenium issue that document this high nutrient status. These relatively high nutrient levels support the fishery in the Elk River but may also translate, though groundwater flows, into increased nutrient levels in the side channel wetlands. Metals, including selenium, may also be moving into these floodplain systems. This process is of concern because lentic areas (still water areas) have a greater potential to convert inorganic selenium to its organic form (Simmons and Wallschläger 2005). The organic form has been identified as a concern for animals because it readily enters the food chain via uptake into plants and invertebrates and then works its way up through to predators, thus exposing upper trophic level wildlife such as fish-eating birds to selenium (Schlekat et al. 2004). Bioaccumulation of selenium has been documented in burbot in the Koocanusa Reservoir, but there is little data on uptake in other fish species or wildlife. Chapman et al. 2005 reviewed the available data regarding selenium impacts on two fish, one amphibian, three songbird and eight waterfowl species and concluded that there were no indications of impacts in either lotic or lentic habitats. However, Chapman et al. (2005) acknowledged that the two cutthroat trout effects studies resulted in some contradictory findings. A recent study by Orr et al. 2012 confirmed greater accumulation of selenium in lentic areas, largely because of greater uptake at the base of the food chain compared to lotic areas. The cumulative effects of the combination of water quality concerns (notably selenium, elevated nutrients, other trace metals, and sulphate) plus interactions between water quality and habitat alterations are the subject of a cumulative effects initiative called the Elk Valley Cumulative Effects Management Framework. This initiative is a multi-stakeholder program involving a range of interests and agencies (Stella Swanson, pers. comm.).

Bench wetlands: On the adjacent benches in this valley there is one lake, one pond and two small wetlands in the Grave Lake area.

Mid elevation floodplain systems: Oxbow and side channel habitats occur on the floodplain of the Elk River upstream of Elkford, within the focal area, but at slightly higher elevation. Large silt based sedge meadow and bog systems also occur near the source of the Elk River in Cadorna Creek and just below the Elk Lakes. In the Fording River system there is a lower floodplain that is included in the focal area, then a canyon reach, and then an extensive higher elevation floodplain system, including several oxbows and side channels, just below the mine. The upper half of this system has been lost to mining infrastructure related to the Fording River mine.

Mid elevation riparian zones: Most of the tributaries in this area are in incised valleys and are generally steep. Most were seriously impacted by the 2013 flood event. Michel Creek contains two major transportation corridors that have effectively diked the river in many areas, limiting the ability of the creek and floodplain to handle major flood events. As a result there is damage to Highway 3 and/or the railway bed during most major flood events.

3. Mapping of Wetland and Riparian Habitat and Ownership

Focal Area analysis: Table 1 provides data on land ownership in the Elk Valley focal area.

Table 1: Land ownership in the Elk River focal area.

Focal Area - Land Status	Hectares (ha)	Percent (%)
Conservation Property	26,480	41.8%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	0	0.0%
Provincial Park and Protected Areas	0	0.0%
Total Conservation Lands	26,480	41.8%
Crown Land (Federal and Provincial)	7,239	11.4%
Sub-total	33,719	53.3%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	0	0.0%
Private	24,972	39.5%
Sub-total	24,972	39.5%
No Ownership Data		
Blank (Ownership Uncertain)-Without Lakes	4,607	7.3%
Unknown	2	0%
Sub-total	4,609	7.3%
Total Land Area (without large lakes and reservoirs)	63,300	100.0%

The only bench wetlands in this focal area are located in the Grave Lake area.

TRIM data analysis: Table 2 provides data on land ownership for the swamp and marsh categories in the TRIM database, in the Elk Valley focal area.

Table 2: The area of swamp and marsh TRIM categories for the Elk Valley focal area.

Focal Area - Swamp And Marsh (Trim)	Hectares (ha)	Percent (%)
Conservation Property	79	31.7%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	0	0.0%
Provincial Park and Protected Areas	0	0.0%
Total Conservation Lands	79	31.7%
Crown Land (Federal and Provincial)	15	6.0%
Sub-total	94	37.8%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	0	0.0%
Private	109	43.8%
Sub-total	109	43.8%
No Ownership Data		
Blank (Lakes Removed)	46	18.5%
Unknown	0	0.0%
Sub-total	46	18.5%
Total Land Area (without large lakes and reservoirs)	249	100.0%

Floodplain area analysis: Three portions of the Elk River floodplain are mapped for floodplain risk; however, they do not include the Hosmer strip where the Nature Conservancy of Canada (NCC) has recently made major acquisitions. Jamieson et al. 1997 looked at enhancement and securement options on the floodplain from Elko to Elkford. This work covered all of the floodplain except for a portion above Elkford. That work identified both habitat types and ownership. In 1997 most of this floodplain area was private land, made up of small holdings north of the river and the large unit holding that belonged to TEMBEC, a forest company, on the south side of the river. In 2004 the NCC acquired 1,110 ha of land on the floodplain between Elko and Sparwood in an agreement with TEMBEC. These lands, plus provincial park lands and crown land on the floodplain now total 2669 ha (Table 3). This represents 22.2% of the entire floodplain. However, riparian, river, and other habitats were assessed in this work. In 2014, 77.1% of the remaining river, bar, riparian and wetlands habitat on this floodplain is now secured. With the other conservation lands at the Big Ranch, (484 ha, a portion of which is on the floodplain), the area secured on this floodplain approaches the securement target of 80%. The floodplain above Elkford is about one-third private.

Table 3: Land ownership on the lower Elk River floodplain, Elko to Elkford (From Jamieson et al. 1997).

Floodplain Area - Land Status	Hectares (ha)	Percent (%)
Conservation Property	1,099	22.2%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	0	0.0%
Provincial Park and Protected Areas	0	0.0%
Total Conservation Lands	1,099	22.2%
Crown Land (Federal and Provincial)	1,570	31.8%
Sub-total	2,669	54.0%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	0	0.0%
Total Private	2,271	46.0%
Sub-total	2,271	46.0%
No Ownership Data		
Blank (Ownership Uncertain)-Without Lakes	0	0.0%
Unknown	0	0.0%
Sub-total	0	0.0%
Total Land Area (without large lakes and reservoirs)	4,940	100.0%

4. Background Information

Recreational Use

The Elk River and its floodplain are very important to several recreational interests, including fishing and hunting interests, boating interests and naturalists. Guided fishing is an important local business sector.

Stewardship Examples

There is a local watershed stewardship group called the Elk River Watershed Alliance that has been in existence since 2010.

Public Education Examples

Wildsight has developed a conservation education program in this valley and wetland and riparian ecology is a part of that program.

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Mapping Data Resources

Predictive Ecosystem Mapping (PEM) mapping is available for the entire focal area. One area downstream of Fernie has been mapped using Terrestrial Ecosystem Mapping (TEM). There is also TEM mapping for all of the NCC lands in the valley (NCC 2010). Machmer et al. 2004 and Bayley et al. 2004 provide additional mapping of wetlands. Cottonwood and other deciduous species were mapped for this area as part of a regional mapping project (Jamieson et al. 2001). Jamieson et al.1997 looked at enhancement and securement options for the area from Elko to Elkford. Polzin et al. 2008 completed LIDAR based mapping

for a corridor along the Elk River and some of its tributaries. Improved Predictive Ecosystem Mapping for this area is anticipated to be available in late. This includes mapping the lower valleys, parks and private land. This PEM will cover the entire Elk Valley focal area and may be used for identifying and broadly classifying wetland and riparian habitat. The in-house wetland analysis was based on TRIM features, which may under-represent wetlands and only distinguishes if wetlands are treed or non-treed.

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Appendix 5: Focal Area Analysis for the Creston Valley

1. Introduction

The conservation lands in this valley constitute one of largest wetland systems in the province and in the Columbia Basin.

2. Basic Ecological Processes

Pre-settlement the Creston Flats were part of a massive floodplain system that stretched from Bonner's Ferry, Idaho, to Kootenay Lake in BC. Much of it flooded each spring. It was a very large silt based floodplain wetland system. Today the Kootenay River is diked for most of its length and the majority of the floodplain is now farmland.

Diked Wetlands: There are several diked wetlands units in the CVWMA and four units in the Yaqa Nuki wetlands portion. Pumps are used to draw water in and out of the Duck Lake unit. A pump on the lower Goat River provides water, via ditches, to the various units in the Yaqa Nuki wetlands. All the other units on the CVWMA are supplied by flows from Summit, Corn and Boundary creeks. Control valves on the river allow for managers to maintain levels in most situations.

During major flood events when there can be a major difference in the levels in the river versus the wetlands, water is allowed to flow from the Kootenay River into the wetlands to reduce hydrostatic pressure on the dikes. Diked wetlands with stable water levels are assumed to be much more productive for both waterfowl and other species. This is supported by Wilson et al. 2004, which documents the major increases in biodiversity in the CVWMA over the six decades of its existence. The assumption is that the inherent productivity has increased with warmer water temperatures and stable water levels. However, there is little data (nitrogen and phosphorous levels, chlorophyll production, micro and macro-invertebrates) collected in this valley to support this supposition. The best available data for this focal area includes data on nitrogen, phosphorous, chlorophyll a and macro-invertebrates collected in four areas for three years for stream fed wetland systems along the west side of the valley on the US side (Geoengineers, 2006, 2007).

The only data available on the Canadian side is from the Northern Leopard Frog habitat assessment completed by Ohanjanian and Carli 2010. This work provides water quality parameters (pH, conductivity, nutrient levels, but no invertebrate data) for two ponds used by Northern Leopard Frogs in the CVWMA. Nutrient cycling, carbon storage and cycling and sediment deposition are all fundamentally different from the processes in the riverine wetland systems they have replaced. In general it has been assumed that more emergent vegetation and stable water levels equate with greater diversity and higher productivity for wildlife in general, although that idea has generally been disproved in much of wetland research in the US, especially in the silt based Mississippi River floodplain wetlands.

There are some data available comparing diked versus natural wetlands in the Mississippi delta and Virginia (Atkinson 2010). Work on diked wetland projects and natural wetlands on the Great Plains are available, but wetland systems in that area have fundamentally different soils and more continental climate conditions. Nutrient and sediment flows into the CVWMA diked wetlands now come from the watersheds on the west side of the valley, including Summit, Corn and Boundary creeks, groundwater flows from the Kootenay River, and occasional direct flows through the wetland control structures during high water events. Nutrient sources for the wetlands on the east side of the valley are from the watersheds of the Goat River and Duck Creek, flows off agriculture lands, and effluent flows from the sewage treatment facility for Creston. There are several cattle operations in the Creston area and commercial fertilizer is used for many crops. There are no mines and few industrial sources in this valley. **Floodplain wetland systems:** The lower portion of the Goat River fan, (where old channels provide wetland habitat) and some portions of the lower Kootenay River delta (lower six mile, west side and lake shoreline) are outside of the diking system and are flooded during spring freshet, during major storm events and during high water periods in Kootenay Lake.

Floodplain cottonwood systems: There are large cottonwood stands on portions of the floodplain and the alluvial fans of Summit Creek and the Goat River. There are mature stands of cottonwood below Highway 16, with some recruitment in the old channels in that area. There is recruitment occurring on the islands and point bars above Highway 16 for 5-6 km upstream on the braided portion of the Goat River. The low portion of the Goat River fan is grazed. This area is mostly grassland with little cottonwood recruitment. Cottonwood and willow species have expanded into areas that were formerly sedge meadow systems north of Summit Creek (M. Beaucher, pers. comm.). One stand covers approximately three hectares and appears to

be 20 to 40 years old. A project to restore riparian vegetation along the lower two kms of the Goat River is underway (Masse Environmental Consulting Ltd. 2013).

Cottonwood dominated systems along the dikes and levees of the Kootenay River: Mature stands of cottonwood, decadent in some areas, occur as a narrow fringe along the dikes from the US boundary to Kootenay Lake. There is minimal recruitment due to a dense shrub layer in some areas, but with some younger plants recruiting by suckering from adjacent old stands. Summer cattle grazing in some areas and winter browsing by elk in other areas is having an impact on some of these younger plants (M. Beaucher, pers. comm.). There has been recruitment in three age classes on the levees on the delta where the Kootenay River flows into the lake (Jamieson and Braatne 2001). These stands have established over the last 50 to 75 years along the point extending out into the lake from the east channel. Some of these recruitment age classes have occurred since Libby Dam was constructed.

3. Mapping of Wetland and Riparian Habitat and Ownership

Focal Area analysis: Table 1 provides data on land ownership in the Creston Valley focal area.

Table 1: Land ownership in the Creston Valley focal area.

Focal Area - Land Status	Hectares (ha)	Percent (%)
Conservation Property	584	1.5%
Conservation Property Within a WMA	2	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	6,839	182.3%
Provincial Park and Protected Areas	0	0.0%
Total Conservation Lands	7,425	19.0%
Crown Land (Federal and Provincial)	1,845	4.7%
Sub-total	9,270	23.8%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	2,436	6.2%
Private	18,731	48.0%
Sub-total	21,167	54.3%
No Ownership Data		
Blank (Ownership Uncertain)-Without Lakes	8,557	21.9%
Unknown	0	0.0%
Sub-total	8,557	21.9%
Total Land Area (without large lakes and reservoirs)	38,994	100.0%

TRIM data analysis: Table 2 provides data on land ownership in the Creston Valley focal area.

Table 2. The area of swamp and marsh TRIM categories for the Creston Valley focal area.

Focal Area - Swamp and Marsh (Trim)	Hectares (ha)	Percent (%)
Conservation Property	5	0.2%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	2,269	86.4%
Provincial Park and Protected Areas	0	0.0%
Total Conservation Lands	2,274	86.6%
Crown Land (Federal and Provincial)	16	0.6%
Sub-total	2,290	87.2%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	300	11.4%
Private	19	0.7%
Sub-total	319	12.1%
No Ownership Data		
Blank (Lakes Removed)	18	0.7%
Unknown	0	0.0%
Sub-total	18	0.7%
Total Land Area (without large lakes and reservoirs)	2,627	100.0%

Floodplain analysis: Flood risk mapping is available for the entire floodplain. This boundary was used to develop a more detailed assessment of land ownership for the floodplain portion of the focal area (Table 3). There is detailed habitat mapping for the CVWMA (Wilson et al. 2004) but not for the wetlands on the Yaqa Nukiy (also known as Lower Kootenay Band) lands.

Table 3: Land ownership on the Creston Valley floodplain.

Floodplain Area - Land Status	Hectares (ha)	Percent (%)
Conservation Property	156	0.9%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	5,975	34.9%
Provincial Park and Protected Areas	0	0.0%
Total Conservation Lands	6,131	35.8%
Crown Land (Federal and Provincial)	257	1.5%
Sub-total	6,388	37.3%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	2,298	13.4%
Total Private	7,267	42.4%
Sub-total	9,565	55.8%
No Ownership Data		
Blank (Ownership Uncertain)-Without Lakes	1,179	6.9%
Unknown	0	0.0%
Sub-total	1,179	6.9%
Total Land Area (without large lakes and reservoirs)	17,132	100.0%

Land use changes on this floodplain have been massive in the past but now seem to be stabilized, with a clear division between farmland and wetlands. Ownership and land use are very clearly defined on this floodplain. The floodplain is either intensively farmed lands, or conservation lands dominated by wetlands and riparian cottonwood systems. There is also an area called the West Farm that is owned by the CWS (adjacent to the Kootenay River near Duck Lake) that is leased out to a local farmer. Finally, there is a recent NCC land securement project on Duck Creek, a portion of which is on the floodplain.

The Canadian portion is about ½ of the entire floodplain, from Bonner's Ferry to Kootenay Lake. US Fish and Wildlife Service 2011 provides an overview of conservation lands in the entire system that includes all the different ownerships involved on both sides of the Canada/US border. This work suggests a total of 11,774 ha/25,838 ac are in conservation status on both sides of the border, of which 5720 ha/12,585 ac are wetlands. Of this, the largest unit is the CVWMA. There are 13 different conservation properties on the US side. The former floodplain covered some 34,000 ha/75,000 ac. Conservation lands now constitute about (34.4%) of this area.

4. Background Information

Recreational Use

The wetlands and riparian areas in this valley are very important to several recreational interests, including fishing and hunting, boating and naturalists.

Stewardship Examples

These wetlands provide important economic, social and environmental benefits for the local community of Creston. There is a small stewardship group, the Yaqan Nuki Wetlands Friendship Society that is providing maintenance for the diked wetlands on the Yaqan Nuki (also known as Lower Kootenay Band) lands. There is another group called the Goat River Landowners Association that has been involved in flood control and fisheries habitat projects on the Lower Goat River. At present there is minimal public involvement in the management of the CVWMA, despite various attempts to create a stewardship group for the CVWMA in the past.

Public Education Examples

The CVWMA has the only major wetland education facility in the Canadian portion of the Basin.

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Mapping Data Resources

Predictive Ecosystem Mapping (PEM) mapping is available for the entire focal area (Kootenay Lake Project). Machmer et al. 2004 provides additional mapping of wetlands. Cottonwood and other deciduous species were mapped for this area as part of a regional mapping project (Jamieson et al. 2001). Improved Predictive Ecosystem Mapping for the Kootenay Lake Forest District, which includes Creston Valley, is anticipated to be available in late 2014.

Appendix 6: Focal Area Analysis for the Duncan/Lardeau and Revelstoke Valleys

1. Introduction

The Duncan/Lardeau and Revelstoke focal area includes wetland areas at the top of the Lardeau watershed as well as wetland and riparian portions of the upper Arrow Lakes Reservoir.

2. Basic Ecological Processes

Riparian floodplain complex: The lower Lardeau Valley floodplain is a silt and cobble based river delta system. Cooper and Hamill creeks enter the Duncan River floodplain at the community of Cooper Creek and create a hydraulic dam effect that splits the floodplain into two systems. Meadow Creek enters the upper portion of the floodplain and has developed a large floodplain of its own. Much of the lower floodplain is dominated by cottonwood stands. The hydrograph in this system is made up of seasonal, natural flows from the Lardeau River and controlled flows from the Duncan River. The average peak month discharge (June) for the Lardeau River is $215\text{ m}^3/\text{s}$, for the Duncan pre-dam was $470\text{ m}^3/\text{s}$. Post-dam it is $250\text{ m}^3/\text{s}$ in August (excluding peak month flows that occur during the winter months). The impact of these altered flows is being investigated by the Water Use Planning Process and associated studies over a 10 year period (2009 to approximately 2019). Annual reports (DDMMON#8-1, for 2010, 2011, 2013) are available [online](#).

Groundwater flow plays a major role in such systems. Water is flowing underground across the floodplain, bringing moisture, oxygen and nutrients to the plant communities on the floodplain. The Lardeau River is relatively nutrient and sediment poor as are the flows from the Duncan Reservoir. Pre-dam, there were large lakes in both systems that removed both sediment and nutrients from the system. This effect is relatively minor in the Lardeau River system since several tributaries enter that system below Trout Lake. Spawning kokanee provide an upstream nutrient pump that contributes nitrogen, phosphorous and carbon to the Lardeau River system. Nutrient flows in the lower floodplain are directly connected to nutrient levels in the Lardeau River, since these wetlands and side channels are fed by groundwater flows from the river.

Overall habitat mapping has been completed for the most of the lower floodplain, as documented by Krebs et al. 2012. Work on going since 2009 (Polzin and Rood 2013) is identifying cottonwood and other woody species recruitment along the river. Air photo analyses from flights flown in 2009 and 2012 provide data on the age structure of forest stands, and mapping of riparian species including old age cottonwood, spruce and cedar stands. Additional flights in 2015 and 2018 will document future changes that occur in the riparian plant community.

The floodplain of the Columbia River at Revelstoke is confined by dikes in most areas. There is some development of riparian vegetation below the dikes. Again, the hydrology is complicated by regulated water levels in the Arrow Lakes Reservoir.

Floodplain wetland systems: An old side channel on the east side of the Duncan/Lardeau delta has developed into a marsh system. Beaver play a role in maintaining this system. There is also an old side channel on the west side of the delta and ponds on the shoreline islands that are used by waterfowl. The lower portion of Meadow Creek, originally a floodplain system, has been developed for agriculture. Meadow Creek is channelized from the hamlet of Meadow Creek along Highway 31 for one km.

At Revelstoke, there is some development of wetlands below the dikes along the Columbia and Illecillewaet rivers. The wetlands below high pool (440 m) in the Arrow Lakes Reservoir were not included in this analysis.

Conifer dominated floodplain on the Lardeau River: Upstream of the lower floodplain the Lardeau River has a narrow floodplain that supports primarily conifer stands (ICHmw2 and ICHwk1). This portion of the system is critical to maintaining the Gerrard rainbow fishery. It is a cobble/gravel based system; some oxbow and side channel habitats occur.

Mid elevation floodplains: A series of mid-elevation (830 m/2500 ft) floodplain wetland systems occur from the upper end of Trout Lake to Armstrong Lake in the Arrow Lakes Reservoir watershed. This wetland complex is a combination of shrub carr, bog and fen complexes that occur above Trout Lake and extend for 4.2 km along Trout/Wilkie Creek to the summit of the Lardeau/Beaton Creek divide. Just over the divide there is another similar bog/fen system along Beaton Creek for 2.5 km to

Staubert Lake and another for 2.0 km above Armstrong Lake. There is little human settlement in these systems except at the community of Trout Lake.

Mid elevation wetlands: there are a few wetlands above the Arrow Lakes Reservoir in the Galena Bay area. More extensive wetlands occur on the benches on the west side of the reservoir opposite Galena Bay, on private land.

3. Mapping of Wetland and Riparian Habitat and Ownership

Focal Area analysis: Table 1 provides data on land ownership in this focal area.

Table 1: Land ownership in the Duncan/Lardeau and Revelstoke focal area.

Focal Area - Land Status	Hectares (ha)	Percent (%)
Conservation Property	706	1.6%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	0	0.0%
Provincial Park and Protected Areas	2,035	4.7%
Total Conservation Lands	2,741	6.4%
Crown Land (Federal and Provincial)	6,529	15.2%
Sub-total	9,270	21.5%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	0	0.0%
Private	8,003	18.6
Sub-total	8,003	18.6%
No Ownership Data		
Blank (Ownership Uncertain)-Without Lakes	16,545	38.4%
Unknown	9,213	21.4%
Sub-total	25,758	59.9%
Total Land Area (without large lakes and reservoirs)	43,031	100.0%

TRIM data analysis: Table 2 provides data on land ownership in the Duncan/Lardeau and Revelstoke focal area.

Table 2: The area of swamp and marsh TRIM categories for the Duncan/Lardeau and Revelstoke focal area.

Focal Area - Swamp and Marsh (Trim)	Hectares (ha)	Percent (%)
Conservation Property	60	5.9%
Conservation Property Within a WMA	-	-
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	0	0.0%
Provincial Park and Protected Areas	17	1.7%
Total Conservation Lands	77	7.6%
Crown Land (Federal and Provincial)	369	36.3%
Sub-total	446	43.9%

Private & First Nation Reserve Lands		
First Nation Reserve Lands	0	0.0%
Private	375	36.9%
Sub-total	375	36.9%
No Ownership Data		
Blank (Lakes Removed)	78	7.7%
Unknown	117	11.5%
Sub-total	195	19.2%
Total Land Area (without large lakes and reservoirs)	1,016	100%

Floodplain areas analysis: Flood risk mapping is available for the lower Lardeau and Revelstoke floodplains. These boundaries were used to develop an assessment of land ownership for the Duncan/Lardeau floodplain (Table 3). Habitat mapping for most of the Duncan/Lardeau floodplain is available in Krebs et al. 2012. The Duncan/Lardeau floodplain is a mix of private land, crown and conservation lands. Land use changes on the Lardeau floodplain have been large in the past but now seem to be stabilized.

Table 3: Land ownership on the Duncan/Lardeau floodplain.

Floodplain Area - Land Status	Hectares (ha)	Percent (%)
Conservation Property	388	19.7%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	0	0.0%
Provincial Park and Protected Areas	0	0.0%
Total Conservation Lands	388	19.7%
Crown Land (Federal and Provincial)	243	12.3%
Sub-total	631	32.0%
Private & First Nations Reserve Lands		
First Nation Reserve Lands	0	0.0%
Total Private	644	32.7%
Sub-total	644	32.7%
No Ownership Data		
Blank (Ownership Uncertain)-Without Lakes	694	35.2%
Unknown	0	0.0%
Sub-total	694	35.2%
Total Land Area (without large lakes and reservoirs)	1,969	100.0%

Most of the floodplain in the Revelstoke area is in provincial crown, municipal or BC Hydro ownership.

4. Background Information

Recreational Use

The Lardeau River is very important from a fisheries perspective, especially for Gerrard trout spawning and is an important local use area. The floodplain areas at Revelstoke are very important as a community amenity.

Stewardship Examples

There are local stewardship groups in place including Friends of the Lardeau River and North Columbia Environmental Society

Public Education Examples

There are educational kiosks on the various conservation properties in the Lardeau/Duncan area.

5. References

- Aim Ecological Consultants 2007. Footprint impact of BC Hydro dams on aquatic and wetland primary productivity in the Columbia Basin. For: Columbia Basin Fish and Wildlife Compensation Program.
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Mapping Data Resources

Predictive Ecosystem Mapping (PEM) mapping is available for this area. There is also TEM mapping for Machmer et al. 2004 provide additional mapping of wetlands. Cottonwood and other deciduous species were mapped for this area as part of a regional mapping project (Jamieson et al. 2001). Improved Predictive Ecosystem Mapping for this area is anticipated to be available in late 2014.

Appendix 7: Focal Area Analysis for the Slocan Valley

1. Introduction

The Slocan Valley floodplain systems are among the few low elevation floodplain systems remaining in the West Kootenay. Probably the most important value of the river and floodplain is as an amenity for people in the valley, for the landscape views it provides, along with rafting, tubing, swimming and fishing opportunities.

2. Basic Ecological Processes

The productivity of the wetland and floodplain areas in this focal area are dependent on the fundamental geological and ecological processes that have created the system and maintain its productivity. In this system, one of the critical processes was the presence of spawning salmon prior to the construction of the Grand Coulee Dam in the lower floodplain. The various wetland and riparian complexes are described below.

Lower Slocan River Floodplain: The lower Slocan River is a medium scale, silt and gravel based floodplain system based primarily on silt and gravel deposition by Lemon Creek and further downstream; by the Little Slocan River. The lower Slocan system has three major tributaries; the Slocan River flowing from Slocan Lake and its headwaters, Lemon Creek and the Little Slocan River. There is a large shallow water complex from Slocan City to Lemon Creek that is effectively a widening in the river created by the damming effect of the alluvial fan of Lemon Creek. The main flows from Slocan Lake are sediment and nutrient poor. Both are taken up, or deposited, in the lake. As a result, the river above Lemon Creek carries very little sediment. River temperatures are variable, depending on summer wind conditions on the lake (Corbett 2006). The reach of the Slocan River just below Lemon Creek supports far higher trout numbers and biomass than the reaches further upstream or downstream.

The Slocan River is nutrient poor and is nitrogen limited due to phytoplankton blooms in the lake. Up until 1936, spawning salmon contributed to nutrient balance in this area. Oliver 1998 estimates that the “spawning run of Chinook salmon into the Slocan and Little Slocan rivers was between 9,000 and 18,000 fish per year. Assuming an average weight of 8.4 kg per fish and based on 0.325% P and 3.0 % nitrogen recovery per body weight (reported in Ashley and Slaney 1997), the nutrient contribution from Chinook salmon carcasses to the food web likely ranged from 246 – 491 kg of P (i.e., 4.1 – 8.2 kg/km) and from 2268 – 4536 kg of N (i.e., 37.8 – 75.6 kg/km). In light of the combined escapements for all species, the loss of nitrogen and phosphorus from decaying salmon carcasses to whole-river nutrient dynamics was likely considerable”.

It is likely that wetlands in this system are to some degree less productive due to the lack of nutrients and sediment in the system.

There is evidence, in the form of very large cedar stumps, that the original vegetation along the river was large Western Red cedar stands, likely with a cottonwood component and some other conifers. Stumps with a diameter of 2 m can be found along the river (G. Oliver, pers. comm.). These stands were logged in the 1800s and have been replaced by cottonwood stands in some areas and extensive areas of agricultural land in small holdings. Large log jams likely occurred in the system, altering the dynamics of channel movement. Removal of tree cover along the river banks in many areas has also affected river function and stream temperature.

Wetlands along the lower floodplain are made up of side channel habitats in the lower portion (Crescent Valley to Passmore) with mostly single channel river habitat, some islands and a narrow strip of trees along most of the river. There are several oxbow lakes, connected to the river in some cases, and several wetland areas on lower end of river bends. This results in an interchange of nutrients and sediment between the river and the connected wetlands.

The Little Slocan Lakes and floodplain: This system, to the west of the Slocan River, is a small floodplain system of riparian and wetland vegetation created by alluvial fans that enter that valley from the west. There are well developed bogs, fens and wetland areas in this system.

Upstream of Slocan Lake there are wetland areas at Hills and at either end of Summit Lake. All of these systems are at relatively low elevation, with high heat units and good growing conditions.

3. Mapping of Wetland and Riparian Habitat and Ownership

Focal Area analysis: Table 1 provides data on land ownership in the Slocan Valley focal area.

Table 1: Land ownership in the Slocan Valley focal area.

Focal Area - Land Status	Hectares (ha)	Percent (%)
Conservation Property	228	0.5%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	0	0.0%
Provincial Park and Protected Areas	2,959	7.1%
Total Conservation Lands	3,187	7.6%
Crown Land (Federal and Provincial)	1,500	3.6%
Sub-total	4,687	11.2%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	0	0.0%
Private	11,791	28.2%
Sub-total	11,791	28.2%
No Ownership Data		
Blank (Ownership Uncertain)-Without Lakes	25,348	60.6%
Unknown	3	0%
Sub-total	25,351	60.6%
Total Land Area (without large lakes and reservoirs)	41,829	100.0%

TRIM data analysis: Table 2 provides data on land ownership of the swamp and marsh categories in TRIM, for the Slocan Valley focal area.

Table 2: The area of swamp and marsh TRIM categories for the Slocan Valley focal area.

Focal Area - Swamp and Marsh (Trim)	Hectares (ha)	Percent (%)
Conservation Property	0	0.0%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	0	0.0%
Provincial Park and Protected Areas	0	0.0%
Total Conservation Lands	0	0.0%
Crown Land (Federal and Provincial)	14	4.5%
Sub-total	14	4.5%

Private & First Nation Reserve Lands		
First Nation Reserve Lands	0	0.0%
Private	220	70.3%
Sub-total	220	70.3%

No Ownership Data		
Blank (Lakes Removed)	79	25.2%
Unknown	0	0.0%
Sub-total	79	25.2%
Total Land Area (without large lakes and reservoirs)	313	100.0%

Floodplain area analysis: Floodplain risk mapping was available for the lower Slocan Valley Table 3). A Sensitive Habitat Inventory provides detailed mapping of habitats at lower elevations in the Slocan Valley from Slocan Lake to Crescent Valley (Durand 2013). There is one wildlife sanctuary below Slocan City and a Nature Trust of BC property downstream of Lemon Creek. Land use changes on this floodplain have been massive in the past but now seem to be stabilized.

Table 3: Land ownership on the Slocan River floodplain.

Floodplain Area - Land Status	Hectares (ha)	Percent (%)
Conservation Property	65	2.9%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	62	0.4%
Wildlife Management Area	0	0.0%
Provincial Park and Protected Areas	0	0.0%
Total Conservation Lands	127	5.7%
Crown Land (Federal and Provincial)	72	3.2%
Sub-total	199	9.0%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	0	0.0%
Private	1,216	54.8%
Sub-total	1,216	54.8%
No Ownership Data		
Blank (Ownership Uncertain)-Without Lakes	805	36.3%
Unknown	0	0.0%
Sub-total	805	36.3%
Total Land Area (without large lakes and reservoirs)	2,220	100.0%

4. Background Information

Recreational Use

The floodplain and river are very important to several recreational interests, including fishing and hunting, boating and naturalists. Rafting and floating the river are important uses.

Stewardship Examples

There are several local stewardship groups in place including the Perry Ridge Water Users Association, the Slocan Lake Stewardship Society, the Slocan River Stream Keepers, the Slocan Lake Research Centre, the Slocan River Riparian Restoration Program, Slocan River Watch, the Slocan Valley Watershed Alliance, the Slocan Solutions Society and the Slocan Valley Wetlands Working Group (SWAMP). There is also a community forest, managed by the Slocan Integral Forestry Cooperative in the watershed.

Public Education Examples

The various stewardship groups have websites providing people with an understanding of issues in this valley related to water and resource management.

5. References

- Braatne, J. and B. Jamieson 2001. The Impact of flow regulation on riparian cottonwood forests of the Yakima River. For: North West Power Planning Council and Bonneville Power Administration, Portland Oregon.
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- Utzig, G. and D. Schmidt 2011. Dam Impact Footprint Summary. For: Columbia Basin Fish and Wildlife Compensation Program.

Mapping Data Resources

Predictive Ecosystem Mapping (PEM) mapping is available for this area. TEM mapping is not. Machmer et al. 2004 provide additional mapping of wetlands. Cottonwood and other deciduous species were mapped for this area as part of a regional mapping project (Jamieson et al. 2001). A recent mapping project, i.e. Sensitive Habitat Inventory provides detailed mapping of lower elevations in the valley from Slocan Park/Crescent Valley to Slocan City, including all of the lower floodplain (Durand 2013). Improved Predictive Ecosystem Mapping for this area is anticipated to be available in late 2014.

Appendix 8: Focal Area Analysis for the Robson Valley

1. Introduction

The Robson Valley is far to the north relative to the other focal areas. It supports fundamentally different wetland and floodplain systems in a much cooler environment. It is located in a different provincial management region (Prince George) and some of the processes for protecting and managing resources are different. Mapping designations not found in the East or West Kootenay (i.e. protected areas and wildlife areas designations) are found in this focal area.

2. Basic Ecological Processes

The productivity of the wetlands and floodplain areas in this focal area are described below.

Diked Wetlands: Cranberry Marsh south of Valemount was originally a shallow lake. It was converted to farmland at the west end and into a diked marsh on the east end by Ducks Unlimited Canada in the 1970s. There is also an oxbow called Horseshoe Lake adjacent to McBride that was converted to a diked wetland system by Ducks Unlimited Canada the same era. These are both stable water systems with relatively high productivity for this valley (B. Harrison, pers. comm.).

Robson Valley Floodplains: The Fraser River floodplain is a large scale, silt and gravel based floodplain system. It supports a relatively narrow floodplain, vegetated by white spruce and cottonwood, with a wide valley bench above, supporting aspen and lodgepole pine, generally 50 to 100m above the floodplain (Norecol Environmental Consultants, 1992). This system is driven by glacial flows from several tributaries on both sides of the valley. Most of the wetlands occur as oxbows and as shrub carr and fen systems. There are four wetland systems downstream of Tete Jaune Cache that have been isolated from the Fraser River by the railway grade and have been altered over time. River temperatures are low, as are groundwater flows into the various floodplain wetlands. River productivity is low despite the presence of salmon and the upstream nutrient pump provided by their presence. The run is not large (1500 to 5500/year). There are few industrial or agricultural sources of nutrients or pollutants. Nutrient contributions from croplands and artificial fertilizer are likely a minor contributor since only a small portion of the watershed is cultivated. All of these systems occur within a variant of the sub-boreal forest system.

Bench wetlands: There are a few wetlands, bogs, fens, ponds, and small lakes along the benches of the upper Fraser valley.

Mid-elevation floodplain systems productivity: There are several higher elevation floodplain systems in the tributary streams on either side of the valley. The floodplain of the Rausch River is some 20 km long and is included in the focal area. It is at only slightly higher elevation than the main Fraser River valley. Similar systems occur in the upper Canoe River (12 km) and the mid elevation portion of the Holmes River (8 km). These systems tend to be dominated by sedge meadow fens and bog systems with adjacent stands of conifers dominated by spruce rather than cottonwood. Conditions in these systems are driven by floodplain conditions in combination with frost pocket climatic conditions. Water temperatures are low throughout the growing season due to glacial melt in late summer.

Mid-elevation riparian zones: There is a riparian zone of generally conifer forests (with shrub communities and deciduous trees in many areas) along tributaries through the focal area that are of value to wetland and riverine species.

3. Mapping of Wetland and Riparian Habitat and Ownership

Focal Area analysis: Table 1 provides data on land ownership in the Robson Valley focal area.

Table 1: Land ownership in the Robson Valley focal area.

Focal Area - Land Status	Hectares (ha)	Percent (%)
Conservation Property	63	0.1%
Conservation Property Within a WMA	127	0.2%
Conservation Reserve (Wildlife Sanctuaries, etc.)	884	1.1%
Wildlife Management Area	219	0.3%
Provincial Park and Protected Areas	5,547	7.0%
Total Conservation Lands	6,840	8.6%
Crown Land (Federal and Provincial)	2,078	2.6%
Sub-total	8,918	11.3%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	0	0.0%
Private	31,221	39.4%
Sub-total	31,221	39.4%
No Ownership Data		
Blank (Ownership Uncertain)-Without Lakes	39,019	49.3%
Unknown	0	0.0%
Sub-total	39,019	49.3%
Total Land Area (without large lakes and reservoirs)	79,158	100.0%

Detailed habitat mapping is available for this focal area (Calder and Eskstrand 2013). However, no floodplain mapping is available for this focal area. Table 1 provides an overview of ownership for the entire focal area. The focal area boundary is based on the BEC zone for Sub-Boreal Spruce - dry - hot McLennan (SBSdh1). Since it is an ecological boundary, the boundary is 300 m/900 ft higher on the north slope of the valley versus the south slope. As a result this focal area includes large areas at higher elevation areas in the upper Fraser and Valemount valleys.

The Fraser River portion of the focal area (below Tete Jaune Cache) is mostly private ownership along the river. There is some crown land where the major tributaries enter the Fraser River. The Fraser system upstream of Tete Jaune Cache toward Mt. Robson is mostly crown. Lower McLennan Creek is mostly crown, with more private land on the floodplain close to Valemount. The Canoe river floodplain is about 50% crown land. Conservation lands securing wetlands occur at Cranberry Marsh. The Horseshoe Lake Ducks Unlimited Canada project is surrounded by private land. There are two conservation properties at Holliday Creek and East Twin Creek. There are reserves for conservation at the McLellan/Fraser confluence, an important salmon spawning area. Several islands in the Fraser River were also given protection as part of land use plan for the valley. There are four provincial parks and protected areas within the focal area (Lower Rausch River Protected area, West Twin Protected Area, Jackman Flats and Rear Guard Falls Provincial Parks that provide securement for parts of the focal area. Most provincial park lands are on the valley benches or at higher elevation.

TRIM data analysis: Table 2 provides data on land ownership of the swamp and marsh categories in TRIM, for the Robson Valley focal area.

Table 2: The area of swamp and marsh TRIM categories for the Robson Valley focal area.

Focal Area - Swamp And Marsh (Trim)	Hectares (ha)	Percent (%)
Conservation Property	77	4.2%
Conservation Property Within a WMA	0	0.0%
Conservation Reserve (Wildlife Sanctuaries, etc.)	0	0.0%
Wildlife Management Area	183	10.1%
Provincial Park and Protected Areas	118	6.5%
Total Conservation Lands	378	20.8%
Crown Land (Federal and Provincial)	81	4.5%
Sub-total	459	25.3%
Private & First Nation Reserve Lands		
First Nation Reserve Lands	0	0.0%
Private	771	42.4%
Sub-total	771	42.4%
No Ownership Data		
Blank (Lakes Removed)	587	32.3%
Unknown	0	0.0%
Sub-total	587	32.3%
Total Land Area (without large lakes and reservoirs)	1,817	100%

4. Background Information

Recreational Use

The Fraser River and floodplains are very important to several recreational interests, including fishing and hunting, boating and naturalists. Salmon and bear viewing are also important.

Stewardship Examples

The Fraser Headwaters Alliance is a local group interested in ecological sustainability in the Robson Valley and the upper Fraser River watershed. There are also community forests in the Valemount, Dunster and McBride areas. **Public Education Examples**

There is no information on any public education actions in this valley.

5. References

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Mapping Data Resources

Machmer et al. 2004 completed an overall GIS based inventory of wetlands for the Compensation Program area using TRIM data, including this focal area. This focal area does not have PEM mapping and only a few areas of TEM mapping. Recent work (Calder and Eskstrand 2013) provides up to date mapping, however some errors were noted in wetland classification for the area. Cottonwood and other deciduous species were mapped for this area as part of a regional mapping project (Jamieson et al. 2001).