Duncan Dam Project Water Use Plan

DDMWORKS-01 Lower Duncan River Argenta Slough Erosion Protection

Reference: DDMWORKS-01

Ecological Inventory of Argenta Slough

Study Period: June 14 to November 1, 2016

Ecofish Research Ltd., Suite F, 450 8th St., Courtenay, B.C. V9N 1N5

January 18, 2017

Ecological Inventory of Argenta Slough

Prepared for:

BC Hydro Water
6911 Southpoint Drive, 11th Floor
Burnaby, BC, V3N 4X8

January 18, 2017

Prepared by:

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1. INTRODUCTION

Argenta Slough is a wetland complex on the floodplain of the Lower Duncan River, known to provide important wildlife habitat (Herbison *et al.* 2002). The lower portion of Argenta Slough is located adjacent to an actively-eroding meander bend of the Duncan River (a.k.a. Argenta bend), immediately upstream to the river's outlet to Kootenay Lake (Figure 1). The Duncan Dam Water Use Plan (WUP) Consultative Committee expressed concern that continued channel migration and bank erosion at the meander bend could drain the lower portion of Argenta Slough, resulting in a loss of valuable habitat.

An erosion risk assessment was commissioned by BC Hydro (as part of DDMMON-01 - Argenta Slough Erosion Protection) to investigate the potential for physical works to mitigate bank erosion in the lower reach of the Duncan River. However, the cost estimates for the physical works exceeded the $150,000 allocated by the Duncan Dam WUP Consultative Committee to address erosion at Argenta bend. In addition, construction of the proposed physical works has the potential to cause environmental damage to Argenta Slough (Matsubara and Ellis 2013). Due to the cost and potential disturbance that the physical works could cause to the wetland, the Consultative Committee has rejected the proposed physical works to mitigate bank erosion at Argenta bend.

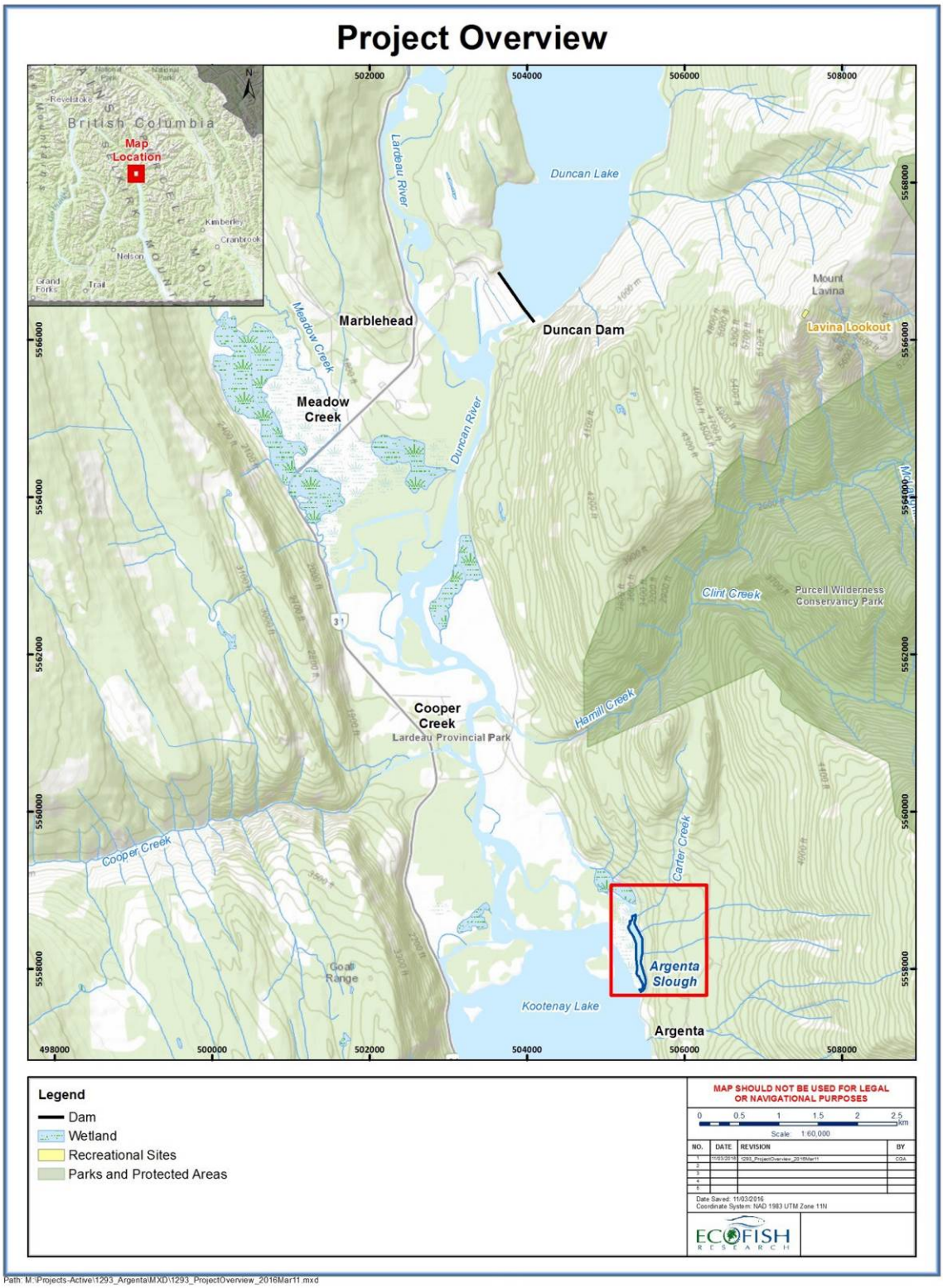
Ecofish Research Ltd. (Ecofish) was retained by BC Hydro to provide an Ecological Inventory for Lower Argenta Slough to better understand the potential loss of wetland habitat and function that may occur should the Duncan River breach that portion of the slough. Previous inventory work has been conducted by North Kootenay Consulting (Herbison 2006, 2015); these existing sources of information were updated and expanded upon to provide a scientific assessment of the biological values present in Lower Argenta Slough.

2. PROJECT OBJECTIVES

The objectives of the Ecological Inventory for Lower Argenta Slough are as follows:

1) Delineate and describe wetland type by area using existing information and orthophoto interpretation.
2) Provide an inventory of plant and wildlife species that may be present in the study area, including species at-risk and sensitive ecosystems.
3) Determine the likelihood of presence based on species occurrence records, range, distribution, and habitat requirements. A similar approach will also be taken for any ecological communities at-risk.
4) Describe and evaluate wetland function, as defined by the Federal Policy on Wetland Conservation (Government of Canada 1991), and the existing condition of wetland habitat that is present in Lower Argenta Slough.

Figure 1. Lower Argenta Slough in relation to Duncan Dam and Kootenay Reservoir.

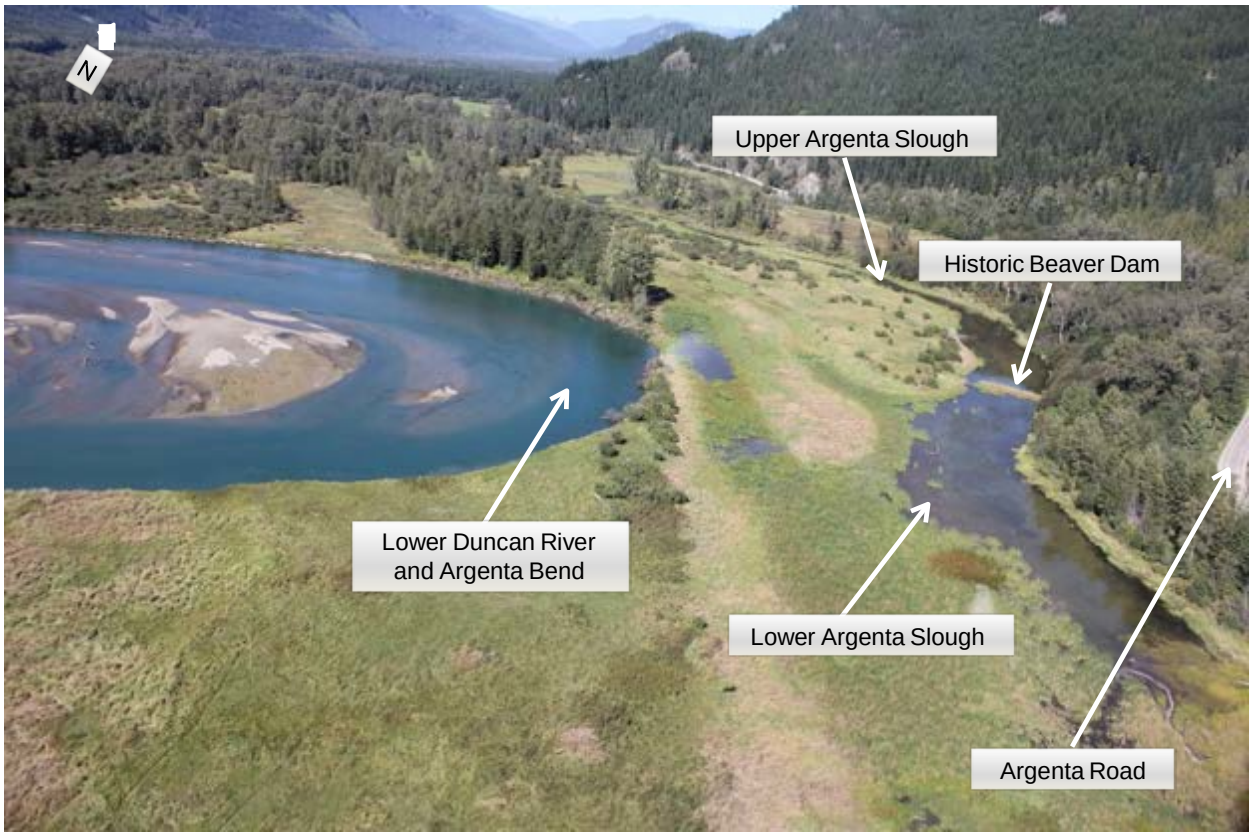


3. STUDY AREA

Argenta Slough is a wetland complex located in the Duncan-Lardeau river valley in southeastern British Columbia. It is located in the Interior Cedar–Hemlock dry, warm West Kootenay biogeoclimatic variant (ICHdw1, NDT3), surrounded by Interior Cedar-Hemlock moist, warm biogeoclimatic subzone (ICHmw2). These biogeoclimatic zones are characterized as having warm, moist summers and mild winters with snowfall (Braumandle and Curran 1992).

The study area comprises the lower (southern) one-third of Argenta Slough, a linear wetland located on the east side of the Lower Duncan River floodplain (Map 1). The Lower Argenta Slough study area is approximately 0.25 km^2 and is located adjacent to an actively-eroding meander bend of the Duncan River, a short distance upstream from the north end of Kootenay Lake. The total length of Argenta Slough is approximately 3.2 km long, and the area of study involves the lower 800 m, from the southernmost berm (Berm 1, an abandoned beaver dam) to the slough's outlet to the Lower Duncan River delta (Figure 2). All wetland-related habitats between the shore of Duncan River and Argenta Road were considered in this Ecological Inventory, as all of these habitats are inundated when Kootenay Lake backwaters the Duncan River during the spring freshet, and all have the potential to be permanently altered or lost if the Duncan River intersects the Lower Slough (Matsubara and Ellis 2013).

Figure 2. Lower Argenta Slough extends south from an abandoned beaver dam (a.k.a Berm 1) to Kootenay Lake delta (not pictured). Photo provided by BC Hydro.



4. METHODOLOGY

4.1. Wetland Delineation and Classification

Ecosystem mapping can be used to record site conditions and provide a framework for monitoring ecosystem response to management (RIC 1998). Wetland vegetation communities in Argenta Slough were delineated on orthophotos in ArcMAP (v. 10) in consideration of the *Standard for Terrestrial Ecosystem Mapping in British Columbia* (TEM) (RIC 1998, 2000), following Provincial wetland and terrestrial mapping classification schemes (MOF 2002, Mackenzie and Moran 2004, MOE 2006), and in consideration of local mapping projects (MOE 1991, Krebs *et al.* 2013, Herbison 2015, DataBC 2016 [VRI]). Wetland vegetation community classifications were further supported by photographs and comments from other local reports (Jackson *et al.* 2009, Jackson *et al.* 2014, Jackson *et al.* 2015, Krebs *et al.* 2013, Polzin and Rood 2013). Wetland community polygons were delineated by a terrestrial ecologist experienced in air photo interpretation and familiar with ecosystems in the ICH, on orthophotographs taken during low and high water conditions in 2009 and 2011, respectively. Polygons were delineated at a maximum scale of 1:800. A number of attributes were recorded for each polygon delineated through air photo interpretation. These included: decile (proportion of polygon dominated by a site series, i.e., association of vegetation species occurring on a site with similar moisture and nutrient regime), site series, site association, TEM map codes, and structural stage; areas for each polygon; assignments of mapsheet numbers and biogeoclimatic zones; and polygon descriptions from previous mapping work (Table 1). Terrain and soil attributes were not included in the database; however, they are reflected in adoption of the bioterrain approach to polygon delineation (RIC 1998). Additional background data sources were searched including Sensitive Ecosystem Inventory (SEI) and Terrestrial Ecosystem Mapping (TEM) projects; however, no projects were located in the vicinity of the Argenta Slough or in the ICHdw1 (DataBC 2016).

Table 1. Attribute table associated with wetland vegetation community polygons.

Attribute	Label	Description
FID	FID	Unique polygon identifier
Mapsheet	Mapsheet	1:20,000 mapsheet number
BEC zone	BEC_ZONE	The first-rank unit in the hierarchical Biogeoclimatic Ecosystem Classification (BGC) system[1]
BEC subzone	BEC_SUBZONE	The second-rank unit in the BGC system[1]
BEC variant	BEC_VRT	A third-rank unit in the BGC system occurring within particular subzones[1]
Ecosystem type	Type	Group or class of wetland[2]
Wetland community map number	Number	Alphanumeric number for each wetland type delineated in Argenta Slough
Decile 1	SDEC_1	The proportion of the polygon covered by Component 1, in deciles. Deciles in components 1–3 must total 10. Decile 1 must be greater or equal to Decile 2, which must be greater or equal to Decile 3
Site series 1	SITES_S1	Site series. Site series is a vegetation community association based on the sites ability to produce specific climax vegetation within a particular BGC Subzone or Variant
Site association 1	SiteA_1	Association of physically or biologically similar ecosystems that would have similar vegetation at climax[2]
Site series map	SITEM_S1	Site series map code[3]
Structural stage 1	STRCT_S1	The structure of the vegetation cover at the time of survey, ranging
Structural stage modifier 1	STRCT_M1	Substage of structural stage used for stages 1-3[1]
Decile 2	SDEC_2	See above
Site series 2	Site_S2	See above
Site association 1	SiteA_1	See above
Structural stage 2	STRCT_S2	See above
Structural stage modifier 2	STRCT_M2	See above
Comments	Comments	Additional pertinent information regarding the polygon
Confidence	Confidence	Confidence of assessment
Area	AREA	Area in m^2
Previous ID	Poly_ID	Overlap with mapped polygon from previous mapping[4]
Previous ID	Pre_mapcd	Overlap with mapped polygon from previous mapping[5]
Previous label	Herbison14	Overlap with previous ecosystem label[5]
Previous description	Herb_bioph	Overlap with previous biophysical description[5]
Previous description	Herb_wildl	Overlap with previous wildlife description[5]

[1]Described in *Field Manual for Describing Ecosystems in the Field* (MOFR 2010) and RIC 1998

[2] Mackenzie and Moran 2004

[3] MOE 2006

[4] Krebs *et al.* 2013

[5] Herbison 2015 draft

4.2. Wetland Function and Condition

Wetland functions are defined as a process or series of processes that take place within a wetland. The condition of a wetland determines how well a wetland is performing its functions, and can be assessed by the presence, or absence, of certain indicators. Argenta Slough functions primarily as a wetland. We assessed the conditions of the wetland habitat by examining the hydrology and hydrologic connectivity, vegetation composition, wildlife use, and landscape connectivity of the study area. This is discussed in detail in the following sub-sections. There is currently inadequate data available to quantitatively assess wetland function and condition through the development of indicators; however, qualitative assessment is made where data are available. Socio-economic values identified in the federal policy, such as ecological services, were not considered in this assessment (Government of Canada 1991).

4.2.1. Hydrology and Connectivity

The formation, persistence, size, and function of wetlands are controlled by hydrologic processes. Some of the major hydrologic functions of wetlands include flood storage and mitigation, groundwater recharge, alterations to local climate, and erosion reduction. These typical hydrological functions could not be assessed with the limited data available, and are beyond the scope of this assessment. As this is an Ecological Inventory, hydrological function of Lower Argenta Slough was assessed in terms of wetland habitat availability and connectivity (described in Section 5.2.1).

Due to the lack of existing field data, assessment of wetland hydrological function and condition was largely qualitative. The assessment relied on a handful of air and ground photos, orthophoto images, and technical reports (Herbison 2006, 2015, Jackson *et al.* 2009, Matsubara and Ellis 2010, 2013, Polzin *et al.* 2010, Polzin and Rood 2014). In addition, daily precipitation and air temperature data[1] for the period 1985 to 2015 are available for the Duncan Lake Dam weather station 1142574 maintained by Environment Canada, and flow and, or level data[2] are available for the Water Survey Canada (WSC) gauge 08NH118, Duncan River Below Lardeau River, since 1963, and WSC gauge 08NH064, Kootenay Lake at Queens Bay, since 1931. These data were reviewed to provide a description of current and past climate and hydrological conditions at the site.

The hydrology of a wetland is largely responsible for the vegetation of the wetland, which in turn affects the value of the wetland to wildlife. The duration and seasonality of flooding and (or) soil saturation, groundwater level, soil type, and drainage characteristics exert a strong influence on the number, type, and distribution of plants and plant communities in wetlands. The hydrological condition of wetland habitat was further assessed from ecologically relevant data such as

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[1] Data obtained from the Pacific Climate Impacts Consortium website https://pacificclimate.org/data/bc-station-data

[2] Historical and real-time date available from http://wateroffice.ec.gc.ca/.

vegetation composition and the ecological communities present in Lower Argenta Slough; these methods are described in Section 4.2.2.

4.2.2. Vegetation Composition

Vegetation composition was considered concurrent with ecosystem mapping of wetland vegetation communities by reviewing ecosystem classification schemes (MOF 2002, Mackenzie and Moran 2004, MOE 2006), local mapping projects (MOE 1991, Krebs *et al.* 2013, Herbison 2015, DataBC 2016 [VRI]), and other projects (Jackson *et al.* 2009, Jackson *et al.* 2014, Jackson *et al.* 2015, Krebs *et al.* 2013, Polzin and Rood 2013).

Vegetation community composition is largely influenced by the hydrology, soil moisture, and nutrient regime of a wetland. This data was unavailable and hence limited vegetation community descriptions. However, a search of ecosystems and species at-risk provided indication of what vegetation communities could occur on sites with moisture, nutrient, and hydrodynamic indexes similar to what is expected in Lower Argenta Slough and in similar biogeoclimatic zones (CDC 2016a). Conservation ranks were also assigned to mapped polygons, as appropriate. Furthermore, each mapped polygon was assigned a high, medium, or low 'confidence in classification' rank to account for the fact that no field work was conducted and background literature was limited in scope, data, and applicability.

4.2.3. Wildlife Use

A list of wildlife species potentially occurring within Argenta Slough was compiled from the BC Species and Ecosystem Explorer (CDC 2016b). All species occurring within the Interior Cedar Hemlock biogeoclimatic zone, Kootenay Lake Forest District, Kootenay Ministry of Environment Region (MOE Region 4), and the Central Kootenay Regional District were considered for their potential to occur within Argenta Slough based on habitat requirements. As the aforementioned location information is incomplete for some species within the BC Species and Ecosystem Explorer database, some species with incomplete location information were added back onto the list based on known habitat requirements. All species that are either provincially or federally designated as at-risk or regionally significant according to the Fish and Wildlife Compensation Plan Draft (BC Hydro 2012) or the Duncan-Lardeau Flats Conservation Properties Land Management Plan (Krebs *et al.* 2013) are noted. Species were then classified according to their likelihood of occurrence within Argenta Slough (Section 4.2.3.1). Species that have either been observed within Argenta Slough, or have a moderate likelihood of occurring within Argenta Slough were classified by habitat use (Section 4.2.3.2), and species that have been observed within Argenta Slough were classified by their potential dependence on the habitat provided within the Lower Argenta Slough (Section 4.2.3.3).

4.2.3.1. Likelihood of Wildlife Occurrence

The likelihood of wildlife species presence within Argenta Slough was classified as either: high, moderate, low or negligible. The classification criteria are defined as:

- High/Confirmed: The range and distribution of the species overlap or border with Argenta Slough, suitable habitat is present and the species has been detected within Argenta Slough. Species presence information was gleaned from Herbison (2015) and

DataBC (2016) data layers (BC Frogwatch Amphibians, BC Frogwatch Reptiles, BC Frogwatch Turtles, Biological Resources – Birds, Ecological Reports Catalogue, Species and Ecosystems at Risk – Publicly Available Occurrences – Conservation Data Centre, Wildlife Species Inventory).

- Moderate: The range and distribution of the species overlap or border with Argenta Slough and suitable habitat is likely present; however, the species has not been detected within Argenta Slough.
- Low: The range and distribution of the species may overlap or border with Argenta Slough; however, while suitable habitat may be present, Argenta Slough is unlikely to provide suitable habitat and the species is unlikely to occur within Argenta Slough.
- Negligible: The range, distribution or habitat requirements of the species do not overlap or border with Argenta Slough. It is very unlikely that the species is ever present within Argenta Slough.

Species with a high/confirmed or moderate likelihood of occurrence are listed in tables in Section 5.2.3 with further details on at-risk species provided in the text. A list of species with a low or negligible likelihood of occurrence is provided in Table 2.

4.2.3.2. Wildlife Habitat Use

For species with a moderate or high/confirmed likelihood of occurrence, consideration was given to the functions that Argenta Slough provides to each species in terms of breeding, foraging, and/or migratory stopover habitat, as per the classification scheme detailed in Table 2.

4.2.3.3. Likelihood of Potential Dependence

Wildlife species that have been confirmed to be present within Argenta Slough were classified as having a high, moderate, or low likelihood of being dependant on habitat within the Lower Argenta Slough. The degree to which individuals of each species may be dependent on Lower Argenta Slough is defined as:

- High: Wildlife species may be highly dependent on habitat within Lower Argenta Slough. The local populations depend on the habitat available within the Lower Argenta Slough for breeding, foraging and/or migratory stopover habitat and similar habitat may not be available within the seasonal ranges of the individuals that have been observed within the Slough.
- Moderate: Wildlife species confirmed presented in the Lower Argenta Slough; however, the species is not entirely dependent on Lower Argenta Slough. For example, the species has been confirmed to breed in Upper Argenta Slough or the species' habitat requirements are more general and not closely linked to wetland habitat.
- Low: Wildlife species may be dependent on habitat within Argenta Slough; however, the species primarily breeds or forages in adjacent areas including riparian meadows and waterbodies such as Kootenay Lake.

Table 2. Wildlife habitat use classification scheme.

Habitat Use	Likelihood of Habitat Use	Criteria Definition
Breeding	Breeding and associated foraging habitat are provided directly by Lower Argenta Slough, with habitat suitability likely affected by potential hydrology changes.	
	Confirmed	Breeding confirmed (Herbison 2015).
	Probable	Breeding is probable based on habitat requirements, species detectability, and previous level of survey effort.
	Possible	Breeding is possible based on habitat requirements, species detectability, and previous level of survey effort.
Foraging	Foraging habitat is provided directly by Lower Argenta Slough but breeding habitat is either not provided by or not restricted to the Slough. Foraging habitat suitability would likely be affected by potential hydrology changes.	
Foraging - Migratory Stopover	Probable	Occurrence was confirmed but timing of occurrence was unclear. Lower Argenta Slough falls within the migratory range of the species but not the breeding or overwintering range.
	Possible	The species has not been observed but suitable foraging habitat is present. Lower Argenta Slough is within the migratory range of the species but not the breeding or overwintering range.
Foraging - Winter	Confirmed	Foraging was observed within open water near Carter Creek during the winter (Herbison 2015).
	Probable	Occurrence was confirmed but timing of occurrence is not clear. Winter foraging is possible, particularly in association with the protected open waters near Carter Creek, based on species' winter range and habitat requirements.
	Possible	Species has not been observed but winter foraging is possible, particularly in association with the protected open waters near Carter Creek, based on species' winter range and habitat requirements.
Foraging - Transient		Suitable foraging habitat exists within Lower Argenta Slough but is part of a much larger home range.
Adjacent Habitat		Consideration of adjacent habitat use was only given to species that were confirmed to have been observed during surveys of Lower Argenta Slough (Herbison 2015). This classification was used when primary habitat requirements are provided by adjacent habitat rather than directly by Lower Argenta Slough. Adjacent habitat includes the adjacent cottonwood stands, forest and caves, Duncan River, Kootenay Lake, and the Kootenay River.

4.2.4. Connectivity

Wetland connectivity is a highly dynamic process. Wetting and drying cycles determine the frequency with which water connects habitats, and wetlands can alternate from high connectivity during floods to extreme fragmentation during droughts. Hydrology not only affects the physical elements that define the connectivity of the landscape - it also shapes biological connectivity - the composition, abundance and fecundity of wetland biota, and thus the type and abundance of organisms that disperse.

Rigorous field and modelling methods for assessing physical and biological connectivity exist; however, due to data limitations, the assessment of wetland connectivity for Lower Argenta Slough was largely qualitative and focused on hydrological connectivity. The assessment relied on a handful of air photos, orthophoto images, and technical reports (Herbison 2006, 2015,

Jackson *et al.* 2009, Matsubara and Ellis 2010, Polzin *et al.* 2010, Polzin and Rood 2014), used to determine the spatial and temporal connectivity of wetland habitat.

5. RESULTS

5.1. Wetland Delineation and Classification

Lower Argenta Slough is a wetland complex composed of shallow water, seasonally flooded marsh, and flood/ riparian forest ecosystems (Table 3, Map 2). Seasonally flooded marsh communities occupy the majority of the lower slough followed by cottonwood dominated riparian forests and then permanently inundated shallow water communities. The full wetland community mapping polygon shapefile has been provided as part of this deliverable.

The likelihood of rare or at-risk ecological communities can be partially predicted by the biogeoclimatic (BEC) zone and site series present. The ICHdw1 has few wetland areas and not many at-risk communities had been documented within this BEC zone at the time that this mapping was conducted. This may be due to a lack of survey effort in this BEC zone, as the classification scheme available at the time of mapping was based on few plots and very few plots had been installed in the wetter site series (Braumandle and Curran 1992, Mackillop 2012, Mackillop pers. comm., 2012, 2016). An updated guide for ecosystem classification and identification in the South-Central Columbia Mountains, that includes more refined classifications based on a higher number of plots, was released in September 2016 (Mackillop and Ehman 2016), after the project mapping was completed.

Table 3. Ecosystem types expected to occur in Lower Argenta Slough.

Ecosystem Type	Wetland Community Map Number	Site Association or Site Series	Site Association or Site Series Name	TEM Map Code	Map Code Name	Area (m^2)	Area (ha)
Shallow Water	1a	Shallow water	-	WL	Wetland	15,114	1.51
	1b	Shallow water	-	WL	Wetland	8,322	0.83
	1c	Shallow water	-	WL	Wetland	366	0.04
Marsh	2a	Wm05/Wm06	Common cattail marsh/Great bulrush marsh	WL	Wetland	7,421	0.74
	2b	Wm01 (Wm02)	Beaked sedge - water sedge (Swamp horsetail - Beaked sedge)	WL	Wetland	55,147	5.51
	2c	Wm01 (Wf01)	Beaked sedge - Water sedge (Water sedge - Beaked sedge)	WL	Wetland	63,881	6.39
	2d	Wm05 (Wm02)	Common cattail marsh (Swamp horsetail - Beaked sedge)	WL	Wetland	22,977	2.30
Flood/Forest	3a	Fm02	Cottonwood - Spruce - Red-osier dogwood	SH	Cottonwood - Mountain Alder Grass	23,353	2.34
	3b	Fm02/03	Cottonwood - Spruce - Red-osier dogwood (CwHw - White Pine - Devil's Club)	HD	CwHw-White Pine-Devil's Club	19,223	1.92

* Note: brackets denoting second site series means that the association is close the bracketed association, the backslash indicates that both ecosystems are present within the polygon.

5.2. Wetland Function and Condition

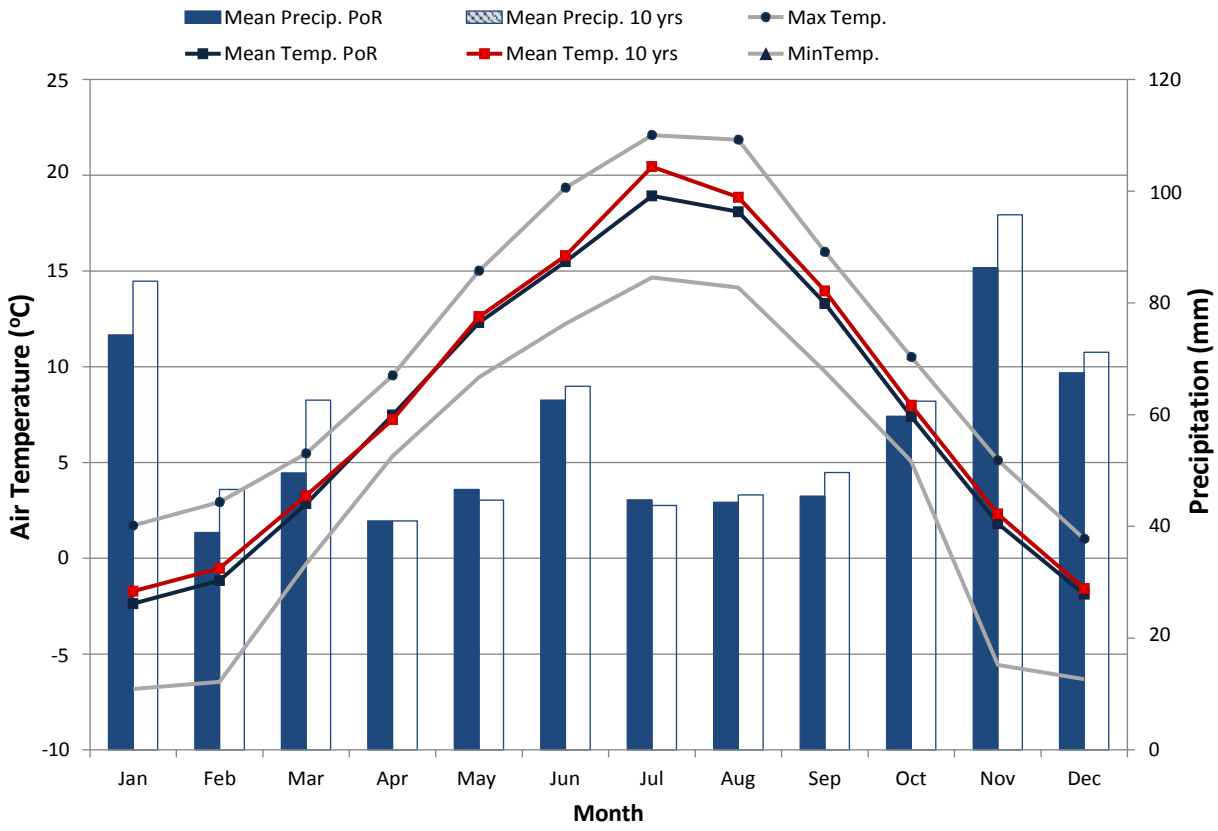
5.2.1. Hydrology

The hydrology of a wetland is largely responsible for the composition of vegetation of a wetland, which in turn affects the value of the wetland to wildlife. Due to the lack of site specific data, inferences on the hydrologic condition of the Lower Argenta Slough were made from locally available climate and hydrology data and reports.

Daily average air temperature at the Duncan Lake Dam weather station for the period 1985 to 2015 ranged from -2.4°C in January to 18.9°C in July (Figure 3). Over the last 10 years, the daily average temperature from November to March has increased by 3.7°C compared to the average temperature in the previous 20 years (1985-2005), providing evidence of warmer winters over recent years. This increase in temperature has the potential to provide more open water habitat during winter. Likewise, daily average temperatures during the growing season (April to October) have increased by 5.7°C in the last 10 years, compared to the previous 20 years. This increase in air temperature has likely resulted in an increase in evapotranspiration rates, potentially resulting in greater water level drawdown during the growing season.

Average annual precipitation at Duncan Lake Dam weather station for the period 1985 to 2015 was 661 mm. Minimum precipitation was 411 mm in 1987 and maximum precipitation was 829 mm in 2012. Precipitation is generally highest from November through January and lowest in April (Figure 3). Over the last 10 years, snowfall typically comprised 26% of the total annual precipitation, but has been as low as 13.4%, and typically occurs from December through February. Annual precipitation was higher than average in eight of the last ten years, with the highest precipitation on record (since 1985) for the months of January through March, June, July, September, and October occurring between 2011-2014. The lowest precipitation on record for August and September occurred in 2011. The seasonal and interannual hydrological response of wetland water levels to precipitation events is unknown.

Figure 3. Monthly mean, minimum, and maximum air temperature, and mean total monthly precipitation recorded at Duncan Lake Dam for the 1985-2015 period of record (PoR), and mean monthly air temperature and total precipitation for the last 10 years (2006-2015).



Besides precipitation, Lower Argenta Slough receives water inputs from Upper Argenta Slough and runoff from three seepage springs originating from the local hillside to the east of the slough. One of the springs, Carter Creek, is said to flow year-round and maintains open water habitat in the lower slough during winter months (Herbison 2015). It is unknown whether Lower Argenta Slough receives other groundwater inputs, or discharges water to the local aquifer; though Herbison (2015) has identified locations of potential subsurface recharge (Table 4).

Seasonally high groundwater tables may be associated with Duncan River. Herbison (2006) hypothesized that Upper Argenta Slough receives water inputs from Lower Duncan River via a spring, but the magnitude, timing, and duration of this input has not been measured. Groundwater monitoring at upland riparian sites along the Lower Duncan River since 2009, indicates a very close correlation in groundwater elevation and river stage (measured at the gauging station 08NH118) during the growing season (Polzin *et al.* 2010, Polzin and Rood 2014). The high correlation between river stage and groundwater levels were found at measurement sites located 4 m away from the river; the full horizontal extent of this relationship is unknown (wetland habitat within the lower slough is 30 m away from the river).

Wetland habitat in Argenta Slough appears to be associated with a channel depression that may have once been a former channel or floodplain channel of the Duncan River that was cut off from mainstem flow as the river changed course. Photos taken of the site (Herbison 2015) show water flowing through the wetland complex; however, the location, rate, timing, and duration of flow have not been recorded. In the past, beaver activity has had the effect of ponding water in Upper Argenta Slough and reducing water levels in Lower Argenta Slough (Herbison 2006); however, the effect of beaver activity on the hydrology of the site has not been documented in recent years. Continuous water levels have not been collected in the slough to date, and thus the annual range in water levels above and below the abandoned beaver dam 1 (Berm 1) has not been documented (Map 1).

Lake level and river flow data (WSC gauges 08NH064 and 08NH118 respectively), topographic survey data (Matsubara and Ellis 2010), upland riparian water elevation data (Polzin *et al.* 2010), and observations from a local biologist (Herbison 2015) provide some insight into the hydrological regime of Lower Argenta Slough. The slough is flooded annually when Kootenay Lake levels are at an elevation of 532.5 m or higher (Matsubara and Ellis 2013). This inundation event typically occurs in June, corresponding to the spring freshet (Figure 4), and based on lake level data from 2011-2015, may last from 4 days (2015) to 86 days (2012) (Figure 5). River flows typically peak in July or August (Figure 4); the effect of peak river flows on water levels at the slough has not been documented. Water level measurements made at upland riparian sites in the Duncan River delta have found water level to be influenced more by Kootenay Lake levels than by Duncan River flow and stage (Polzin *et al.* 2010). However, it is likely that the area of the slough is increased when lake waters are backwatered during high river flows. After the spring freshet, water levels in the slough are expected to slowly recede through late summer to perennial low levels in winter.

Figure 4. Mean monthly discharge for the Lower Duncan River at Station 08NH118 and mean monthly water levels for Kootenay Lake at Station 08NH064 from 1969 (post Duncan Dam construction) to 2015, and for the last 10 years (2006-2015).

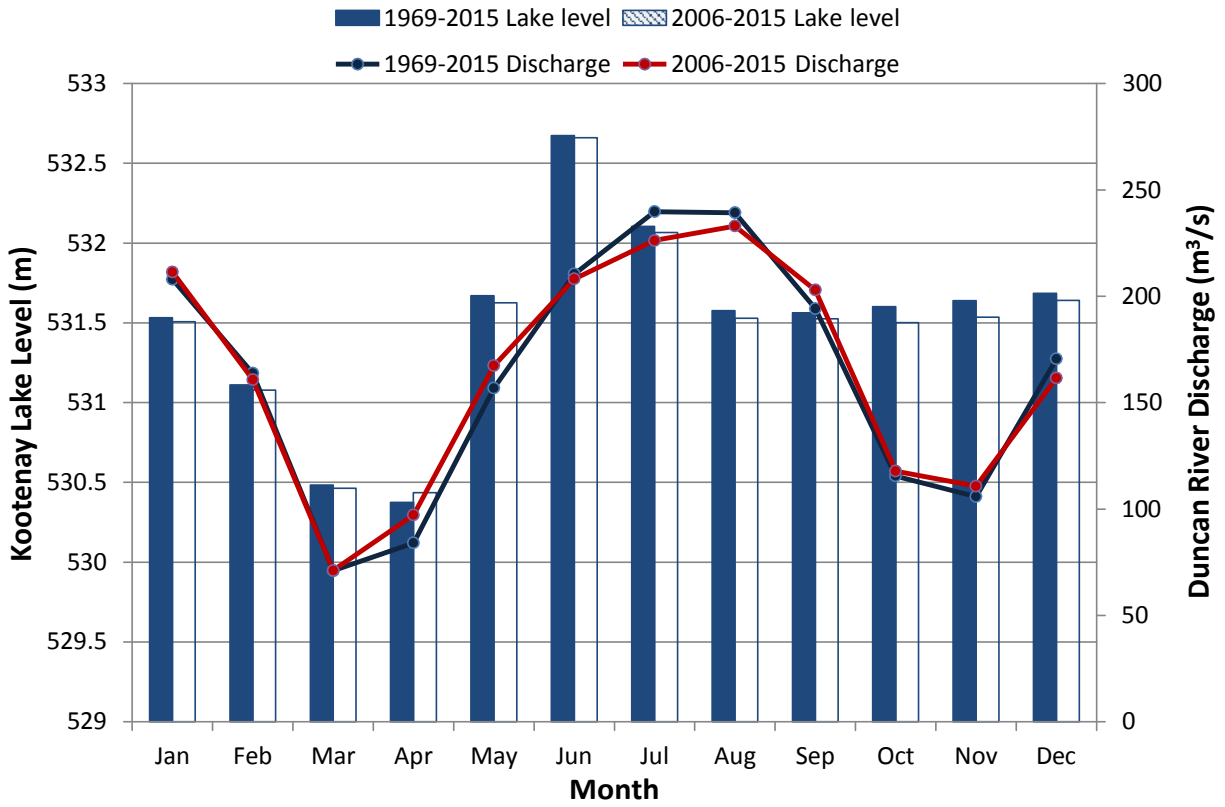
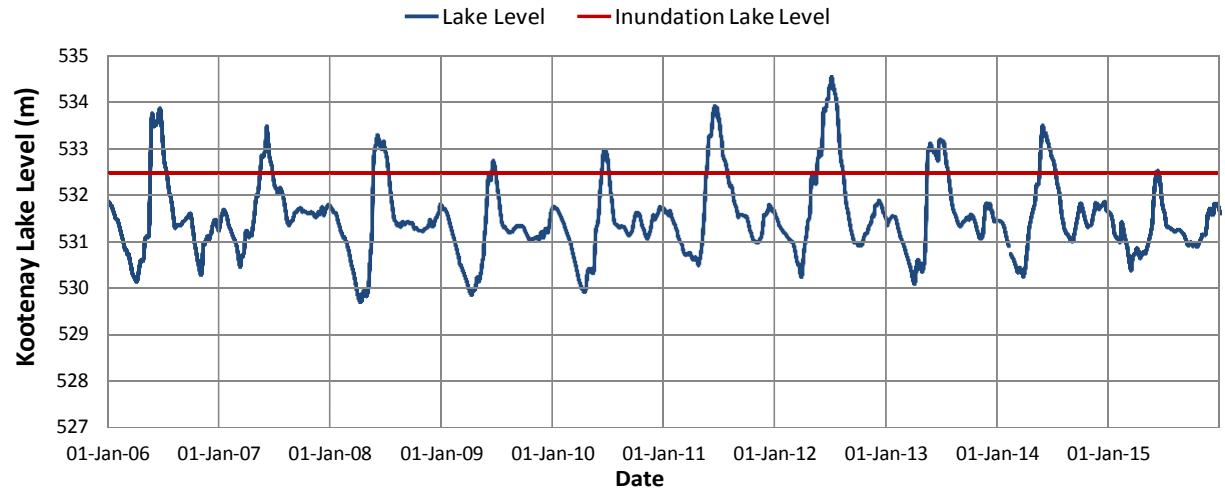


Figure 5. Daily average water levels for Kootenay Lake at Station 08NH064 for the last 10 years (2006-2015), showing the timing and duration of potential inundation of the slough at a lake elevation of 532.5.



Wetland vegetation is known to reflect local hydrological flooding regimes. Thus, wetland ecosystem type and site associations (or series) provide further insight into the hydrology of the study area and are described in the following section (Section 5.2.2), and summarized in Table 4. Note that the confidence in some of these classifications is low due to lack of data (Section 5.1).

5.2.2. Vegetation Composition

The ecosystem types and vegetation communities that comprise the Lower Argenta Slough are a product of the local nutrient and moisture regime. In general, the site is expected to have a rich to very rich nutrient regime as it receives nutrients from upslope sources and from the Lower Duncan River. The majority of the slough is flooded in some years, and receives year-round moisture from upslope sources, the Lower Duncan River, and Kootenay Lake. This moisture provides very wet to wet soil conditions throughout the growing season. The pH is likely neutral in most of the slough that is receiving freshwater inputs, to slightly alkaline in the upper portion of the slough due to evapotranspiration (Mackenzie and Moran 2004).

The site conditions present in Lower Argenta Slough are known to support provincially at-risk ecosystems, and are likely to support others (Table 4). The provincially red-listed ecological community “Cottonwood - Spruce - Red-osier dogwood” (Fm02) was identified in the Lower Argenta Sough accounting for approximately 2.34 ha. Three provincially blue-listed ecosystems were identified in the Lower Argenta Sough. The largest blue-listed ecological community is the “Beaked sedge - water sedge (Swamp horsetail - Beaked sedge)” (Wm01(Wm02)) covering approximately 5.51 ha followed by the “Common cattail marsh (Swamp horsetail - Beaked sedge): (Wm05(Wm02)), accounting for approximately. 2.30 ha. The smallest blue-listed community is the “Common cattail marsh/Great bulrush marsh (Wm05/Wm06) covering approximately 0.74 ha. The conservation value of ecological communities increases with size. Generally the minimum size of a community that will be tracked by the Province is 0.05 ha or 30 linear meters (CDC 2016a), thus those at-risk communities expected to be present in Lower Argenta Slough are of conservation value.

The potential of a site to support rare communities can be partially predicted by the site series and seral stage of a site. Within Lower Argenta Slough, the moist and rich site series with subsurface flow may support the red-listed Cottonwood - Spruce - Red-osier dogwood (Fm02) or Black Cottonwood/Common Snowberry – Roses (Fm01) ecological communities. The refined ecosystem classification for the ICHdw1 (Mackillop and Ehman 2016), released after the project mapping was completed, will help to predict the likelihood of these communities occurring in the Lower Argenta Slough.

It is currently unknown if any rare plants occur in Lower Argenta Slough. Small spike rush (*Carex microcephala*) (blue-listed, S3, G5) was reported on nearby, and potentially similar fluvial floodplain habitats, across the river mouth adjacent to Kootenay Lake in 1979, but is expected to be extirpated (CDC 2016a).

Ecosystem change and disturbance have been observed in Lower Argenta Slough both recently and historically due to climate change, invasive species, and land management in the Lower

Duncan wetland complex and adjacent waterbodies, as well as other factors (Krebs *et al.* 2013, T. Biebighauser in Herbison 2015).

These management activities have had local as well as downstream effects such as reduced fluvial disturbance and altered flow regimes, which may have led to succession to different and often more mature ecosystems. For example, fens and graminoid dominated wetland ecosystems have been lost at the head of Kootenay Lake (Krebs *et al.* 2013), and some of these may now be replaced by shrub and tree dominated ecosystems.

The community composition of some Provincially listed marsh communities likely present in Lower Argenta Slough is reported to have changed in the past 10 years. Herbison (2015) reports that the cattail marsh (blue-listed) used to be more extensive prior to 2010. As orthophotographs used in this report were from 2009 and 2011 it is possible that the extent and area of the cattail marsh was overestimated. In contrast, the blue-listed (potentially red-listed) great bulrush marsh may be increasing in permanent shallow water (Herbison 2015) due to increased availability of shallow water habitat and increase salinity.

Several invasive species have been observed in the Argenta Slough and Lower Duncan wetlands that may threaten the condition of the slough; including burdock species, Canada thistle, reed canary grass, bull thistle, common tansey, orange and yellow hawkweed, policemens helmet, and St. John's Wort (Krebs *et al.* 2013, IAPP 2016). Other non-wetland invasive species recorded in the adjacent area (e.g., likely on roadside) that may become a threat if site conditions become drier are spotted knapweed, oxeye daisy, and chickory. Of particular note is reed canary grass (*Phalaris arundinacea*) which is abundant in Lower Argenta Slough and is known to produce a dense canopy that excludes most species (Mackenzie and Moran 2004). Krebs *et al.* (2013) determined that invasive plants pose a high threat to non-forested habitats in the area.

Table 4. Wetland types, status, and function and condition in Lower Argenta Slough (Part 1 of 2).

Ecosystem type	Wetland community map number	Site association or Site series code	Area (ha)	Conservation Rank			Hydrology	Vegetation	Other Features or Comments	Confidence in Classification
				BC List	Provincial	Global				
Shallow Water	1a	Shallow water	1.51	SNR	No status	GNR	Sluggish water; receives year-round flow from Carter Creek, subsurface seepage, and flooding during freshet.	Dense aquatic vegetation[1].	Calcium carbonate deposits, reported to be locally unique and rare by local resident[1].	L
	1b	Shallow water	0.83	SNR	No status	GNR	Sluggish, subsurface seepage, flooding during freshet.	Some aquatic vegetation.		L
	1c	Shallow water	0.04	SNR	No status	GNR	Subsurface seepage and flooding during freshet.			M
Marsh	2a	Wm05/Wm06	0.74	Blue	S3 (2004)	G5	Subsurface seepage and flooding during freshet, water table likely below surface by end of summer due to evapotranspiration.	Cattail marsh with patches of bulrush, transitioning to reed canary grass and other grasses and sedges.	The condition and extent of the cattail marsh has been variable the past five plus years[1], bulrush community may be similar red-listed community.	M
	2b	Wm01 (Wm02)	5.51	Blue	S4 (2010)	G4	Flooded some years.[1]	Transition from sedges to grasses, thickly vegetated.	Conservation rank is for Wm02 (Swamp horsetail - Beaked sedge) community, Wm01 is yellow-listed.	L

* note brackets denoting second site series means that the association is close the bracketed association, the backslash indicates that both ecosystems are present within the

[1]Herbison 2015 Draft

[2]B.C. List Status are assigned based on the Subnational Conservation Status. Red includes any ecological community that is Extirpated, Endangered, or Threatened in B.C. Blue includes any ecological communities that are considered to be of Special Concern in B.C. These communities are particularly sensitive or vulnerable to human activities or natural

[3]Provincial Conservation Status refers to the species or ecological communities conservation status in BC. S2 = imperiled, S3=special concern, vulnerable to extirpation or

[4]Global Rank applies to the ecological community across its entire range. G2=imperiled, G3=vulnerable to extirpation or extinction, G4=apparently secure, GNR=unranked.

Table 4. Wetland types, status, and function and condition in Lower Argenta Slough (Part 2 of 2).

Ecosystem type	Wetland community map number	Site association or Site series code	Area (ha)	Conservation Rank			Hydrology	Vegetation	Other Features or Comments	Confidence in Classification
				BC List	Provincial	Global				
Marsh	2c	Wm01 (Wf01)	6.39	Yellow	S4 (2004)	G4	Floods during freshet and high water events, east slope saturated from subsurface upslope flow.	Flava sedge and water sedge[1], thick cover of other sedges and grasses including infilling with reed canary grass in some areas.	Woody debris has been washed up over much of the polygon. Could support red-listed Wm51 (three-way sedge) community.	L
	2d	Wm05 (Wm02)	2.30	Blue	S3 (2004)	G5	Potential subsurface recharge[1], considerable evapotranspiration.	Cattails, other salt tolerant sedges and grasses.	Brackish	L
Flood/Forest	3a	Fm02	2.34	Red	S2 (2010)	GNR	Floods some years, water movement through root systems most of year.	Middle bench, cottonwood dominated floodplain forest with shrubs including willows and red-osier dogwood. Older sites may host young spruce.	Potential to support Fm01 (black cottonwood/ common snowberry - roses) red-listed community	M
	3b	Fm02/03	1.92	-	-	-	Receives subsurface flow from upslope and toe slope moisture from slough.	Moisture receiving site with cottonwood, alder, aspen, willow and other shrubs, transition to drier Douglas-fir dominated upslope forest.		M

* note brackets denoting second site series means that the association is close the bracketed association, the backslash indicates that both ecosystems are present within the

[1]Herbison 2015 Draft

[2]B.C. List Status are assigned based on the Subnational Conservation Status. Red includes any ecological community that is Extirpated, Endangered, or Threatened in B.C. Blue includes any ecological communities that are considered to be of Special Concern in B.C. These communities are particularly sensitive or vulnerable to human activities or natural

[3]Provincial Conservation Status refers to the species or ecological communities conservation status in BC. S2 = imperiled, S3=special concern, vulnerable to extirpation or

[4]Global Rank applies to the ecological community across its entire range. G2=imperiled, G3=vulnerable to extirpation or extinction, G4=apparently secure, GNR=unranked.

5.2.3. Wildlife Use

5.2.3.1. Amphibians

Four amphibian species, including one species at-risk, have been observed within the Argenta Slough: Columbia Spotted Frog *(Rana luteiventris)*, Long-toed Salamander *(Ambystoma macrodactylum)*, Northern Pacific Treefrog *(Pseudacris regilla)*, and Western Toad *(Anaxyrus boreas)* (Table 5) (Herbison *et al.* 2002). The Western Toad is federally listed as Special Concern under the *Species at Risk Act* (SARA 2002) and provincially blue-listed (Special Concern) (CDC 2016b). The provincial Conservation Framework categorizes the species with a relatively high Priority 2 under Goal 2 (preventing species from becoming at risk).

Breeding has been confirmed within Argenta Slough for the Western Toad and Northern Pacific Treefrog (Herbison 2015) and breeding is probable for the Columbia Spotted Frog and Long-toed Salamander. All four of these species are highly dependent on Lower Argenta Slough. One additional amphibian species that has not been observed but has a moderate likelihood of occurring is Northern Leopard Frog *(Pseudacris regilla)*, which is federally listed as Endangered and provincially red-listed (Extirpated, Endangered or Threatened) (Table 5) (CDC 2016b).

Table 5. Amphibian species with a high/confirmed or moderate likelihood of occurring within Argenta Slough.

Dependency on Lower Argenta Slough	Name[1]		Likelihood of Presence	Habitat Use	Federal Designation		Provincial Designation				
	Common	Scientific			COSEWIC Status	SARA Schedule	BC List	Identified Wildlife[2]	Regionally Significant[3]	Highest Conservation	Highest Conservation
high	Columbia Spotted Frog	*Rana luteiventris*	high/confirmed	breeding - probable	NAR (May 2000)		Yellow			2	2
	Long-toed Salamander	*Ambystoma macrodactylum*	high/confirmed	breeding - probable	NAR (Apr 2006)		Yellow			1	4
	Northern Pacific Treefrog	*Pseudacris regilla*	high/confirmed	breeding - confirmed			Yellow			1,2,3	6
	Western Toad	*Anaxyrus boreas*	high/confirmed	breeding - confirmed	SC (Nov 2012)	1-SC (Jan 2005)	Blue		y	2	2
-	Northern Leopard Frog	*Lithobates pipiens*	moderate	breeding - possible	E (Apr 2009)	1-E (Jun 2003)	Red	Y (May 2004)	y	3	1

[1] Search criteria for species included all species within the Interior Cedar Hemlock (ICH) Biogeoclimatic Zone, Kootenay Lake Forest District, Kootenay MOE Region, and Central Kootenay Regional District.

[2] Identified under the Identified Wildlife Management Strategy.

[3] Regional significance is based on wildlife species identified within the Fish and Wildlife Compensation Plan Draft (BC Hydro 2012) and the Duncan-Lardeau Flats Conservation Properties Land Management Plan (Krebs *et al.* 2013).

[4] Conservation Framework Goals are as follows: Goal 1: Contribute to global effects and ecosystem conservation; Goal 2: Prevent species and ecosystems from becoming at risk; and Goal 3: Maintain the diversity of native species and ecosystems.

[5] This value represents the highest conservation priority assigned to a Conservation Framework Goal under the Conservation Framework. Values range from 1 (highest) to 6 (lowest).

5.2.3.2. Avian Species

A total of 67 avian species have been observed within Argenta Slough (Table 6, Table 7). Breeding has been confirmed for five of these species: American Bittern *(Botaurus lentiginosus)*, Marsh Wren *(Cistothorus palustris),* Pied-billed Grebe *(Podilymbus podiceps)*, Red-winged Blackbird *(Agelaius phoeniceus)*, and Sora *(Porzana carolina)* (Table 6). All confirmed nest sites were located upstream of Beaver Dam 1 (Herbison 2015), thus, there is only a moderate potential these species would be dependent on habitat(s) within Lower Argenta Slough. The American Bittern is provincially blue-listed (CDC 2016b) and is the only at-risk species confirmed to breed within Argenta Slough. Two other blue-listed avian species, the Eared Grebe *(Podiceps nigricollis)* and Great Blue Heron *(Ardea herodias herodias)* have also been observed in Argenta Slough and could potentially breed within or near the slough; however any Great Blue Heron nests would be readily detectable so it is assumed that the Great Blue Heron predominantly uses the slough for foraging. The Horned Grebe *(Podiceps auritus)* is another at-risk species (assessed as Special Concern by COSEWIC) that has been observed in Argenta Slough and potentially breeds in the area. There is a high potential that Eared Grebes, Horned Grebes, and Great Blue Herons would be dependent on Lower Argenta Slough.

Argenta Slough also provides valuable foraging habitat, including migratory stopover and overwintering habitat to several species of waterfowl (Herbison 2015) (Table 7). The provincially blue-listed Tundra Swan (*Cygnus columbianus*) has been observed where the inflow of Carter Creek maintains open water during the winter, along with Canada Geese (*Branta canadensis*), Mallards (*Anas platyrhyncos*), and Trumpeter Swans (*Cygnus buccinator*) (Herbison 2015). These overwintering species are associated with a high potential dependency on Lower Argenta Slough. Five additional species at-risk have been documented foraging in the area: Common Nighthawk *(Chordeiles minor)* is federally listed as Threatened under SARA, Bobolink *(Dolichonyx oryzivorus)* is provincially blue-listed and has been assessed as Threatened by Committee on the Status of Endangered in Canada (COSEWIC), Lewis's Woodpecker *(Melanerpes lewis)* and Olive-sided Flycatcher *(Contopus cooperi)* are provincially blue-listed and federally listed as Threatened under SARA, and Western Grebe *(Aechmophorus occidentalis)* is provincially red-listed and has been assessed as Special Concern by COSEWIC. While Common Nighthawks and Olive-sided Flycatchers likely forage directly over Argenta Slough there is a low potential that they are dependent on Lower Argenta Slough. Bobolinks and Lewis's Woodpecker are more closely associated with adjacent riparian habitats, and Western Grebes are more closely associated with the adjacent riverine and lake habitats. Bobolinks were considered to have a moderate potential dependency on habitat within Lower Argenta Slough. There is a low potential that Lewis's Woodpecker and Western Grebes are dependent on Lower Argenta Slough.

Several other avian species have been assigned a moderate likelihood of occurring within Argenta Slough based on habitat requirements and range (Table 8). While all at-risk species were considered and habitat information within the BC Species and Ecosystems Explorer database was considered, where location information was missing, there may be additional not-

at-risk avian species with a moderate likelihood of occurring within Argenta Slough that are not listed within Table 8.

Table 6. Avian species with a high/confirmed likelihood of occurring within Argenta Slough that are also confirmed to breed or potentially breed in the area.

Dependency on Lower Argenta Slough	Name[1]		Habitat Use	Federal Designation		Provincial Designation				
	Common	Scientific		COSEWIC Status	SARA Schedule	BC List	Identified Wildlife[2]	Regionally Significant[3]	Highest Conservation Framework Goal[4]	Highest Conservation Framework Priority[5]
high	American Coot	*Fulica americana*	breeding - probable	NAR (May 1991)		Yellow			2	2
	American Wigeon	*Anas americana*	breeding - probable			Yellow			1,2,3	6
	Barrow's Goldeneye	*Bucephala islandica*	breeding - probable			Yellow			2	1
	Blue-winged Teal	*Anas discors*	breeding - probable			Yellow			2	2
	Bufflehead	*Bucephala albeola*	breeding - probable			Yellow			1,2,3	6
	Cinnamon Teal	*Anas cyanoptera*	breeding - probable			Yellow			2	4
	Eared Grebe	*Podiceps nigricollis*	breeding - probable			Blue			1,2	4
	Green-winged Teal	*Anas crecca*	breeding - probable			Yellow			3	5
	Horned Grebe	*Podiceps auritus*	breeding - probable	SC (Apr 2009)		Yellow			1,2	4
	Northern Pintail	*Anas acuta*	breeding - probable			Yellow			2	2
	Northern Shoveler	*Anas clypeata*	breeding - probable			Yellow			1,2,3	6
	Ring-necked Duck	*Aythya collaris*	breeding - probable			Yellow			1,2,3	6
	Ruddy Duck	*Oxyura jamaicensis*	breeding - probable			Yellow			1,2,3	6
	Solitary Sandpiper	*Tringa solitaria*	breeding - probable			Yellow			1,2,3	6
	Virginia Rail	*Rallus limicola*	breeding - probable			Yellow			2	2
	Wilson's Snipe	*Gallinago delicata*	breeding - probable			Yellow			2	2
	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	breeding - probable			Yellow			2	2
	Common Goldeneye	*Bucephala clangula*	breeding and overwintering - probable			Yellow			2	3
	Hooded Merganser	*Lophodytes cucullatus*	breeding and overwintering - probable			Yellow			1,2,3	6
	Great Blue Heron, *herodias*	*Ardea herodias herodias*	breeding - possible			Blue	Y (Jun 2006)	y	2	2
moderate	American Bittern	*Botaurus lentiginosus*	breeding - confirmed			Blue		y	2	2
	Marsh Wren	*Cistothorus palustris*	breeding - confirmed			Yellow			1	5
	Red-winged Blackbird	*Agelaius phoeniceus*	breeding - confirmed			Yellow			1,3	5
	Sora	*Porzana carolina*	breeding - confirmed			Yellow			1	5
	Pied-billed Grebe	*Podilymbus podiceps*	breeding - confirmed			Yellow			2	2
	Belted Kingfisher	*Megaceryle alcyon*	breeding - probable			Yellow			2	2
	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	breeding - probable			Yellow			2	2
	Northern Waterthrush	*Parkesia noveboracensis*	breeding - probable			Yellow				6
	Pacific Wren	*Troglodytes pacificus*	breeding - probable			Yellow			1,2,3	6
	Spotted Sandpiper	*Actitis macularius*	breeding - probable			Yellow			3	5
	Killdeer	*Charadrius vociferus*	breeding - possible			Yellow			2	2
	Northern Harrier	*Circus cyaneus*	breeding - possible	NAR (May 1993)		Yellow			2	2
	Ring-billed Gull	*Larus delawarensis*	breeding - possible			Yellow			3	5
low	Eastern Kingbird	*Tyrannus tyrannus*	breeding - probable			Yellow			2	2
	Orange-crowned Warbler	*Oreothlypis celata*	breeding - probable			Yellow			3	5
	Song Sparrow	*Melospiza melodia*	breeding - probable			Yellow			1,2,3	6
	Tree Swallow	*Tachycineta bicolor*	breeding - probable			Yellow			2	2
	Great Horned Owl	*Bubo virginianus*	breeding - possible			Yellow			1,2,3	6
	Osprey	*Pandion haliaetus*	breeding - possible			Yellow			1,2,3	6

[1] Search criteria for species included all species within the Interior Cedar Hemlock (ICH) Biogeoclimatic Zone, Kootenay Lake Forest District, Kootenay MOE Region, and Central Kootenay Regional District.

[2] Identified under the Identified Wildlife Management Strategy.

[3] Regional significance is based on wildlife species identified within the Fish and Wildlife Compensation Plan Draft (BC Hydro 2012) and the Duncan-Lardeau Flats Conservation Properties Land Management Plan (Krebs *et al.* 2013).

[4] Conservation Framework Goals are as follows: Goal 1: Contribute to global effects and ecosystem conservation; Goal 2: Prevent species and ecosystems from becoming at risk; and Goal 3: Maintain the diversity of native species and

[5] This value represents the highest conservation priority assigned to a Conservation Framework Goal under the Conservation Framework. Values range from 1 (highest) to 6 (lowest).

Table 7. Avian species with a high/confirmed likelihood of occurring within Argenta Slough or immediately adjacent habitats, but are unlikely to breed within Argenta Slough.

Dependency on Lower Argenta Slough	Name[1]		Habitat Use	Federal Designation		Provincial Designation				
	Common	Scientific		COSEWIC Status	SARA Schedule	BC List	Identified Wildlife[2]	Regionally Significant[3]	Highest Conservation Framework Goal[4]	Highest Conservation Framework Priority[5]
high	Canvasback	*Aythya valisineria*	foraging - migratory stopover - probable			Yellow			2	2
	Greater Scaup	*Aythya marila*	foraging - migratory stopover - probable			Yellow			2	2
	Least Sandpiper	*Calidris minutilla*	foraging - migratory stopover - probable			Yellow			2	4
	Lesser Scaup	*Aythya affinis*	foraging - migratory stopover - probable			Yellow			2	2
	Pacific Loon	*Gavia pacifica*	foraging - migratory stopover - probable			Yellow			3	5
	Red-breasted Merganser	*Mergus serrator*	foraging - migratory stopover - probable			Yellow			2	4
	Semipalmated Plover	*Charadrius semipalmatus*	foraging - migratory stopover - probable			Yellow			2	4
	Semipalmated Sandpiper	*Calidris pusilla*	foraging - migratory stopover - probable			Unknown			2	2
	Snow Goose	*Chen caerulescens*	foraging - migratory stopover - probable			Yellow			3	5
	Canada Goose	*Branta canadensis*	foraging - overwintering - confirmed			Yellow			1,2,3	6
	Mallard	*Anas platyrhynchos*	foraging - overwintering - confirmed			Yellow			3	5
	Trumpeter Swan	*Cygnus buccinator*	foraging - overwintering - confirmed	NAR (May 1996)		Yellow			1,3	5
	Tundra Swan	*Cygnus columbianus*	foraging - overwintering - confirmed			Blue			3	4
moderate	Bobolink	*Dolichonyx oryzivorus*	foraging - transient	T (Apr 2010)		Blue		y	2	2
	Eurasian Wigeon	*Anas penelope*	foraging - transient			No Status				Not Assessed
low	American Dipper	*Cinclus mexicanus*	foraging - transient			Yellow			1	5
	Common Loon	*Gavia immer*	adjacent	NAR (May 1997)		Yellow			1,2,3	6
	Common Merganser	*Mergus merganser*	adjacent			Yellow			3	5
	Common Nighthawk	*Chordeiles minor*	foraging - transient	T (Apr 2007)	1-T (Feb 2010)	Yellow		y	2	2
	Lewis's Woodpecker	*Melanerpes lewis*	adjacent	T (Apr 2010)	1-T (Jul 2012)	Blue	Y (May 2004)	y	3	2
	Mountain Bluebird	*Sialia currucoides*	adjacent			Yellow			1	4
	Northern Pygmy-Owl	*Glaucidium gnoma*	adjacent			Yellow			2	3
	Olive-sided Flycatcher	*Contopus cooperi*	adjacent	T (Nov 2007)	1-T (Feb 2010)	Blue		y	2	2
	Vaux's Swift	*Chaetura vauxi*	adjacent			Yellow		y	2	2
	Warbling Vireo	*Vireo gilvus*	adjacent			Yellow			1,2,3	6
	Western Bluebird	*Sialia mexicana*	adjacent			Yellow			1,2	4
	Western Grebe	*Aechmophorus occidentalis*	adjacent	SC (May 2014)		Red		y	3	1
	Yellow-rumped Warbler	*Setophaga coronata*	adjacent			Yellow			3	5

[1] Search criteria for species included all species within the Interior Cedar Hemlock (ICH) Biogeoclimatic Zone, Kootenay Lake Forest District, Kootenay MOE Region, and Central Kootenay Regional District.

[2] Identified under the Identified Wildlife Management Strategy.

[3] Regional significance is based on wildlife species identified within the Fish and Wildlife Compensation Plan Draft (BC Hydro 2012) and the Duncan-Lardeau Flats Conservation Properties Land Management Plan (Krebs *et al.* 2013).

[4] Conservation Framework Goals are as follows: Goal 1: Contribute to global effects and ecosystem conservation; Goal 2: Prevent species and ecosystems from becoming at risk; and Goal 3: Maintain the diversity of native species and ecosystems.

[5] This value represents the highest conservation priority assigned to a Conservation Framework Goal under the Conservation Framework. Values range from 1 (highest) to 6 (lowest).

Table 8. Avian species with a moderate likelihood of occurring within Argenta Slough[3].

Name[1]		Habitat Use	Federal Designation		Provincial Designation				
Common	Scientific		COSEWIC Status	SARA Schedule	BC List	Identified Wildlife[2]	Regionally Significant[3]	Highest Conservation Framework Goal[4]	Highest Conservation Framework Priority[5]
American Goldfinch	*Spinus tristis*	breeding - possible			Yellow			2	2
Gadwall	*Anas strepera*	breeding - possible			Yellow			1,2,3	6
Merlin	*Falco columbarius*	breeding - possible	NAR (May 1985)		Yellow			1,2,3	6
Northern Saw-whet Owl	*Aegolius acadicus*	breeding - possible			Yellow			3	5
Redhead	*Aythya americana*	breeding - possible			Yellow			2	2
Rufous Hummingbird	*Selasphorus rufus*	breeding - possible			Yellow			2	2
Violet-green Swallow	*Tachycineta thalassina*	breeding - possible			Yellow			2	2
Willow Flycatcher	*Empidonax traillii*	breeding - possible			Yellow			2	2
Wilson's Phalarope	*Phalaropus tricolor*	breeding - possible			Yellow			2	2
Wilson's Warbler	*Cardellina pusilla*	breeding - possible			Yellow			2	2
Wood Duck	*Aix sponsa*	breeding - possible			Yellow			2	1
Yellow Warbler	*Setophaga petechia*	breeding - possible			Yellow			2	2
Common Tern	*Sterna hirundo*	foraging - migratory stopover	NAR (May 1998)		Unknown			2	2
Greater White-fronted Goose	*Anser albifrons*	foraging - migratory stopover			Yellow			2	4
Double-crested Cormorant	*Phalacrocorax auritus*	foraging - migratory stopover - possible	NAR (May 1978)		Blue			2	2
Northern Shrike	*Lanius excubitor*	foraging - overwintering - possible			Yellow			2	4
Bald Eagle	*Haliaeetus leucocephalus*	foraging	NAR (May 1984)		Yellow			1,2,3	6
Cliff Swallow	*Petrochelidon pyrrhonota*	foraging			Yellow			2	2
Red-tailed Hawk	*Buteo jamaicensis*	foraging	NAR (May 1995)		Yellow			1,2,3	6
Short-eared Owl	*Asio flammeus*	foraging	SC (Mar 2008)	1-SC (Jul 2012)	Blue	Y (May 2004)		2	2
Yellow-breasted Chat	*Icteria virens*	foraging	E (Nov 2011)	1-E (Jun 2003)	Red	Y (May 2004)	y	3	1
Barred Owl	*Strix varia*	foraging - transient			Yellow			1,2,3	6
Golden Eagle	*Aquila chrysaetos*	foraging - transient	NAR (May 1996)		Yellow			2	4

[1] Search criteria for species included all species within the Interior Cedar Hemlock (ICH) Biogeoclimatic Zone, Kootenay Lake Forest District, Kootenay MOE Region, and Central Kootenay Regional District.

[2] Identified under the Identified Wildlife Management Strategy.

[3] Regional significance is based on wildlife species identified within the Fish and Wildlife Compensation Plan Draft (BC Hydro 2012) and the Duncan-Lardeau Flats Conservation Properties Land Management Plan (Krebs *et al.* 2013).

[4] Conservation Framework Goals are as follows: Goal 1: Contribute to global effects and ecosystem conservation; Goal 2: Prevent species and ecosystems from becoming at risk; and Goal 3: Maintain the diversity of native species and ecosystems.

[5] This value represents the highest conservation priority assigned to a Conservation Framework Goal under the Conservation Framework. Values range from 1 (highest) to 6 (lowest).

[3] The potential dependency of species on habitat(s) within Lower Argenta Slough was only assessed for species that have been observed within Argenta Slough (i.e., those with a high/confirmed potential of occurrence within Argenta Slough).

5.2.3.3. Mammals

Six mammal species, including two at-risk species, have been observed within Argenta Slough: American Beaver *(Castor canadensis)*, American Water Shrew *(Sorex palustris)*, Common Muskrat *(Ondatra zibethicus)*, North American River Otter *(Lontra canadensis)*, North American Water Vole *(Microtus richardsoni)*, and Townsend's Big-eared Bat *(Corynorhinus townsendii)* (Table 9) (Herbison 2015). The American Water Shrew and Townsend's Big-eared Bat are provincially blue-listed (CDC 2016b). The American Beaver, American Water Shrew, Common Muskrat, and North American Water Vole likely breed within Argenta Slough and are likely highly dependent on Lower Argenta Slough. The North American River Otter and Townsend's Big-eared Bat are more closely associated with adjacent habitats and likely do not rely on habitat within Argenta Slough for breeding and are thus associated with a moderate and low potential, respectively, to be dependent on Lower Argenta Slough. An additional 17 mammal species have a moderate likelihood of occurring within the slough, including two at-risk species: Grizzly Bears *(Ursus arctos)* (assessed as Special Concern by COSEWIC and considered regionally significant) may forage within Argenta Slough as part of a larger home range, and Little Brown Myotis *(Myotis lucifugus)* (federally listed as Endangered under SARA) may forage over Argenta Slough.

Argenta Slough falls within a legally designated Mule Deer *(Odocoileus hemionus)* ungulate winter range (UWR) (u-4-001 91-MD_121) (MOE 2007); legislated under Section 12 of the *Forests and Range Practices Act* (FRPA 2002) Government Actions Regulation (GAR 2004); however, Argenta Slough itself likely provides little suitable winter foraging habitat due to the lack of snow interception cover and available winter forage. The associated legislated Order and the general wildlife measures restricts forest harvesting within the UWR unless it is for the purpose of improving the quality of the winter range, removing danger trees or approved by statutory decision maker (MOE 2007). Argenta Slough may provide foraging habitat to other regionally significant ungulates such as Moose *(Alces americanus)* and White-tailed Deer *(Odocoileus virginianus)* (Table 9).

Table 9. Mammal species with a high/confirmed or moderate likelihood of occurring within Argenta Slough.[4]

Dependency on Lower Argenta Slough	Name[1]		Likelihood of Presence	Habitat Use	Federal Designation		Provincial Designation				
	Common	Scientific			COSEWIC Status	SARA Schedule	BC List	Identified Wildlife[2]	Regionally Significant[3]	Highest Conservation Framework Goal[4]	Highest Conservation Framework Priority[5]
high	American Beaver	*Castor canadensis*	high/confirmed	breeding - probable			Yellow			3	5
	American Water Shrew	*Sorex palustris*	high/confirmed	breeding - probable			Blue			1,2,3	6
	Common Muskrat	*Ondatra zibethicus*	high/confirmed	breeding - probable			Yellow			1,2,3	6
	North American Water Vole	*Microtus richardsoni*	high/confirmed	breeding - probable			Yellow			1,3	5
moderate	North American River Otter	*Lontra canadensis*	high/confirmed	foraging - transient			Yellow			2	4
low	Townsend's Big-eared Bat	*Corynorhinus townsendii*	high/confirmed	adjacent			Blue		y	2	2
-	American Black Bear	*Ursus americanus*	moderate	foraging - transient	NAR (May 1999)		Yellow			1,2,3	6
-	American Mink	*Neovison vison*	moderate	breeding - probable			Yellow			1,2,3	6
-	Cougar	*Puma concolor*	moderate	foraging - transient			Yellow			1	4
-	Coyote	*Canis latrans*	moderate	foraging - transient			Yellow			1,2,3	6
-	Elk	*Cervus elaphus*	moderate	foraging - transient			Yellow		y	1	5
-	Grizzly Bear	*Ursus arctos*	moderate	foraging - transient	SC (May 2002)		Blue	Y (May 2004)	y	2	2
-	Least Weasel	*Mustela nivalis*	moderate	foraging - possible			Yellow			2,3	4
-	Little Brown Myotis	*Myotis lucifugus*	moderate	foraging - possible	E (Nov 2013)	1-E (Dec 2014)	Yellow			3	5
-	Long-tailed Weasel	*Mustela frenata*	moderate	foraging - possible			Yellow			1,2,3	6
-	Meadow Vole	*Microtus pennsylvanicus*	moderate	foraging - possible			Yellow			1,2,3	6
-	Moose	*Alces americanus*	moderate	foraging - transient			Yellow			1,2,3	6
-	Mule Deer	*Odocoileus hemionus*	moderate	foraging - transient			Yellow		y	1,2,3	6
-	Raccoon	*Procyon lotor*	moderate	foraging - possible			Yellow			1,2,3	6
-	Silver-haired Bat	*Lasionycteris noctivagans*	moderate	foraging - possible			Yellow			2	2
-	Striped Skunk	*Mephitis mephitis*	moderate	foraging - possible			Yellow			1,2,3	6
-	White-tailed Deer	*Odocoileus virginianus*	moderate	foraging - transient			Yellow		y	1,2,3	6
-	Yuma Myotis	*Myotis yumanensis*	moderate	foraging - possible			Yellow			1,2,3	6

[1] Search criteria for species included all species within the Interior Cedar Hemlock (ICH) Biogeoclimatic Zone, Kootenay Lake Forest District, Kootenay MOE Region, and Central Kootenay Regional District.

[2] Identified under the Identified Wildlife Management Strategy.

[3] Regional significance is based on wildlife species identified within the Fish and Wildlife Compensation Plan Draft (BC Hydro 2012) and the Duncan-Lardeau Flats Conservation Properties Land Management Plan (Krebs *et al.* 2013).

[4] Conservation Framework Goals are as follows: Goal 1: Contribute to global effects and ecosystem conservation; Goal 2: Prevent species and ecosystems from becoming at risk; and Goal 3: Maintain the diversity of native species and ecosystems.

[5] This value represents the highest conservation priority assigned to a Conservation Framework Goal under the Conservation Framework. Values range from 1 (highest) to 6 (lowest).

[4] The potential dependency of species on habitat(s) within Lower Argenta Slough was only assessed for species that have been observed within Argenta Slough (i.e., those with a high/confirmed potential of occurrence within Argenta Slough).

5.2.3.4. Reptiles

Three reptile species, including one at-risk species, have been observed within Argenta Slough: Painted Turtle *(Chrysemys picta)*, Common Gartersnake *(Thamnophis sirtalis)*, and Terrestrial Gartersnake *(Thamnophis elegans)* (Herbison 2015) (Table 10). The Painted Turtle is federally listed as Special Concern and provincially blue-listed (CDC 2016b). Painted Turtles breed within Argenta Slough at a known nesting site upstream of Beaver Dam 1 (Herbison 2013) and are thus associated with a moderate potential dependency on the Lower Argenta Slough. The Northern Rubber Boa *(Charina bottae)* (federally listed as Special Concern under SARA), has also been observed within a minimum of 1.5 km of Argenta Slough (DataBC 2016) and has thus been categorized as having a high/confirmed likelihood of occurring within Argenta Slough (Table 10). The Common Gartersnake, Terrestrial Gartersnake and Northern Rubber Boa are associated with low potential dependency on Lower Argenta Slough.

Table 10. Reptile species with a high/confirmed likelihood of occurring within Argenta Slough.

Dependency on Lower Argenta Slough	Name[1]		Habitat Use	Federal Designation		Provincial Designation				
	Common	Scientific		COSEWIC Status	SARA Schedule	BC List	Identified Wildlife[2]	Regionally Significant[3]	Highest Conservation Framework Goal[4]	Highest Conservation Framework Priority[5]
moderate	Painted Turtle -	*Chrysemys picta* pop. 2	breeding - confirmed	SC (Apr 2006)	1-SC (Dec 2007)	Blue		y	3	2
low	Common Gartersnake	*Thamnophis sirtalis*	breeding - probable			Yellow			3	5
	Northern Rubber Boa	*Charina bottae*	breeding - possible	SC (May 2003)	1-SC (Jan 2005)	Yellow		y	2	1
	Terrestrial Gartersnake	*Thamnophis elegans*	breeding - probable			Yellow			1	4

[1] Search criteria for species included all species within the Interior Cedar Hemlock (ICH) Biogeoclimatic Zone, Kootenay Lake Forest District, Kootenay MOE Region, and Central Kootenay Regional District.

[2] Identified under the Identified Wildlife Management Strategy.

[3] Regional significance is based on wildlife species identified within the Fish and Wildlife Compensation Plan Draft (BC Hydro 2012) and the Duncan-Lardeau Flats Conservation Properties Land Management Plan (Krebs *et al.* 2013).

[4] Conservation Framework Goals are as follows: Goal 1: Contribute to global effects and ecosystem conservation; Goal 2: Prevent species and ecosystems from becoming at risk; and Goal 3: Maintain the diversity of native species and ecosystems.

[5] This value represents the highest conservation priority assigned to a Conservation Framework Goal under the Conservation Framework. Values range from 1 (highest) to 6 (lowest).

5.2.4. Connectivity

From a hydrological perspective, wetland and riparian habitat within Lower Argenta Slough is highly connected during periods of high water level, particularly during the spring freshet when the slough is flooded by Kootenay Lake (as described in Section 5.2.1), and less connected during low water periods (Map 3; see also photo documentation in Herbison 2015). However, the timing and duration of this connectivity has not been documented, and can only be estimated based on Kootenay Lake levels (as described in Section 5.2.1) and a handful of photographs. Map 3 consists of two orthophoto images of Lower Argenta Slough, one taken on April 30, 2009 when Duncan River discharge was 73 m^3/s, and the other on July 11, 2011 when river flows were 215 m^3/s. The difference in wetted area of shallow water habitat between low and high water levels in these images is approximately 21,147 m^2; this equates to almost a doubling of wetted area within Lower Argenta Slough (Map 3). It is expected that hydrological connectivity between the Upper Slough and Lower Slough shallow water habitats also increases during backwater events. However, without water level data from both the Upper and Lower Slough, it is not possible to know the timing and duration of hydrologic connection between these habitats.

Beaver activity also plays a large role in the hydrologic connectivity of the Upper and Lower Sloughs. In the past, beaver dams have decreased the hydrologic connection between these two areas. Beaver activity may also affect the hydrologic connection between habitats within the Lower Slough; however, this has not been documented.

With respect to vegetation community composition, hydrological connection may influence wetland vegetation by facilitating the movement of propagules between habitats, providing a cue for germination through the delivery of water, and/or by modifying hydraulic habitat (Thoms *et al.* 2016). The degree of habitat connection can also influence the movement of wildlife. Map 2 shows a high degree of linear connection between shallow water vegetation communities, marsh, and eastern flood/forest communities (specifically Fm02, map number 3b), which may act as corridors for wildlife movement, provided that habitat conditions are suitable. Other communities, like the red-listed Cottonwood-Spruce-Red-osier dogwood vegetation community (Fm02/03, map number 3a) exist in two isolated, almost linear patches, located directly adjacent to Lower Duncan River; though the northern patch may be connected to similar habitat in Upper Argenta Slough, and the southern patch could be accessed from the other flood forest community (Fm02, map number 3b).

6. SUMMARY

The Argenta Slough Ecological Inventory is summarized below and in Table 11. There are a number of data gaps and limitations that restrict wetland delineation and classification, and impede an overall quantitative assessment of ecological function and condition of the Lower Argenta Slough; these have been outlined throughout the report and summarized below.

6.1. Wetland Delineation and Classification

The Lower Argenta Slough is a wetland complex that supports shallow water, seasonally flooded marsh, and flood/riparian forest ecosystems. Wetland ecosystem types and vegetation communities were identified and delineated to the extent possible in consideration of minimal background information, including limited data on vegetation species and soil composition. Ecosystems were also delineated on photographs from 2009 and 2011. Further, the biogeoclimatic classifications and site series in the ICHdw1 were in the process of being reclassified with more detailed inventory information at the time the mapping for this project was conducted. Lastly, it is expected that the vegetation composition of the Lower Argenta Slough is changing and that delineations may not best represent the current state of the slough.

6.2. Wetland Function and Condition

6.2.1. Hydrology and Connectivity

Due to the lack of existing water level and flow data, assessment of wetland hydrological function and condition was largely qualitative. Inferences on the hydrologic condition of the Lower Argenta Slough were made from locally available climate and hydrology data and reports.

Local climate data show warmer air temperatures in both winter and the growing season in recent years, coupled with increased precipitation for all months except April and July. An increase in air temperature has likely resulted in an increase in evapotranspiration rates, potentially resulting in greater water level drawdown during the growing season. These changes have likely resulted in alterations to the vegetation community composition.

Water levels within the slough are highly affected by Kootenay Lake backwatering during the spring freshet; however, the duration and timing of these floods is variable. After the spring freshet, water levels in the slough are expected to slowly recede through late summer to perennial low levels in winter. Lower Argenta Slough may receive groundwater inputs from Lower Duncan River when river stage is high.

From a hydrological perspective, wetland and riparian habitat within Lower Argenta Slough is highly connected during periods of high water level, particularly during the spring freshet when the slough is flooded by Kootenay Lake, and less connected during low water periods. However, the timing and duration of this connectivity has not been documented.

Temperature data is currently being collected at the Lower Slough. Changes to the temperature regime could be due to a number of reasons, including groundwater inputs, lowering of water levels due to evaporation or drainage, and/or river flooding.

In the past, beaver activity has had the effect of ponding water in Upper Argenta Slough and reducing water levels in Lower Argenta Slough (Herbison 2006); however, the effect of beaver activity on the hydrology of the site has not been documented in recent years.

6.2.2. Vegetation Composition

Ecosystems at-risk occurring in the Lower Argenta Slough include blue-listed Common cattail marsh (Wm05) and Great bulrush communities (Wm06), and likely include the red-listed Cottonwood – Spruce – Red-osier dogwood (Fm02) or black cottonwood/ common snowberry – roses (Fm01) and Swamp horsetail – Beaked sedge (Wm51) communities and may include the three-way sedge community (Wm51). It is currently unknown if any rare plants occur in Lower Argenta Slough. Considering the expected soil nutrient and moisture regime, it is possible that other communities at-risk, as well as rare plants occur in the Lower Argenta Slough.

6.2.3. Wildlife Use

Three at-risk species have been confirmed to breed in Argenta Slough: American Bittern, Western Toad and Painted Turtle; however no American Bittern or Painted Turtle nests sites have been detected downstream of Beaver Dam 1. Lower Argenta Slough has been confirmed to provide rearing habitat to Western Toads. An additional three at-risk species have been detected in Argenta Slough and potentially breed there: Eared Grebe, Horned Grebe and American Water Shrew. Furthermore, Northern Rubber Boas have been detected near Argenta Slough and potentially breed in the vicinity.

Argenta Slough provides foraging habitat to a number of at-risk species, including: Tundra Swan, Great Blue Heron, Lewis's Woodpecker, Olive-sided Flycatcher and Bobolink. Argenta Slough also provides migratory stopover and avian overwintering habitat. Argenta Slough falls within a legally designated UWR; however, Lower Argenta Slough is unlikely to provide critical winter foraging habitat for Mule Deer due to a lack of snow interception cover and exposed winter vegetation.

All of these at-risk, regionally significant, and migratory species may have a high to moderate dependency on Lower Argenta Slough; however, targeted surveys have not been conducted and thus, there is a lack of understanding of critical wildlife habitat functions provided by Lower Argenta Slough.

Table 11. Argenta Slough Ecological Inventory summary, including wetland types, status, and function and condition.

Ecosystem type	Wetland community map number	Site association or Site series code	Area (ha)	Conservation Rank			Hydrology	Vegetation Composition	Wildlife	Connectivity	Other Features or Comments	Confidence in Classification
				BC List	Provincial	Global						
Shallow Water	1a	Shallow water	1.51	SNR	No status	GNR	Sluggish water; receives year-round flow from Carter Creek, subsurface seepage, and flooding during freshet.	Dense aquatic vegetation[1].	Likely provides abundant forage for ungulates, small mammals, and waterfowl[1].	Potentially high, especially when connected to upstream and downstream shallow water habitat.	Calcium carbonate deposits, reported to be locally unique and rare by local resident[1].	L
	1b	Shallow water	0.83	SNR	No status	GNR	Sluggish, subsurface seepage, flooding during freshet.	Some aquatic vegetation.		Potentially high, especially when L connected to upstream and downstream shallow water habitat.		
	1c	Shallow water	0.04	SNR	No status	GNR	Subsurface seepage and flooding during freshet.			Low given its small size, may have high hydrologic connection during high flows and flooding events.		M
Marsh	2a	Wm05/Wm06	0.74	Blue	S3 (2004)	G5	Subsurface seepage and flooding during freshet, water table likely below surface by end of summer due to evapotranspiration.	Cattail marsh with patches of bulrush, transitioning to reed canary grass and other grasses and sedges.	Common Muskrat, American Bittern, Red-winged Blackbird and other marsh birds [1].	Medium connectivity - small area, but stretches the length of shallow water habitat identified and described as 1a.	The condition and extent of the cattail marsh has been variable the past five plus years[1], bulrush community may be similar red-listed community.	M
	2b	Wm01 (Wm02)	5.51	Blue	S4 (2010)	G4	Flooded some years.[1]	Transition from sedges to grasses, thickly vegetated.	Northern Harrier, Garter Snake, White-tailed Deer, Elk, and Bobolink. In some years, Western Toad hatchlings have been observed[1].	Medium connectivity - though only one large patch, its large area encompasses much of the western side of the slough.	Conservation rank is for Wm02 (Swamp horsetail - Beaked sedge) community, Wm01 is yellow-listed.	L
	2c	Wm01 (Wf01)	6.39	Yellow	S4 (2004)	G4	Floods during freshet and high water events, east slope saturated from subsurface upslope flow.	Flava sedge and water sedge[1], thick cover of other sedges and grasses including infilling with reed canary grass in some areas.	Western toadlets utilize in fall and winter of 1st year and the spring of the year1. Water Vole and Water Shrew recorded in 1980s. Meadow Voles, Common Snipe, Great Blue Heron observed foraging[1].	High connectivity throughout mid-to lower sections. A small patch exists next to Lower Duncan River which has low connectivity	Woody debris has been washed up over L much of the polygon. Could support red-listed Wm51 (three-way sedge) community.	
	2d	Wm05 (Wm02)	2.30	Blue	S3 (2004)	G5	Potential subsurface recharge[1], considerable evapotranspiration.	Cattails, other salt tolerant sedges and grasses.	Changed from marsh (pre 2008) to shallow open water much of the year by 2011. May be receiving water infiltrating underground from the river.	Medium connectivity - two linear patches run parallel to each other, separated by Wm01 (2c) habitat. Potentially connected to similar habitat in Upper Argenta Slough.	Brackish	L
Flood/Forest	3a	Fm02	2.34	Red	S2 (2010)	GNR	Floods some years, water movement through root systems most of year.	Middle bench, cottonwood dominated floodplain forest with shrubs including willows and red-osier dogwood. Older sites may host young spruce.	Mature cottonwood provide valuable nesting habitat to several avian species and young trees and shrubs provide valuable forage for ungulates.	Medium connectivity- northern patch likely connected to similar habitat in the upper slough. Area of southwestern patch large, but disconnected from similar habitat; though accessible to the linear corridor of the Fm02/03 (3b) community.	Potential to support Fm01 (black cottonwood/ common snowberry - roses) red-listed community	M
	3b	Fm02/03	1.92	-	-	-	Receives subsurface flow from upslope and toe slope moisture from slough.	Moisture receiving site with cottonwood, alder, aspen, willow and other shrubs, transition to drier Douglas-fir dominated upslope forest.		High connectivity - habitat stretches the length of the lower slough and may be connected to similar habitat in the upper slough.		M

* note brackets denoting second site series means that the association is close the bracketed association, the backslash indicates that both ecosystems are present within the polygon.

[1]Herbison 2015 Draft

[2]B.C. List Status are assigned based on the Subnational Conservation Status. Red includes any ecological community that is Extirpated, Endangered, or Threatened in B.C. Blue includes any ecological communities that are considered to be of Special Concern in B.C. These communities are particularly sensitive or vulnerable to human activities or natural events. Yellow communities are expected to be secure.

[3]Provincial Conservation Status refers to the species or ecological communities conservation status in BC. S2 = imperiled, S3=special concern, vulnerable to extirpation or extinction.

[4]Global Rank applies to the ecological community across its entire range. G2=imperiled, G3=vulnerable to extirpation or extinction, G4=apparently secure, GNR=unranked.

REFERENCES

BC Hydro. 2012. Fish and Wildlife Compensation Program, Columbia Basin Plan. Draft. June 2012. Available online at: http://fwcp.ca/app/uploads/2015/07/fwcp_ColumbiaBasinPlan_2012_jun.pdf. Accessed on March 24, 2016.

Braumandle, T.F. and M.P. Curran. 1992. A Field Guide for Site Identification and Interpretation for the Nelson Forest Region. May 1992. Available online at: https://www.for.gov.bc.ca/hfd/pubs/docs/Lmh/Lmh20-1.pdf. Accessed on March 23, 2016.

CDC (BC Conservation Data Centre). 2016a. Element Occurrence Specifications. Available online at: http://www.env.gov.bc.ca/cdc/ecology/eospecs.html. Accessed on March 23, 2016.

CDC (BC Conservation Data Centre). 2016b. BC Species and Ecosystems Explorer. Available online at: http://a100.gov.bc.ca/pub/eswp/. Accessed on March 23, 2016.

DataBC. 2016. iMapBC 2.0. Available online at: http://maps.gov.bc.ca/ess/sv/imapbc/. Accessed on March 25, 2016.

FLNRO (BC Ministry of Forests, Lands, and Natural Resource Operations). 2016. Best Management Practices for Amphibian and Reptile Salvages in British Columbia. Version 1.0., February 10, 2016.

FRPA (Forest and Range Practices Act). 2002. SBC 2002, Chapter 69. Available online at: http://www.bclaws.ca/Recon/document/ID/freeside/00_02069_01. Accessed on March 17, 2016.

GAR *(Forest and Range Practices Act* – Government Actions Regulation). 2004. Available online at http://www.bclaws.ca/civix/document/id/complete/statreg/582_2004. Accessed on March 29, 2016.

Government of Canada. 1991. The Federal Policy on Wetland Conservation. Canadian Wildlife Service, Environment Canada, Ottawa, ON. Available online at: http://nawcc.wetlandnetwork.ca/Federal%20Policy%20on%20Wetland%20Conservation.pdf. Accessed on March 27, 2016.

Herbison B., A. McIntosh, and I. Robertson, 2002. Duncan Dam Wildlife Overview Robertson Environmental Services. Consultant's report prepared for BC Hydro, Burnaby, B.C.

Herbison, B. 2006. Review of water-level management options for the Argenta Slough. Unpublished report prepared for the Fish and Wildlife Compensation Program (FWCP). Nelson, BC.

Herbison B. 2013. Painted Turtles. Annual reports from 1997. Columbia Basin Fish and Wildlife Compensation Program, Nelson.

Herbison, B. 2015. Duncan Dam Water Use Plan, Lower Duncan River Argenta Slough Erosion Protection, Ecological Inventory. Draft. September 2015.

IAPP (Invasive Alien Plant Program). 2016. Available online at: http://maps.gov.bc.ca/ess/hm/iapp/. Accessed on March 21, 2016.

Jackson, M., M. Evelyn, S. McMahon and J. Sheppard. 2009. DDMMON#9: Lower Duncan River Mosquito Monitoring and Management Plan Development. Consultant's report prepared by Culex Environmental, Ltd. for BC Hydro. Available online at: https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/planning_regulatory/wup/southern_interior/2010q2/ddmmon-9_yr1_jan_2010.pdf. Accessed on: March 26, 2016.

Jackson, M., S. McMahon, A. Thielman, B. Herbison, S. Rodman and T. Howay. 2014. DDMMON#9: Lower Duncan River Mosquito Monitoring and Management Plan Development (Year 4). Consultant's report prepared by Culex Environmental, Ltd. for BC Hydro. March 11, 2014. Available online at: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/environment-sustainability/water-use-planning/southern-interior/ddmmon-9-yr4-2014-03-11.pdf. Accessed on March 26, 2016.

Jackson, M., C. Phelan, J. Scholefield, S. McMahon and R. Munshaw. 2015. DDMMON#9: Lower Duncan River Mosquito Monitoring and Management Plan Development (Year 6). Consultant's report prepared by Culex Environmental, Ltd. for BC Hydro.

Krebs, J., R. Clarke and R. Neil. 2013. Duncan – Lardeau Flats Conservation Properties Land Management Plan. Report prepared for the Fish and Wildlife Compensation Program and the Nature Trust of BC. Available online at: http://a100.gov.bc.ca/appsdata/acat/documents/r40329/FinalDuncan-LardeauFlatsConservationPropertiesLan_1448045156746_8044947991.pdf. Accessed on March 21, 2016.

Mackenzie, W. and J. Moran. 2004. Wetlands of British Columbia: A Guide to Identification. Land Management Handbook Number 52. Research Branch, Ministry of Forests. Victoria, BC.

Mackillop, D. 2012. Kootenay-Boundary BEC Update. Available online at: https://www.for.gov.bc.ca/HRE/becweb/Downloads/Downloads_BEC_Updates/Kootenay-Boundary%20BEC%20update%20March%202012.pdf. Accessed on March 22, 2016.

MacKillop, D.J. and A.J. Ehman. 2016. A Field Guide to Site Classification and Identification for Southeast British Columbia: The South-Central Columbia Mountains; also Includes a Supplement for Four Biogeoclimatic Subzones/Variants in the Boundary-Okanagan: Land Management Handbook 70. British Columbia Ministry of Forests, Lands and Natural Resource Operations. Available online at: https://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh70.htm. Accessed January 18, 2017.

Matsubara, D. and E. Ellis. 2010. DDMWORKS -1 Argenta Slough Erosion Protection Assessment. Technical Memorandum prepared for BC Hydro, Burnaby, British Columbia by Kerr Wood Leidal Consulting Engineers.

Matsubara, D. and E. Ellis. 2013. Physical Works No. DDMWORKS-01. Technical Memorandum: 2013 Argenta Slough Assessment. Technical Memorandum prepared for BC Hydro, Burnaby, British Columbia by Kerr Wood Leidal Consulting Engineers. November 29, 2013. 16pp.

MOE (BC Ministry of Environment). 1991. Granby Kettle Terrestrial Ecosystem Mapping.

MOE (BC Ministry of Environment). 2006. Provincial Site Series and Map Code List. Available online at: http://www.env.gov.bc.ca/ecology/tem/list.html. Accessed on March 25, 2016.

MOE (BC Ministry of Environment). 2007. Order – Ungulate Winter Range #U-4-001 – West Kootenay (Arrow TSA, Kootenay Lake TSA, Revelstoke, TSA, TFL 3, TFL 23). February 7, 2007. Available online at: http://www.env.gov.bc.ca/wld/documents/uwr/Order_4-001_ddmwTFL3_Feb07.pdf. Accessed on March 25, 2016.

MOF (BC Ministry of Forests). 2002. A Field Guide for Site Identification and Interpretation for the Nelson Forest Region. Land Management Handbook Number 20. Available online at: https://www.for.gov.bc.ca/hfd/pubs/docs/lmh/LMH20-2.pdf. Accessed on March 23, 2016.

Polzin M.L., S.B. Rood, and B. Herbison. 2010. DDMMON #8-1 Lower Duncan River Riparian Cottonwood Monitoring Program. Year 2 Annual Report – 2010. Interior Reforestation Co. Ltd. and University of Lethbridge, Alberta. Report by Interior Reforestation Co. Ltd., Cranbrook, B.C., for BC Hydro Generations, Water License Requirements, Castlegar, B.C. 74 pp. + appendices. Available online at: https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/planning_regulatory/wup/southern_interior/2011q1/ddmmon-8_yr2_2011-03-01.pdf Accessed on March 31, 2016.

Polzin, M. and S.B. Rood. 2013. DDMMON#8-1 Lower Duncan River Riparian Cottonwood Monitoring Year 3 Annual Report (2012). Consultant's report prepared by Vast Resource Solutions for BC Hydro. Available online at: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/environment-sustainability/water-use-planning/southern-interior/lower-duncan-river-riparian-cottonwood-monitoringddmmon-8-1-yr3-march-2013.pdf. Accessed on March 26, 2016.

Polzin, M.L., and S.B. Rood. 2014. DDMMON #8-1 Lower Duncan River Riparian Cottonwood Monitoring Program. Year 4 Report – 2013. Vast Resource Solutions and University of Lethbridge, Alberta. Unpublished report by Vast Resource Solutions, Cranbrook, B.C., for BC Hydro Generations, Water License Requirements, Castlegar, BC. 53 pp. + Apps. Available online at: https://www.bchydro.com/content/dam/BCHydro/customer-

portal/documents/corporate/environment-sustainability/water-use-planning/southern-interior/ddmmon-8-1-yr4-2014-03-01.pdf Accessed on March 29, 2016.

RIC (Resources Inventory Committee). 1998. Standard for terrestrial ecosystem mapping in British Columbia. Terrestrial Ecosystems Task Force, Ecosystems Working Group. Victoria, BC. May 1998. Available online at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/tem/tem_man.pdf Accessed on March 27, 2016.

RIC (Resources Inventory Committee). 2000. Standard for terrestrial ecosystem mapping (TEM) – Digital data capture in British Columbia. Terrestrial Ecosystems Task Force, Ecosystems Working Group. Victoria, BC. April 2000. Available online at: https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/temcapture/assets/tem.pdf Accessed on March 27, 2016.

SARA (*Species at Risk Act*). 2002. S.C. 2002, c.29. Available online at: http://laws-lois.justice.gc.ca/eng/acts/S-15.3/. Accessed on March 24, 2016.

Thoms, M.C., M.C. Reid, and M.A. Reid. 2016. Ecological significance of hydrological connectivity for wetland plant communities on a dryland floodplain river, MacIntyre River, Australia. Aquatic Sciences, 78(1),139-158. DOI: 10.1007/s00027-015-0414-7

PERSONAL COMMUNICATION

Mackillop, D. 2012. Research Ecologist, FLNRO. In person communication with Leah Ballin, Ecofish Research, August 2012.

Mackillop, D. 2016. Research Ecologist, FLNRO. Email communication with Leah Ballin, Ecofish Research, June 13, 2016.

PROJECT MAPS

ARGENTA SLOUGH ECOLOGICAL INVENTORY

Argenta Slough Study Area

Legend

- Argenta Slough Extent
- Lower Argenta Slough

MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 50 100 200 300 400 500 m

Scale: 1:10,000

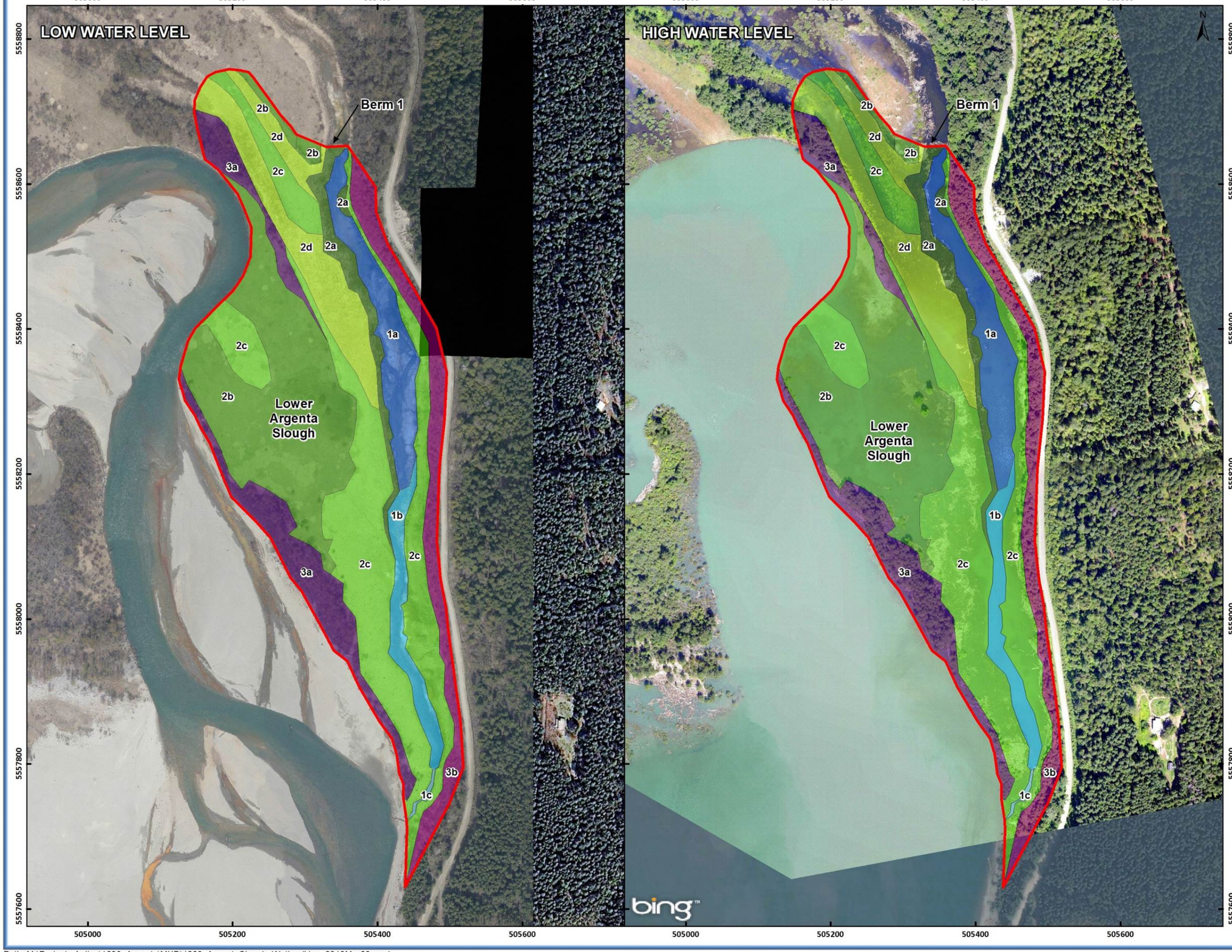
NO.	DATE	REVISION	BY
1	24/03/2016	1293_ArgentaSlough_StudyArea_2016Mar24	CGA
2			
3			
4			
5			

Date Saved: 24/03/2016
Coordinate System: NAD 1983 UTM Zone 11N

ECOFISH RESEARCH

Map 1

Path: M:\Projects-Active\1293_Argenta\MXD\1293_ArgentaSlough_StudyArea_2016Mar24.mxd



ARGENTA SLOUGH ECOLOGICAL INVENTORY

Argenta Slough Wetland Vegetation Communities

Legend

- Lower Argenta Slough

Ecosystem Type (Vegetation community map number)

Shallow Water

- 1a
- 1b
- 1c

Marsh

- 2a
- 2b
- 2c
- 2d

Flood/Forest

- 3a
- 3b

MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 50 100 200 m

Scale: 1:5,000

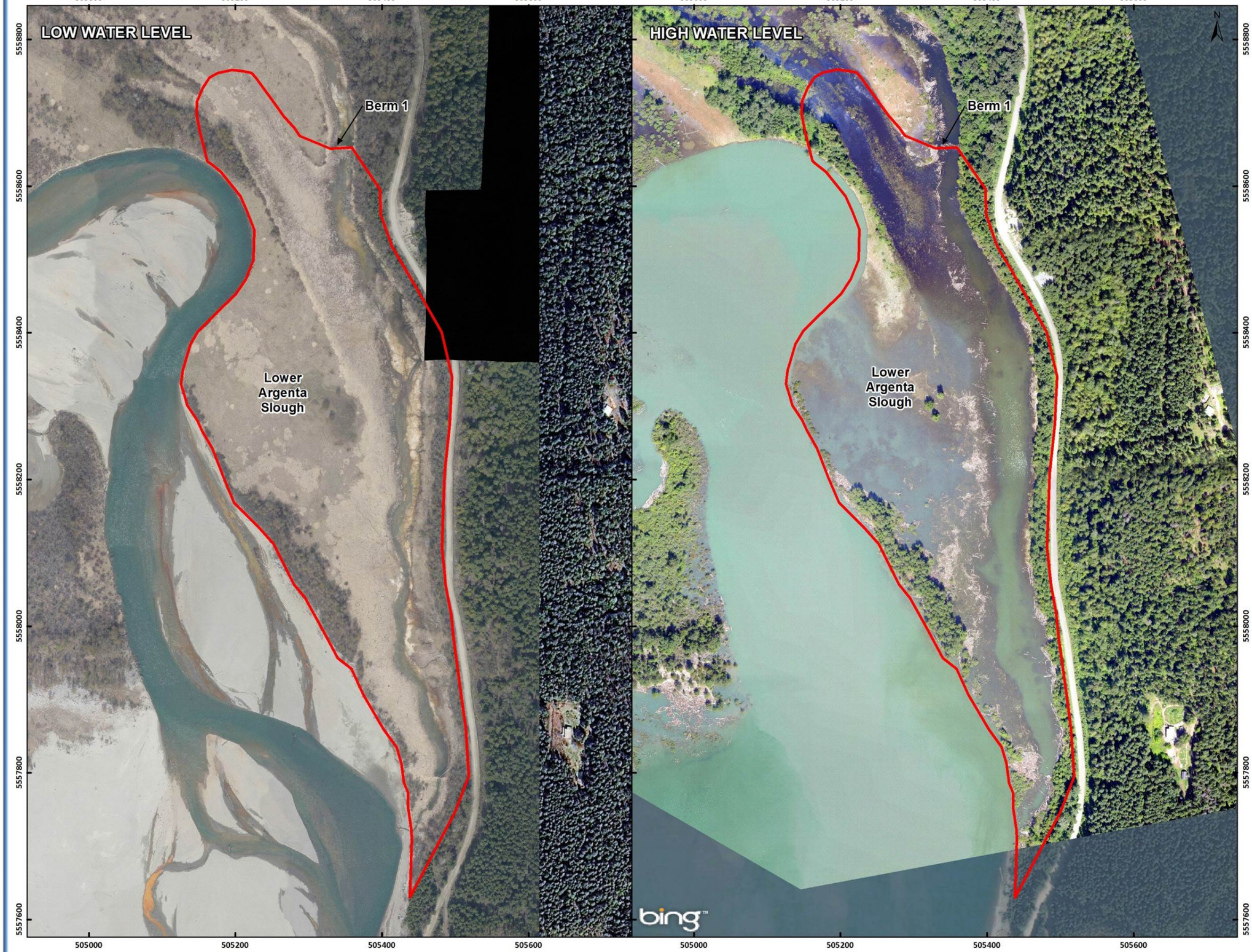
NO.	DATE	REVISION	BY
1	28/03/2016	1293_ArgentaSlough_WetlandVeg_2016Mar28	CGA
2			
3			
4			
5			

Date Saved: 28/03/2016
Coordinate System: NAD 1983 UTM Zone 11N

ECOFISH RESEARCH

Map 2

Path: M:\Projects-Active\1293_Argenta\MXD\1293_ArgentaSlough_WetlandVeg_2016Mar28.mxd



ARGENTA SLOUGH ECOLOGICAL INVENTORY

Argenta Slough
Low and High Water Level

Legend

Lower Argenta Slough

MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 50 100 200 m

Scale: 1:5,000

NO.	DATE	REVISION	BY
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2			
3			
4			
5			

Date Saved: 28/03/2016
Coordinate System: NAD 1983 UTM Zone 11N

ECOFISH RESEARCH

Map 3

Path: M:\Projects-Active\1293_Argenta\MXD\1293_ArgentaSlough_WaterLevel_2016Mar24.mxd

Appendix A. Wildlife species with a low or negligible likelihood of occurrence within Argenta Slough

Table 1. Amphibian and avian species with a low or negligible likelihood of occurring within Argenta Slough.

Species Group	Common Name	Scientific Name
amphibian	Coeur d'Alene Salamander	*Plethodon idahoensis*
avian	American Kestrel	*Falco sparverius*
	Barn Swallow	*Hirundo rustica*
	Black Swift	*Cypseloides niger*
	Black Tern	*Chlidonias niger*
	Boreal Owl	*Aegolius funereus*
	Brown Creeper	*Certhia americana*
	Chestnut-backed Chickadee	*Poecile rufescens*
	Evening Grosbeak	*Coccothraustes vespertinus*
	Harlequin Duck	*Histrionicus histrionicus*
	Herring Gull	*Larus argentatus*
	Long-billed Curlew	*Numenius americanus*
	MacGillivray's Warbler	*Geothlypis tolmiei*
	Mourning Dove	*Zenaida macroura*
	Northern Hawk Owl	*Surnia ulula*
	Pacific-slope Flycatcher	*Empidonax difficilis*
	Palm Warbler	*Setophaga palmarum*
	Pileated Woodpecker	*Dryocopus pileatus*
	Prairie Falcon	*Falco mexicanus*
	Red-eyed Vireo	*Vireo olivaceus*
	Ruffed Grouse	*Bonasa umbellus*
	Steller's Jay	*Cyanocitta stelleri*
	Swainson's Thrush	*Catharus ustulatus*
	Veery	*Catharus fuscescens*
	Vesper Sparrow	*Pooecetes gramineus*
	Western Meadowlark	*Sturnella neglecta*
	Western Screech-Owl, *macfarlanei* subspecies	*Megascops kennicottii macfarlanei*
	Western Wood-Pewee	*Contopus sordidulus*
	White-throated Swift	*Aeronautes saxatalis*
	Dusky Grouse	*Dendragapus obscurus*
	Forster's Tern	*Sterna forsteri*
	Purple Finch	*Haemorhous purpureus*
	Red Crossbill	*Loxia curvirostra*
	Rock Wren	*Salpinctes obsoletus*

Search criteria included all species within the Interior Cedar Hemlock (ICH) Biogeoclimatic Zone, Kootenay Lake Forest District, Kootenay MOE Region, and Central Kootenay Regional District (CDC 2016a).

Table 2. Mammal and reptile species with a low or negligible likelihood of occurring within Argenta Slough.

Species Group	Common Name	Scientific Name
mammal	American Badger	*Taxidea taxus*
	American Marten	*Martes americana*
	Big Brown Bat	*Eptesicus fuscus*
	Bighorn Sheep	*Ovis canadensis*
	Californian Myotis	*Myotis californicus*
	Caribou (southern mountain population)	*Rangifer tarandus* pop. 1
	Fisher	*Pekania pennanti*
	Fringed Myotis	*Myotis thysanodes*
	Grey Wolf	*Canis lupus*
	Hoary Bat	*Lasiurus cinereus*
	Long-eared Myotis	*Myotis evotis*
	Long-legged Myotis	*Myotis volans*
	Mountain Goat	*Oreamnos americanus*
	North American Porcupine	*Erethizon dorsatum*
	Northern Pocket Gopher, *segregatus* subspecies	*Thomomys talpoides segregatus*
	Red-tailed Chipmunk, *simulans* subspecies	*Neotamias ruficaudus simulans*
	Wolverine, *luscus* subspecies	*Gulo gulo luscus*
reptile	Northern Alligator Lizard	*Elgaria coerulea*
	Western Skink	*Plestiodon skiltonianus*

Search criteria included all species within the Interior Cedar Hemlock (ICH) Biogeoclimatic Zone, Kootenay Lake Forest District, Kootenay MOE Region, and Central Kootenay Regional District (CDC 2016a).