Vegetation and Wildlife Mitigation and Monitoring Plan 2023 Annual Report

Site C Clean Energy Project

04 April 2024

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1.0 Introduction

The Vegetation and Wildlife Mitigation and Monitoring Plan (VWMMP) describes the measures that will be used to mitigate the adverse effects of the Site C Clean Energy Project (the Project) on vegetation and ecological communities and wildlife resources during the construction and operation of the Project. The Plan was developed in accordance with the conditions of the Project's provincial Environmental Assessment Certificate (EAC #E14-02, or 'the EAC') and Federal Decision Statement (FDS) issued for the Project in 2014. The draft and first revisions of the VWMMP were submitted to regulatory agencies and Aboriginal Groups for review and feedback on 17 October 2014, and 7 April 2015, respectively. The final VWMMP was submitted to the same recipients on 5 June 2015, and is posted on the Site C Project website at https://www.sitecproject.com/sites/default/files/Veg_and_Wildlife_Mit_and_Mon_Plan.pdf.

The purpose of this annual report is to describe the mitigation and monitoring measures that are described in the VWMMP and were implemented in 2023.

2.0 Objective and Scope

The objective of this VWMMP Annual Report (the Report) is to describe the mitigation and monitoring measures implemented in 2023 to meet the requirements of FDS conditions 9, 10, 11, 16 and 18 and EAC conditions 9 to 12, 14 to 16, 19, 21, 23, and 24. These conditions, and where they are addressed in current or past VWMMP Annual Reports are listed in Tables 1 and 2 below.

The requirements of EAC conditions 8 and 13 (for Vegetation and Ecological Communities), and conditions 17, 18, 20, and 22 (for Wildlife Resources) are addressed in the Construction Environmental Management Plan (CEMP) and/or the Vegetation Clearing and Debris Management Plan (VCDMP). Therefore, those conditions are not addressed in this report.

Table 1. Federal Decision Statement conditions and associated annual report sections

FDS Condition	Condition	Report Section
9	Disturbance and destruction of migratory birds	Section 6.1
9.1	The Proponent shall ensure that the Designated Project is carried out in a manner that avoids mortality and disturbance of migratory birds and their nests.	Section 6.1.1
9.2	The Proponent shall prepare and submit to the Agency an annual schedule, describing the location and timing for construction and reservoir filling activities, 90 days prior to initiating any of these activities.	Section 6.1.2
9.3	The Proponent shall develop, in consultation with Environment Canada, a plan to monitor and mitigate potential disturbance of breeding migratory birds in and adjacent to the Project Activity Zone, including the area immediately downstream of the dam where risks to migratory bird nests could occur, during construction, reservoir filling and	Section 6.1.3

FDS Condition	Condition	Report Section
	operation.	
9.9	The Proponent shall address potential risks of bird collisions with the transmission line, in consultation with Environment Canada, by:	
9.9.1	conducting a risk assessment for bird collisions under the current transmission line design;	2016 Annual Report (Section 6.1.3)
9.9.2	determining if additional mitigation measures could be implemented to reduce the risk of bird collisions;	Section 6.1.4
10	Non-wetland migratory bird habitat	Section 6.2
10.2	The Proponent shall develop, in consultation with Environment Canada, a plan that addresses potential effects of the Designated Project on non-wetland migratory bird habitat.	
10.3	The plan shall include:	
10.3.1	non-wetland migratory bird habitat baseline conditions for habitat that would be permanently lost, habitat that would be fragmented and habitat that would remain intact;	Section 6.2.1
10.3.2	migratory bird abundance, distribution and use of non-wetland habitat;	Section 6.2.2
10.3.3	measures to mitigate the changes in aquatic and riparian-related food resources and other habitat features associated with a change from a fluvial to a reservoir system;	Section 6.2.3
10.3.4	compensation measures to address the unavoidable loss of non-wetland migratory bird habitat, including habitat associated with the Canada Warbler, the Cape May Warbler and the Bay-Breasted Warbler;	Section 6.2.4
10.3.5	an analysis of the effects of any compensation measures identified in condition 10.3.4 on the current use of lands and resources for traditional purposes by Aboriginal peoples; and	Section 6.2.5
10.3.6	an approach to monitor and evaluate the effectiveness of the mitigation or compensation measures to be implemented and to verify the accuracy of the predictions made during the environmental assessment on non-wetland migratory bird habitat, including migratory bird use of that habitat.	Section 6.2.6
11	Wetlands used by migratory birds and for current use of lands and resources for traditional purposes	Section 6.3
11.1	The Proponent shall mitigate the potential effects of the Designated Project on wetland habitat used by migratory birds, species at risk and for current use of lands and resources for traditional purposes by Aboriginal people.	Section 6.3.1
11.2	The Proponent shall develop, in consultation with Environment Canada, Reservoir Area Aboriginal groups and Immediate Downstream	Section 6.3.2

FDS Condition	Condition	Report Section
	Aboriginal groups, a plan that addresses potential effects of the Designated Project on wetland habitat used by migratory birds, species at risk and for current use of lands and resources for traditional purposes.	
11.3	The Proponent shall, in developing the plan, describe how the mitigation hierarchy and the objective of no net loss of wetland functions were considered.	Section 6.3.3
11.4	The plan shall include:	
11.4.1	baseline data on the biogeochemical, hydrological and ecological functioning of the wetlands and associated riparian habitat in the area affected by the Designated Project, including: ground and surface water quality and quantity; vegetation cover; biotic structure and diversity; migratory bird abundance, density, diversity and use; species at risk abundance, density, diversity and use; and current use of the wetlands for traditional purposes by Aboriginal people, including the plant and wildlife species that support that use	Section 6.3.4
11.4.2	mitigation measures to maintain baseline wetland functions for those wetlands that will not be permanently lost;	Section 6.3.5
11.4.3	an approach to monitor and evaluate any changes to baseline conditions, as defined in condition 11.4.1 and identify improvements based on monitoring data;	Section 6.3.6
11.4.4	compensation measures to address the unavoidable loss of wetland areas and functions supporting migratory birds, species at risk, and the current use of lands and resources by Aboriginal people in support of the objective of full replacement of wetlands in terms of area and function	Section 6.3.7
11.8	The Proponent shall commence the implementation of the compensation measures specified in condition 11.4.4 no later than five years from the initiation of construction.	Section 6.3.8
11.9	The Proponent shall implement each component of the plan and provide to the Agency an analysis and summary of the implementation of the plan, as well as any amendments made to the plan in response to the results, on an annual basis during construction and at the end of year 1, 2, 3, 5, 10, 15, 20 and 30 of operation.	Section 6.3.9
16	Species at risk, at-risk and sensitive ecological communities and rare plants	
16.1	The Proponent shall ensure that potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants are addressed and monitored.	Section 6.4
16.2	The Proponent shall develop, in consultation with Environment Canada, a plan setting out measures to address potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants.	Section 6.4

FDS Condition	Condition	Report Section
16.3	The plan shall include:	
16.3.1	field work to verify the modeled results for surveyed species at risk and determine the habitat that would be permanently lost, habitat that would be fragmented and habitat that would remain intact for those species, including the Short-eared Owl, the Western Toad and the Myotis Bat species	2015 Annual Report (Section 6.4.1)
16.3.2	surveys to determine whether the rare plant species potentially facing extirpation in the Project Activity Zone are found elsewhere in the region	2017 Annual Report (Section 6.4.1; Section 7.2.1; Appendix 9)
16.3.3	measures to mitigate environmental effects on species at risk and at-risk and sensitive ecological communities and rare plants;	Section 6.4.1
16.3.4	conservation measures to ensure the viability of rare plants, such as seed recovery and plant relocation;	Section 6.4.2
16.3.5	an approach to avoiding or minimizing the use of herbicides and pesticides in areas that could impact species at risk, at-risk and sensitive ecological communities and rare plants;	2017 Annual Report (Section 6.4.4)
16.3.6	an approach to monitor and evaluate the effectiveness of mitigation measures and to verify the accuracy of the predictions made during the environmental assessment on species at risk, at-risk and sensitive ecological communities and rare plants; and	Section 6.4.3
16.3.7	an approach for tracking updates to the status of listed species identified by the Government of British Columbia, Committee on the Status of Endangered Wildlife in Canada, and the Species at Risk Act, and implementation of additional measures, in accordance with species recovery plans, to mitigate effects of the Designated Project on the affected species should the status of a listed species change during the life of the Designated Project.	Section 6.4.4

Table 2. Environmental Assessment Certificate conditions and associated annual report sections

EAC Condition	Condition	Report Section
Vegetation and Ecological Communities		
9	The EAC Holder must develop a Vegetation and Invasive Plant Management Plan to protect ecosystems, plant habitats, plant communities, and vegetation with components applicable to the construction phase.	Section 7.1
	The Vegetation and Invasive Plant Management Plan must include at least the following:	

EAC Condition	Condition	Report Section
	Invasive Species	
	• Surveys of existing invasive species populations prior to construction.	2015 Annual Report (Section 7.1.1)
	• Invasive plant control measures to manage established invasive species populations and to prevent invasive species establishment.	Section 7.1.1
	Rare Plants and Sensitive Ecosystems	
	• The EAC Holder must expand its modelling, including completing field work, to improve identification of rare and sensitive plant communities and aid in delineation of habitats that may require extra care, 90 days prior to any Project activities that may affect these rare or sensitive plant communities	2015 Annual Report (Section 7.1.3)
	• The EAC Holder must, with the use of a Qualified Environmental Professional (QEP), complete an inventory in areas not already surveyed and use rare plant location information as inputs to final design of access roads and transmission lines. These pre-construction surveys must target rare plants as defined in Section 13.2.2 of the Environmental Impact Statement (EIS) including vascular plants, mosses, and lichens.	Section 7.1.2
	• The EAC Holder must create and maintain a spatial database of known rare plant occurrences in the vicinity of Project components that must be searched to avoid effects to rare plants during construction activities. The database must be updated as new information becomes available and any findings of new rare plant species occurrences must be submitted to Environment Canada[1] and the BC Ministry of Environment (MOE[2]) using provincial data collection standards.	Section 7.1.3
	• The EAC Holder must implement construction methods to reduce the impact to rare plants, maximize use of existing access corridors, and construct transmission towers and temporary roads away from wetlands and known rare plant occurrences.	Section 7.1.4
	• Protect known occurrences of Tufa seeps, wetlands and rare plants located adjacent to construction areas. Install signage and flagging where	Section 7.1.5

[1] Currently known as Environment and Climate Change Canada (ECCC).

[2] Currently known as the BC Ministry of Ministry of Land, Water and Resource Stewardship (MLWRS).

EAC Condition	Condition	Report Section
	necessary, as determined by the QEP, to indicate the boundaries of the exclusion area.	
	• The EAC Holder will engage the services of a Rare Plant Botanist during construction to design and implement an experimental rare plant translocation program in consultation with MOE using the BC MOE’s Guidelines for Translocation of Plant Species at Risk in BC (Maslovat 2009).	Section 7.1.6
10	The EAC Holder must fund or undertake directly with the use of a Rare Plant Botanist the following, during construction:	2017 Annual Report (Section 7.2)
	• Targeted surveys in the Regional Assessment Area (RAA; as defined in the amended EIS) to identify occurrences of the 18 directly affected rare plant species (as defined in the amended EIS), and rare plant species identified by MOE’s Conservation Framework requiring additional inventories	2017 Annual Report (Section 7.2.1 and Appendix 9)
	• A study focused on clarifying the taxonomy of *Ochroleucus* bladderwort (*Utricularia ochroleuca*), including field, herbaria, and genetic work in consultation with FLNR and the MOE (BC Conservation Data Centre).	2017 Annual Report (Section 7.2.2 and Appendix 10)
11	EAC Holder must compensate for the loss of rare and sensitive habitats and protect occurrences of rare plants by developing, or funding the development and implementation of a compensation program, during construction, that includes:	Section 7.3
	• Assistance (financial or in-kind) to the managing organization of suitable habitat enhancement projects in the RAA (RAA as defined in the amended EIS).	Section 7.3.1
	• Direct purchase of lands in the RAA and manage these lands and suitable existing properties owned by the EAC Holder to enhance or retain rare plant values where opportunities exist.	Section 7.3.2
	The EAC Holder must engage with FLNR, MOE and Aboriginal Groups with regard to the development of the compensation program.	Section 7.3.3
12	The EAC Holder must develop a Wetland Mitigation and Compensation Plan.	Section 7.4
	The Wetland Mitigation and Compensation Plan must include an assessment of wetland function lost as a result of the Project that is important to migratory birds	Section 7.4.1

EAC Condition	Condition	Report Section
	and species at risk (wildlife and plants). The Wetland Mitigation and Compensation Plan must be developed by a QEP with experience in wetland enhancement, maintenance and development.	
	The Wetland Mitigation and Compensation Plan must include at least the following:	
	• Information on location, size and type of wetlands affected by the Project	Section 7.4.1.1
	• If roads cannot avoid wetlands, culverts will be installed under access roads to maintain hydrological balance, and sedimentation barriers will be installed;	2017 Annual Report (Section 7.3.1.2)
	• Stormwater management will be designed to control runoff and direct it away from work areas where excavation, spoil placement, and staging activities occur.	2017 Annual Report (Section 7.3.1.3)
	• Develop, with the assistance of a hydrologist, site-specific measures prior to construction to reduce changes to the existing hydrologic balance and wetland function during construction of the Jackfish Lake Road and Project access roads and transmission line.	2017 Annual Report (Section 7.3.1.4)
	• All activities that involve potentially harmful or toxic substances, such as oil, fuel, antifreeze, and concrete, must follow approved work practices and consider the provincial BMP guidebook Develop with Care (BC Ministry of Environment 2012 or as amended from time to time).	2017 Annual Report (Section 7.3.1.5)
14	The EAC Holder must develop a Vegetation and Ecological Communities Monitoring and Follow-up Program for the construction phase and first 10 years of the operations phase. The Vegetation and Ecological Communities Monitoring and Follow-up Program must be developed by a QEP. The Vegetation and Ecological Communities Monitoring and Follow-up Program must include at least the following:	Section 7.5
	• Definition of the study design for the rare plant translocation program (see condition 9).	7.5.1
	• Plan for following-up monitoring of any translocation sites to assess the survival and health of translocated rare plant species, under the supervision of a Rare Plant Botanist.	7.5.2

EAC Condition	Condition	Report Section
	• Measurement criteria, including vegetation growth, persistence of rare plants and establishment / spread of invasive plant species, and associated monitoring to document the effectiveness of habitat enhancement and possible compensation programs.	7.5.3
Wildlife Resources		
15	The Wildlife Management Plan must be developed by a QEP.	Section 4.0
	The Wildlife Management Plan must include at least the following:	
	• Field work, conducted by a QEP, to verify the modelled results for surveyed species at risk and determine, with specificity and by ecosystem, the habitat lost or fragmented for those species. The EAC Holder must use these resulting data to inform final Project design and to develop additional mitigation measures, as needed, as part of the Wildlife Management Plan, in consultation with Environment Canada and FLNR.	2015 Annual Report (Section 7.3.1)
	• Measures to avoid, if feasible, constructing in sensitive wildlife habitats. If avoiding sensitive wildlife habitats is not feasible, condition 16 applies.	Section 7.6.1
	• If sensitive habitats, such as wetlands, are located immediately adjacent to any work site, buffer zones must be established by a QEP to avoid direct disturbance to these sites.	Section 7.6.2
	• Protocol for the application of construction methods, equipment, material and timing of activities to mitigate adverse effects to wildlife and wildlife habitat.	Section 7.6.3
	• Protocol to ensure that lighting is focused on work sites and away from surrounding areas to manage light pollution and disturbance to wildlife. If lighting cannot be directed away from surrounding areas, the EAC Holder must ensure additional mitigation measures are implemented to reduce light pollution, including light shielding.	Section 7.6.4
	• A mandatory environmental training program for all workers so that they are informed that hunting in the vicinity of any work site/Project housing site is strictly prohibited for all workers. The EAC Holder must ensure that all workers are	Section 7.6.5

EAC Condition	Condition	Report Section
	familiar with the Wildlife Management Plan.	
16	If loss of sensitive wildlife habitat or important wildlife areas cannot be avoided through Project design or otherwise mitigated, the EAC Holder must implement the following measures, which must be described in the Vegetation and Wildlife Mitigation and Monitoring Plan.	Section 7.7
	The Vegetation and Wildlife Mitigation and Monitoring Plan must include the following compensation measures:	
	• Compensation options for wetlands must include fish-free areas to manage the effects of fish predation on invertebrate and amphibian eggs and larvae and young birds.	Section 7.7.1
	• Mitigation for the loss of snake hibernacula, artificial dens must be included during habitat compensation.	Section 7.7.2
	• Management of EAC Holder-owned lands adjacent to the Peace River suitable as breeding habitat for Northern Harrier and Short-eared Owl.	2017 Annual Report (Section 7.6.1)
	• Establishment of nest boxes for cavity-nesting waterfowl developed as part of wetland mitigation and compensation plan, and established within riparian vegetation zones established along the reservoir on BC Hydro-owned properties.	Section 7.7.3
	• A design for bat roosting habitat in HWY 29 bridges to BC Ministry of Transportation and Infrastructure (MOTI) for consideration into new bridge designs located within the Peace River valley.	Section 7.7.4
	• Following rock extraction at Portage Mountain, creation of hibernating and roosting sites for bats.	Section 7.7.5 VWMMP Section 8.7.6
	• Creation of natural or artificial piles of coarse woody debris dispersed throughout the disturbed landscape to maintain foraging areas and cold-weather rest sites, and arboreal resting sites, for the fisher population south of the Peace River.	Section 7.7.6
19	The EAC Holder must use reasonable efforts to avoid and reduce injury and mortality to amphibians and snakes on roads adjacent to wetlands and other areas where amphibians or snakes are known to migrate across roads including locations with structures designed for wildlife passage	Section 7.8
21	The EAC Holder must ensure that measures implemented to manage harmful Project effects on	Section 7.9

EAC Condition	Condition	Report Section
	wildlife resources are effective by implementing monitoring measures detailed in a Vegetation and Wildlife Mitigation and Monitoring Plan.	
	The Vegetation and Wildlife Mitigation and Monitoring Plan must be developed by a QEP.	Section 4.0
	The Vegetation and Wildlife Mitigation and Monitoring Plan must include at least the following:	
	• Monitor Bald Eagle nesting populations adjacent to the reservoir, including their use of artificial nest structures.	Section 7.9.1
	• Monitor waterfowl and shorebird populations and their use of natural wetlands, created wetlands, and artificial wetland features.	Section 7.9.2
	• Monitor amphibian use of migration crossing structures installed along Project roads.	Section 7.9.3
	• Survey songbird and ground-nesting raptor populations during construction and operations	Section 7.9.4
	• Require annual reporting during the construction phase and during the first 10 years of operations to the Environmental Assessment Office (EAO), beginning 180 days following commencement of construction.	Section 7.9.5
23	The EAC Holder must maintain current knowledge of Project effects on the status of listed species by tracking updates for species identified by the Province, the Committee on the Status of Endangered Wildlife in Canada, and the *Species at Risk Act.*	Section 7.10
24	The EAC Holder must identify suitable lands for ungulate winter range by the end of the first year of construction, on BC Hydro-owned lands, or Crown lands, in the vicinity of the Project in consultation with FLNR. If FLNR determines that identified winter range is required, the EAC Holder must identify and maintain suitable BC Hydro- owned lands for ungulate winter range to the satisfaction of FLNR and for the length of time determined by FLNR.	Section 7.11

3.0 Consultation

Consultation regarding the development and implementation of individual programs conducted in 2023 is provided below.

3.1 Canadian Wildlife Service

In 2023 BC Hydro continued to consult with the Canadian Wildlife Service (CWS) of Environment and Climate Change Canada (ECCC) during plan development and implementation. Consultation occurred primarily through the Vegetation and Wildlife Mitigation and Monitoring Technical Committee (VWTC), to which CWS, BC Hydro, and provincial agencies belong. The VWTC was established by the provincial Comptroller of Water Rights under Conditional Water Licences 132990 and 132991 (see Section 3.2).

3.2 Consultation with the Province

The VWTC was established by the Comptroller of Water Rights under Conditional Water Licences 132990 and 132991 to provide ongoing engagement between BC Hydro, Ministry of Environment and Climate Change Strategy (MOECCS) and the Ministry of Land, Water, and Resource Stewardship (MLWRS; formerly the Ministry of Forests, Lands, Natural Resource Operations and Rural Development aka. FLNRO) with respect to the implementation of vegetation and wildlife mitigation and monitoring programs. The province requested that the VWTC be formed as a sub-committee of the existing BC and BC Hydro joint Fish / Hydro Management Committee. CWS joined the VWTC in July 2016.

The VWTC met in person or via conference call six times in 2023 to address the Program Areas listed in Schedule A of Conditional Water Licenses 132990 and 132991. Table 3 summarizes the status of the Schedule A Program Areas as of 31 December 2023.

Table 3. Status of Schedule A Program Area Plans as of 31 December 2023.

Program Area Plans	Status
Completed	
1. Ungulates	Complete
2.1. Wetlands and Riparian Habitat: Wetland Function Assessment	Complete
2.2. Wetlands and Riparian Habitat: Downstream Vegetation Monitoring	Complete
3. Fisher	Complete
4.1 Bats – Bat Box Mitigation and Monitoring	Complete
4.2 Bats – Portage Mountain Quarry Monitoring	Complete
5.1. Snakes – Downstream Monitoring	Complete
5.2. Snakes – Hibernacula Mitigation and Monitoring	Complete
6.1. Amphibians – Downstream Monitoring	Complete
6.2. Amphibians – Migration Mitigation	Complete
8.3. Breeding and Migratory Birds – Common Nighthawk	Complete
8.4. Breeding and Migratory Birds – Woodpeckers	Complete
8.5. Breeding and Migratory Birds – Nest Monitoring	Complete

Program Area Plans	Status
10.2 Cavity-nesting species – Wildlife Tree creation	Complete
11.2. Rare Plants – Regional Surveys	Complete
12. Sharp-tailed Grouse	Complete
13. Lighting Effects	Complete
14. Carnivore Den Sites	Complete
15. Other Raptors	Complete
16. Other Species at Risk	Complete
17. Furbearers - Fishers	Complete
18. Ungulate calving habitat	Complete
19. Mineral licks	Complete
20. Bear and carnivore habitats	Complete
In Progress or Ongoing	
4. Bats – Portage Mountain Quarry Hibernacula	In progress
7. Bald Eagle	Ongoing
9. Ground Nesting Raptors	Ongoing
11.1. Rare Plants - Translocation	Ongoing
8.1. Breeding and Migratory Birds - Songbirds	Ongoing
8.2. Breeding and Migratory Birds – Waterbirds	Ongoing
10.1 Cavity Nesting Species – Nest box monitoring	Ongoing

4.0 Qualified professionals

The Qualified Professionals involved in the development and implementation of vegetation and wildlife mitigation and monitoring programs in 2023 are listed in Table 4. This list is not exhaustive as it is possible that some individuals and subcontractors helped with field work or other work phases that we have overlooked in our acknowledgements.

Table 4. Qualified Professionals involved in development and implementation of programs in 2023.

Qualified Professional	Area of Work
Brent Matsuda, M.Sc., R.P.Bio., BC Hydro	Vegetation and Wildlife
Harry van Oort, M.Sc., R.P.Bio., BC Hydro	Vegetation and Wildlife
Brock Simons, M.Sc., R.P.Bio., BC Hydro	Vegetation and Wildlife
Natasha Bush, M.Sc., P.Ag., EcoLogic Consultants Ltd.	Experimental Rare Plant Translocation, Wetland Monitoring Program
Dan McAllister, M.Sc., P.Ag., EcoLogic	Experimental Rare Plant Translocation
Jamie Fenneman, Ph.D., R.P.Bio., EcoLogic	Experimental Rare Plant Translocation
Alice Lee, B.Sc., MLA, BIT, EcoLogic	Experimental Rare Plant Translocation
Ryan Durand, M.Sc., R.P.Bio., EcoLogic	Experimental Rare Plant Translocation, Wetland

Qualified Professional	Area of Work
	Monitoring Program
Jason Jones, Ph.D., R.P.Bio., P. Biol., EcoLogic	Experimental Rare Plant Translocation, Wetland Monitoring, Downstream Vegetation Monitoring
Katherine Garrah, M.Sc., A.Ag., EcoLogic	Experimental Rare Plant Translocation
Holly Buehler, M.Sc., EcoLogic	Experimental Rare Plant Translocation
Randy Krichbaum, M.Sc., P.Biol., R.P.Bio., Eagle Cap Consulting Ltd.	Pre-construction Rare Plant Surveys and Experimental Rare Plant Translocation
Margaret Krichbaum, B.Sc., Eagle Cap Consulting Ltd.	Pre-construction Rare Plant Surveys and Experimental Rare Plant Translocation
Jeff Matheson M.Sc., R.P.Bio., P.Biol., Tetra Tech Canada Inc.	Program Manage, Senior Biologist, Breeding bird and raptor monitoring
Elyse Hofs, B.Sc., Dipl.T., Tetra Tech Canada	Breeding bird and raptor monitoring
Heather Bianchini, R.T. Biol., Tetra Tech Canada	Breeding bird and raptor monitoring
Robert McMahon, M.Sc., Ausenco Sustainability	Project manager, cavity nesting bird mitigation, waterbird monitoring, Portage Mountain bat monitoring, bald eagle monitoring, migratory bird nest monitoring
Jay Brogan, M.Sc., R.P.Bio., Ausenco Sustainability	Project manager, cavity nesting bird mitigation, waterbird monitoring, Portage Mountain bat monitoring, bald eagle monitoring, migratory bird nest monitoring
Charlie Palmer, M.Sc., P.Biol., R.P.Bio, Ausenco Sustainability	Strategic advisor, cavity nesting bird mitigation, waterbird monitoring, Portage Mountain bat monitoring, bald eagle monitoring, migratory bird nest monitoring
Toby St. Clair, M.Sc., Ausenco Sustainability	Waterbird monitoring, Migratory bird nest monitoring
Felix Martinez-Nunez, M.Sc., R.P.Bio, Ausenco Sustainability	Portage Mountain bat monitoring, cavity nesting bird monitoring
Catherine Craig, M.Sc., R.P.Bio., Ausenco Sustainability	Migratory bird nest monitoring, waterbird monitoring
Lorraine Andrusiak, M.Sc., R.P.Bio., Ausenco Sustainability	Portage Mountain bat monitoring, cavity nesting bird mitigation, bald eagle monitoring, migratory bird nest monitoring, waterbird monitoring
Tess Forstner, M.Sc., R.P.Bio., Ausenco Sustainability	Portage Mountain bat monitoring
Florian Reurink, Ph.D., Ausenco Sustainability	Project Coordinator, Cavity nesting bird mitigation, waterbird monitoring
Jeremiah Kennedy, Ausenco Sustainability	Cavity nesting bird mitigation, waterbird monitoring
Jamie Townsend, B.Sc., T.Ag., Ausenco Sustainability	Cavity nesting bird mitigation, waterbird monitoring
Tara MacKey, B.A., EPt., Ausenco Sustainability	Project Coordinator, field support
Ewa Kielasinska, M.A., GIS(PG), Ausenco Sustainability	Geomatics Specialist, wildlife programs
Dan Webster, B.Sc., P.Ag., R.P.Bio., P.Biol.,	Bald eagle nest monitoring, waterbird monitoring,

Qualified Professional	Area of Work
Eco-Web Ecological Consulting	management plan updates
Brian Paterson, B.Sc., B.E., R.P.Bio., Zonal Ecosystem and Wildlife Consultants Ltd.	Bald eagle nest monitoring, fisher den monitoring
Iain Jones, M.Sc., Dipl. Tech., R.P.Bio., WSP	Senior Wildlife Biologist, Wildlife mitigation structure monitoring program director, technical review and environmental compliance QEP
Tanya Seebacher, M.Sc., R.P.Bio., WSP	Snake artificial den monitoring
Mitch Firman, B.Sc. WSP	Bat box monitoring
Mike Sarell, R.P.Bio., Ophiuchus Consulting	Snake artificial den monitoring, bat artificial hibernacula design consultant
Todd Manning, MA.Sc., R.P.Bio., R.P.F., Strategic Resource Solutions	Wildlife Trees
Larry Davis, M.Sc., R.P.Bio., Davis Environmental Ltd.	Fisher den monitoring

5.0 Structure and Content

The mitigation and monitoring measures discussed in this report are organized into two parts: Section 6.0 describes those mitigation and monitoring measures that were implemented to meet the requirements of the FDS conditions; Section 7.0 describes those measures that were implemented to meet the requirements of the EAC conditions. Cross-references are provided in Section 7.0 where information provided to meet the EAC conditions is the same as that provided for the FDS conditions.

Of the programs outlined in the Vegetation and Wildlife Mitigation Plan, only riparian plantings, which are required by FDS 10.3.3, were not implemented in 2023. Those plantings will be implemented as part of site reclamation, after reservoir filling.

6.0 Implementation of Mitigation and Monitoring Measures – Federal Decision Statement Conditions

Conditions 9, 10, 11, and 16 of the FDS, respectively, set out the mitigation and monitoring requirements for the disturbance and destruction of migratory birds, non-wetland migratory bird habitat, wetlands used by migratory birds and for current use of lands and resources for traditional purposes, and species at risk, at-risk and sensitive ecological communities and rare plants (Table 1).

6.1 Federal Decision Statement Condition 9: Migratory Bird Mitigation and Monitoring

This section of the annual report summarizes the programs conducted in 2023 in accordance with the requirements of FDS condition 9, shown below.

9. Disturbance and destruction of migratory birds
9.1. The Proponent shall ensure that the Designated Project is carried out in a manner that avoids

mortality and disturbance of migratory birds and their nests.

9.2. The Proponent shall prepare and submit to the Agency an annual schedule, describing the location and timing for construction and reservoir filling activities, 90 days prior to initiating any of these activities.

9.3. The Proponent shall develop, in consultation with Environment Canada, a plan to monitor and mitigate potential disturbance of breeding migratory birds in and adjacent to the Project Activity Zone, including the area immediately downstream of the dam where risks to migratory bird nests could occur, during construction, reservoir filling and operation.

9.4. The plan shall include measures to undertake construction, reservoir filling and operation in a manner that avoids or minimizes the risk of disturbance and mortality to migratory birds and their nests.

9.5. The Proponent shall, in preparing the plan, consult:

9.5.1. Environment Canada's policy on Incidental Take of Migratory Birds in Canada; and

9.5.2. Environment Canada's avoidance guidelines on General Nesting Periods of Migratory Birds in Canada.

9.6. The Proponent shall submit to the Agency and Environment Canada a draft copy of the plan for review 90 days prior to initiating construction.

9.7. The Proponent shall submit to the Agency the final plan a minimum of 30 days prior to initiating construction. When submitting the final plan, the Proponent shall provide to the Agency an analysis that demonstrates how it has appropriately considered the input, views or information received from Environment Canada.

9.8. The Proponent shall implement the plan and provide to the Agency an analysis and summary of the implementation of the plan, as well as any amendments made to the plan in response to the results, on an annual basis during construction and for the first five years of operation.

9.9. The Proponent shall address potential risks of bird collisions with the transmission line, in consultation with Environment Canada, by:

9.9.1. conducting a risk assessment for bird collisions under the current transmission line design;

9.9.2. determining if additional mitigation measures could be implemented to reduce the risk of bird collisions; and

9.9.3. implementing any additional mitigation measures (e.g. line marking and diversions), to minimize impacts.

6.1.1 Condition 9.1

This section summarizes actions taken in accordance with the following requirement of Condition 9.1: *The Proponent shall ensure that the Designated Project is carried out in a manner that avoids mortality and disturbance of migratory birds and their nests.*

In accordance with Condition 9.1, BC Hydro has, where feasible, given Project requirements and constraints, scheduled vegetation clearing outside of the migratory bird nesting period. The Project occurs within Zone B5, for which ECCC describes a general nesting period for migratory birds of 19 April to 29 August[3]. BC Hydro developed Section 4.17 of the CEMP to address the requirements of Condition 9.1 and EAC Condition 17 and provided an outline of the nest survey protocol in Section 3.5.1 of the Vegetation Clearing and Debris Management Plan.

BC Hydro developed a pre-clearing nesting activity survey methodology, which outlines specific field procedures to be followed to determine the likelihood that migratory bird nests are present in areas scheduled to be disturbed. The protocol also describes the approach for determining appropriate situation- and species-specific disturbance setback buffers to be applied around

[3] https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html#_zoneB_calendar

locations where nests are likely to be present. That document was broadly distributed to contractors starting when it was first developed in 2015 and 2016. The document was revised in 2018 and 2019 and inserted as Appendix N of the CEMP, starting with rev.6.1 in 2019.

In 2023, pre-clearing nesting activity surveys were completed between April and August wherever small-scale clearing within the migratory bird nesting period could not be avoided. If active or suspected nest areas were identified, protective buffers were established around active nests, as determined by a Qualified Environmental Professional (QEP). Contractor compliance with appropriate steps for mitigating the risk of incidental take of migratory birds, nests and eggs was monitored by BC Hydro environmental monitors and the Independent Environmental Monitor (IEM).

6.1.2 Condition 9.2

This section summarizes actions taken in accordance with the following requirement of Condition 9.2: *The Proponent shall prepare and submit to the Agency an annual schedule, describing the location and timing for construction and reservoir filling activities, 90 days prior to initiating any of these activities.*

An initial construction schedule was submitted to CEAA on 17 October 2014. The most recently revised construction schedule, updated in January 2024, can be found in Appendix 1.

6.1.3 Condition 9.3

This section summarizes actions taken in accordance with the following requirement of Condition 9.3: *The Proponent shall develop, in consultation with Environment Canada, a plan to monitor and mitigate potential disturbance of breeding migratory birds in and adjacent to the Project Activity Zone, including the area immediately downstream of the dam where risks to migratory bird nests could occur, during construction, reservoir filling and operation.*

6.1.3.1 Songbird surveys

The songbird monitoring program is focussed on passerines (songbird perching birds), hummingbirds, swifts, doves, kingfisher, and pigeons (all members of the orders Passeriformes, Apodiformes, Columbiformes, and Coraciiformes), which are collectively referred to as songbirds. Songbird baseline surveys were conducted in 2006, 2008, 2011 and 2012 in support of the EIS. Surveys were again conducted annually 2016 through 2023 as part of the monitoring program. The Breeding Bird Follow-up Monitoring – Songbirds 2023 Annual Report can be found in Appendix 2.

In addition, surveys for bank swallow (*Riparia riparia*) which are designated as ‘threatened’ under Schedule 1 of the federal *Species at Risk Act* (SARA) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) were conducted at known colonies in 2023 to assess the presence and breeding status within an area of the construction site called Area A. The observations of this assessment are presented in Appendix 3.

6.1.3.2 Common nighthawk surveys

Common Nighthawk is designated as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Threatened under Schedule 1 of the federal Species at Risk Act (SARA), and listed as Yellow (secure) in British Columbia. Common nighthawk surveys were conducted in 2010 and 2012 in support of the EIS. Surveys again occurred over two years, with approximately half occurring in 2018 and half in 2019 as part of the monitoring program. The Common Nighthawk Follow-up Monitoring 2018 and 2019 annual reports were provided in the 2018 and 2019 VWMMP annual reports.

6.1.3.3 Woodpecker surveys

Woodpecker surveys were conducted in 2010 in support of the EIS. Woodpecker surveys are being completed in the project footprint within the Peace River Valley and in the BC Hydro proposed mitigation properties over a two-year period (2018 and 2019) as part of the monitoring program. The Breeding Bird Follow-up Monitoring – Woodpeckers 2019 Annual Report was provided in the 2019 VWMMP annual report.

6.1.3.4 Waterbird surveys

The waterbirds survey program is focussed on shorebirds, marsh birds, waterfowl, and other birds associated with aquatic and wetland habitats (collectively known as 'waterbirds'). Waterbird surveys were conducted in the Peace River and adjacent wetlands in 2006 and 2008 and 2012 through 2014. Those waterbird surveys were conducted using fixed-wing aircraft and twin-engine helicopter surveys and, to a lesser extent, ground and boat surveys. No shorebirds were documented during helicopter and fixed-wing aircraft surveys between 2012 and 2014 because of the difficulty detecting small birds using aerial surveys. As a result, methods were adapted in 2017 to continue the use of fixed-wing aircraft for aerial surveys, and to add ground, river boat, unmanned aerial vehicle and autonomous recording unit survey methods. However, aerial surveys make identifying most waterbirds to the species level difficult, and therefore the aerial component of waterbird surveys was discontinued and not applied after 2017. In discussion with CWS, unmanned aerial vehicles were discontinued in 2020 because they were not shown to be efficient for waterbird data collection. The Waterbirds Follow-up Monitoring 2023 Annual Report can be found in Appendix 4.

6.1.3.4 Migratory bird nest monitoring

A migratory bird nest monitoring program was developed and first implemented in 2021 to monitor the potential disturbance to breeding migratory birds from fluctuating water levels caused by construction and operations activities. In 2022, 39 days of nest searching and monitoring surveys were conducted from June 2 to July 11, 2022. No surveys were conducted in 2023 as per the Migratory Bird Nest Monitoring Plan (BC Hydro 2022) to conduct surveys in alternate years assuming an initial reservoir fill in 2023, then in alternate years over the first 10 years of operations. As reservoir fill has now been planned for fall of 2024, these surveys will commence in 2025 as the first year of operations.

6.1.4 Condition 9.9.2

This section summarizes actions taken in accordance with the following requirement of Condition 9.9.2: *The Proponent shall address potential risks of bird collisions with the transmission line, in consultation with Environment Canada, by determining if additional mitigation measures could be implemented to reduce the risk of bird collisions.*

A risk assessment for bird collisions with the transmission line was included in Section 6.1.3 of the 2016 VWMMP Annual Report. Since that time, changes have been incorporated in the transmission line design and implemented in construction that further reduce the risk of bird collisions:

- Phase to phase spacing is more than 12 meters, preventing any electrocution hazard that exists on distribution lines;
- Conductor size is approximately 1.25” diameter, therefore easier for birds to see. Each phase of the conductor will be configured in a square-shaped bundle of four, with spacing of 0.5 meters between each conductor, thus further increasing visibility for birds.
- There are no shield wires on most of the line. Shield wires are smaller in diameter and harder for birds to see and will only be installed in the last kilometer of each end of the line.
- Water crossings of the Peace and Moberly rivers will have marker spheres on them, which will increase visibility for birds.
- Guy wires on the structures are relatively low to the ground, as they connect to the tower at 2/3 the height of the tower. The lower height of the guy wires will reduce risk to birds. The bottoms of the guy wires are marked with bright yellow plastic guards, which will increase their visibility, and further reduce risk to birds.

6.2 Federal Decision Statement Condition 10: Non-Wetland Migratory Bird Habitat Mitigation and Monitoring

This section of the annual report summarizes the applicable components of the VWMMP implemented to fulfill FDS condition 10 in 2023 in accordance with the requirements of FDS condition 10.8. For context, the complete requirements of FDS condition 10 are shown below.

10. Non-wetland migratory bird habitat

10.1. The Proponent shall mitigate the potential effects of the Designated Project on non-wetland migratory bird habitat.

10.2. The Proponent shall develop, in consultation with Environment Canada, a plan that addresses potential effects of the Designated Project on non-wetland migratory bird habitat.

10.3. The plan shall include:

10.3.1. non-wetland migratory bird habitat baseline conditions for habitat that would be permanently lost, habitat that would be fragmented and habitat that would remain intact;

10.3.2. migratory bird abundance, distribution and use of non-wetland habitat;

10.3.3. measures to mitigate the changes in aquatic and riparian-related food resources and other habitat features associated with a change from a fluvial to a reservoir system;

10.3.4. compensation measures to address the unavoidable loss of non-wetland migratory bird habitat, including habitat associated with the Canada Warbler, the Cape May Warbler and the Bay-Breasted Warbler;

10.3.5. an analysis of the effects of any compensation measures identified in condition

10.3.4 on the current use of lands and resources for traditional purposes by Aboriginal peoples; and

10.3.6. an approach to monitor and evaluate the effectiveness of the mitigation or compensation measures to be implemented and to verify the accuracy of the predictions made during the environmental assessment on non-wetland migratory bird habitat, including migratory bird use of that habitat.

10.4. The Proponent shall submit to the Agency and Environment Canada a draft copy of the plan for review:

10.4.1. for conditions 10.3.1, 10.3.2, 10.3.3 and 10.3.6, 90 days prior to initiating construction; and

10.4.2. for conditions 10.3.4 and 10.3.5, 90 days prior to implementing any component of the compensation plan.

10.5. The Proponent shall submit to the Agency the final plan:

10.5.1. for conditions 10.3.1, 10.3.2, 10.3.3 and 10.3.6, a minimum of 30 days prior to initiating construction; and

10.5.2. for conditions 10.3.4 and 10.3.5, a minimum of 30 days prior to implementing any component of the compensation plan.

10.6. When submitting each component of the final plan, the Proponent shall provide to the Agency an analysis that demonstrates how it has appropriately considered the input, views or information received from Environment Canada.

10.7. The Proponent shall commence the implementation of the compensation measures specified in condition 10.3.4 no later than five years from the initiation of construction.

10.8. The Proponent shall implement each component of the plan and provide to the Agency an analysis and summary of the implementation of the applicable component of the plan, as well as any amendments made to the plan in response to the results, on an annual basis during construction and at the end of year 1, 2, 3, 5, 10, 15, 20 and 30 of operation.

6.2.1 Condition 10.3.1

This section summarizes actions taken in accordance with the following requirement of Condition 10.3.1: *The plan shall include non-wetland migratory bird habitat baseline conditions for habitat that would be permanently lost, habitat that would be fragmented and habitat that would remain intact.*

The collection of data on non-wetland migratory bird habitat baseline conditions is done through implementation of the migratory bird monitoring plans, of which the 2023 surveys are discussed in Section 6.1.3 in relation to FDS Condition 9.3 (monitor and mitigate potential disturbance of breeding migratory birds).

6.2.2 Condition 10.3.2

This section summarizes actions taken in accordance with the following requirement of Condition 10.3.2: *The plan shall include migratory bird abundance, distribution, and use of non-wetland habitat.*

The collection of data on non-wetland migratory bird abundance, distribution and use of non-wetland habitat is done through implementation of the migratory bird monitoring plans, of which the 2023 surveys are discussed in Section 6.1.3 in relation to FDS Condition 9.3 (monitor and mitigate potential disturbance of breeding migratory birds).

6.2.3 Condition 10.3.3

This section summarizes actions that are being taken in accordance with the following requirement of Condition 10.3.3: *The plan shall include measures to mitigate the changes in aquatic and riparian-related food resources and other habitat features associated with a change from a fluvial to a reservoir system*.

Mitigation measures have been developed to reduce potential adverse impacts associated with a change from a fluvial to a reservoir system by increasing the area of shallow water habitat at along the reservoir shoreline. These measures are expected to enhance fish habitat and also benefit migratory birds by increasing the abundance and availability of aquatic plants, aquatic invertebrates, and fish.

All habitat enhancements listed in the Fisheries and Aquatic Habitat Management Plan[4] (FAHMP) were completed in 2023. Annual reports describing the status of implementation of these projects are available on the Site C Project website[5].

6.2.4 Condition 10.3.4

This section summarizes actions taken in accordance with the following requirement of Condition 10.3.4: *The plan shall include compensation measures to address the unavoidable loss of non-wetland migratory bird habitat, including habitat associated with the Canada Warbler, the Cape May Warbler and the Bay-Breasted Warbler.*

BC Hydro continues to manage three properties (i.e., Marl Fen, Rutledge and Wilder Creek) that were retained partly to provide habitat for non-wetland migratory birds. Management plans for those properties were included in the 2015 annual report. Updates to these management plans commenced at the end of 2023 with an anticipated completion of updates to the plans in 2024.

In 2019, Ducks Unlimited Canada conducted the physical works necessary at Golata Canyon Ranch to create approximately 50 ha of sedge wetland (see Section 6.3.2). Vegetation developing on the periphery of this wetland is expected to also help support non-wetland migratory birds. No new properties were added to the program in 2023. However, BC Hydro engaged various land conservancy organizations in 2023 to develop potential partnerships for habitat acquisition opportunities, including negotiations with a private landowner which for various reasons, did not come to fruition. BC Hydro's Properties team has also begun searching MLS listings for suitable forested lots and continues to do so.

6.2.5 Condition 10.3.5

This section summarizes actions taken in accordance with the following requirement of Condition 10.3.4: *The plan shall include an analysis of the effects of any compensation measures identified in condition 10.3.4 on the current use of lands and resources for traditional purposes by Aboriginal peoples.*

To date, compensation measures to address the unavoidable loss of non-wetland migratory bird habitat have been restricted to fee simple lands. Compensation actions enacted on fee simple lands are not expected to affect current use of lands and resources for traditional purposes by Indigenous peoples. Access to fee simple lands is controlled by the owner, or, in the case of BC Hydro, the leaseholder of lands leased by BC Hydro.

6.2.6 Condition 10.3.6

This section summarizes actions taken in accordance with the following requirement of Condition 10.3.6: *The plan shall include an approach to monitor and evaluate the effectiveness of the mitigation or compensation measures to be implemented and to verify the accuracy of the*

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[4] BC Hydro. 2015. Fisheries and Aquatic Habitat Management Plan. Site C Clean Energy Project. Revision 1: June 1, 2015. Available at: https://www.sitecproject.com/sites/default/files/Fisheries_and_Aquatic_Habitat_Management_Plan.pdf.

[5] Available at: https://www.sitecproject.com/document-library/environmental-and-socio-economic-plans-and-reports

predictions made during the environmental assessment on non-wetland migratory bird habitat, including migratory bird use.

An approach to monitor the effectiveness of mitigation and compensation measures and to verify the accuracy of the predictions made during the environmental assessment on non-wetland migratory birds is done within the migratory bird monitoring plans. The migratory bird monitoring surveys conducted in 2023 are discussed in Section 6.1.3 in relation to FDS Condition 9.3 (monitor and mitigate potential disturbance of breeding migratory birds).

6.3 Federal Decision Statement Condition 11: Wetland Mitigation and Monitoring

This section of the annual report summarizes the components of the VWMMP implemented to fulfill FDS condition 11 in 2023 in accordance with the requirements of FDS condition 11.9. For context, the complete requirements of FDS condition 11 are listed below.

11.	**Wetlands used by migratory birds and for current use of lands and resources for traditional purposes**
11.1	The Proponent shall mitigate the potential effects of the Designated Project on wetland habitat used by migratory birds, species at risk and for current use of lands and resources for traditional purposes by Aboriginal people.
11.2.	The Proponent shall develop, in consultation with Environment Canada, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups, a plan that addresses potential effects of the Designated Project on wetland habitat used by migratory birds, species at risk and for current use of lands and resources for traditional purposes.
11.3.	The Proponent shall, in developing the plan, describe how the mitigation hierarchy and the objective of no net loss of wetland functions were considered.
11.4.	The plan shall include:
	11.4.1. baseline data on the biogeochemical, hydrological and ecological functioning of the wetlands and associated riparian habitat in the area affected by the Designated Project, including: ground and surface water quality and quantity; vegetation cover; biotic structure and diversity; migratory bird abundance, density, diversity and use; species at risk abundance, density, diversity and use; and current use of the wetlands for traditional purposes by Aboriginal people, including the plant and wildlife species that support that use;
	11.4.2. mitigation measures to maintain baseline wetland functions for those wetlands that will not be permanently lost;
	11.4.3. an approach to monitor and evaluate any changes to baseline conditions, as defined in condition 11.4.1 and identify improvements based on monitoring data;
	11.4.4. compensation measures to address the unavoidable loss of wetland areas and functions supporting migratory birds, species at risk, and the current use of lands and resources by Aboriginal people in support of the objective of full replacement of wetlands in terms of area and function; and
	11.4.5. an analysis of the effects of any compensation measures identified in condition 11.4.4 on the current use of lands and resources for traditional purposes by Aboriginal peoples.
11.5.	The Proponent shall submit to the Agency, Environment Canada, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups a draft copy of the plan for review:
	11.5.1. for conditions 11.4.1, 11.4.2 and 11.4.3, 90 days prior to initiating construction; and
	11.5.2. for conditions 11.4.4 and 11.4.5, 90 days prior to implementing any component of the compensation plan.
11.6.	The Proponent shall submit to the Agency the final plan:

	11.6.1. for conditions 11.4.1, 11.4.2 and 11.4.3, a minimum of 30 days prior to initiating construction; and 11.6.2. for conditions 11.4.4 and 11.4.5, a minimum of 30 days prior to implementing any component of the compensation plan.
11.7.	When submitting each component of the final plan, the Proponent shall provide to the Agency an analysis that demonstrates how it has appropriately considered the input, views or information received from Environment Canada, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups.
11.8.	The Proponent shall commence the implementation of the compensation measures specified in condition 11.4.4 no later than five years from the initiation of construction.
11.9.	The Proponent shall implement each component of the plan and provide to the Agency an analysis and summary of the implementation of the plan, as well as any amendments made to the plan in response to the results, on an annual basis during construction and at the end of year 1, 2, 3, 5, 10, 15, 20 and 30 of operation.

6.3.1 Condition 11.1

This section summarizes actions taken in accordance with the following requirement of Condition 11.1: *The Proponent shall mitigate the potential effects of the Designated Project on wetland habitat used by migratory birds, species at risk and for current use of lands and resources for traditional purposes by Aboriginal people.*

The CEMP (Section 4.5) states that riparian habitat is to be protected by retaining "a 15 m machine-free riparian buffer from the Ordinary High Water Mark of watercourses and waterbodies during clearing, except where worker safety prohibits manual tree falling and vegetation removal methods, and as addressed in a site specific prescription prepared and endorsed by a QEP". The CEMP (Section 4.5) also requires that lay-down and material storage areas be located "at least 15 m from the Ordinary High Water Mark".

The location and boundaries of wetland habitats near construction areas are field-truthed, their boundaries flagged, and coordinates recorded using GPS. This information was also used when determining the location of access roads that are being used to construct the transmission line. Mitigation for loss of wetland habitat is discussed in Section 6.3.2.

6.3.2 Condition 11.2

This section summarizes actions taken in accordance with the following requirement of Condition 11.2: *The Proponent shall develop, in consultation with Environment Canada, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups, a plan that addresses potential effects of the Designated Project on wetland habitat used by migratory birds, species at risk and for current use of lands and resources for traditional purposes.*

Potential effects of Site C on wetland habitat are being addressed within a wetland compensation plan, which has the objective of no net loss of wetland functions, as per FDS condition 11.3.

BC Hydro continues to manage the Marl Fen property, which was retained (in part) to protect Marl Fen that makes up part of the property. The management plan for that property was included in the 2015 annual report. This plan is currently being updated.

In 2019, Ducks Unlimited Canada (DUC) conducted the physical works necessary at Golata Canyon Ranch to create approximately 50 ha of sedge wetland. The development of this wetland area, as vegetation establishes and wetland functions increase, will be monitored over time.

DUC does not have the funding to rebuild aging water control infrastructure, and as a result has been required by their respective water licenses to decommission infrastructure at 13 wetlands in BC since 2009, returning those wetlands to approximately pre-construction conditions and losing functional wetland area. Providing funding to DUC to rebuild aging water control infrastructure saves wetland area from being lost, and therefore meets international best practice standards for biodiversity offsets. DUC continues to identify historically constructed wetlands that are nearing the end of the 30-year lifespan of their water control infrastructure within the Peace and Omineca Regions as wetland offsets for Site C.

Water control infrastructure at three wetlands were rebuilt in 2022 and one in 2023 (Scott Lake), which represents about 245 ha of wetland area that would otherwise be lost. Pending permits and access issues, aging water control infrastructure is planned to be rebuilt at the other three wetlands in 2024 and 2025, which will preserve another 50 ha. In total, rebuilding the infrastructure at the wetlands to date is estimated to have resulted in preserving 245 ha of wetland area that would otherwise be lost.

BC Hydro estimates that a further 35 ha of wetland will be created during reclamation of Area A. In total, the wetland compensation opportunities that have been constructed or identified for Site C total an estimated 280 ha of wetland. Additional wetland compensation is required beyond what has been constructed or identified, and BC Hydro is working with DUC, land conservancy organizations, and local Indigenous Groups to identify further wetland compensation opportunities. The total area that will be required as compensation has yet to be determined due in part to uncertainty regarding total wetland impacts, which is being addressed through wetland monitoring. Wetland compensation opportunities identified so far are primarily sedge wetlands, but BC Hydro is working with DUC to explore options to integrate other wetland types into compensation planning.

A wetland monitoring program has been developed through consultation with and review by MOECCS, MLWRS, and CWS through the VWTC. Based on the requirements for wetland monitoring described in FDS Condition 11, the monitoring program was developed to comprise the following:

- collection of baseline data on the biogeochemical, hydrological and ecological functioning of the wetlands and associated riparian habitat in the area affected by the Designated Project;
- an evaluation of change to baseline wetland conditions due to the Project;
- selection of compensation measures for loss of wetland areas and functions, including reclamation, improvement, creation and protection; and
- flexibility in the monitoring program to allow for further refinement in the characterization of baseline and affected wetlands, as data become available.

The monitoring program includes direct measures of groundwater quality and quantity, surface water quality and quantity, vegetation cover, structure and diversity, and rare plant occurrence. Wetland monitoring also includes wetland delineation to help evaluate and improve wetland mapping. Further data on biotic structure and diversity, and migratory bird and species at risk abundance, density, diversity and use will be gathered through focussed monitoring plans (e.g., see Section 6.1.3 for details on waterbird surveys). Baseline data regarding current use of wetlands for traditional purposes by Aboriginal people have been gathered by the BC Hydro Indigenous Relations team through ground-truthing with FN groups, who will also gather and compile data regarding changes to use of wetlands for traditional purposes.

In 2022 a field program was conducted focusing on monitoring wetlands that were sampled in 2020 and 2021. That program marked the end of construction monitoring, with all program wetlands sampled. Monitoring will occur again in 2025, and by 2027 all wetlands in the monitoring program will have had a two and five-year monitoring assessment completed, which will allow for an analysis of change in wetland parameters and an assessment of the need to continue monitoring each wetland (i.e., if change is not present and/or not ongoing, then further monitoring is not likely to result in useful additional data).The wetland monitoring program annual report for 2022 was included in the 2022 Annual Report.

Through consultation with and review by MOECCS, MLWRS, and CWS through the VWTC, BC Hydro developed the Wetland Function Assessment (WFA) tool to measure progress towards the objective of no net loss of wetland functions. The WFA assesses the unavoidable loss of wetland area and function that supports migratory birds, amphibians, bats, species at risk, and species important to Indigenous land use due to Project activities. In assessing the loss of wetland area and function, the WFA process informs compensation measures for full replacement of wetland area and function. Wetland function is defined as the natural processes that are associated with wetlands but does not refer to the benefits of those processes to humans.

6.3.3 Condition 11.3

This section summarizes actions taken in accordance with the following requirement of Condition 11.3: *The Proponent shall, in developing the plan, describe how the mitigation hierarchy and the objective of no net loss of wetland functions were considered.*

The mitigation framework has three main steps, as outlined in the Environment Canada's Operational Framework for Use of Conservation Allowances (2012):

- Avoid proposed impacts;
- Minimize proposed impacts; and
- Address any residual environmental effects that cannot be avoided or sufficiently minimized with the use of conservation allowances.

Measures to avoid where feasible, and to minimize impacts to wetlands where avoidance is not feasible, are described in the CEMP and the Site C Vegetation Clearing and Debris Management Plan. For residual impacts to wetlands, BC Hydro is working to create, restore and enhance wetlands with the objective of no net loss of wetland functions. Determining the residual impacts to wetland functions, and the appropriate amount and type of wetlands to develop as conservation allowances, will be done through application of the Wetland Function Assessment, combined with application of the associated wetland monitoring program (see Section 6.3.2 above). The wetland monitoring program is designed to measure residual impacts to wetlands due to Site C, as well as to measure positive changes to wetland functions because of BC Hydro's efforts to create, restore and enhance wetlands.

6.3.4 Condition 11.4.1

This section summarizes actions taken in accordance with the following requirement of Condition 11.4.1: *The plan shall include baseline data on the biogeochemical, hydrological and ecological functioning of the wetlands and associated riparian habitat in the area affected by the Designated Project, including: ground and surface water quality and quantity; vegetation cover; biotic structure and diversity; migratory bird abundance, density, diversity and use; species at* *risk abundance, density, diversity and use; and current use of the wetlands for traditional purposes by Aboriginal people, including the plant and wildlife species that support that use.*

Baseline data on the biogeochemical, hydrological and ecological functioning of wetlands and associated riparian habitat were collected during baseline surveys in support of the EIS, and subsequent surveys of wetlands, including those likely to be impacted by the transmission line RoW. See Section 6.3.2 for a description of the wetland monitoring program.

6.3.5 Condition 11.4.2

This section summarizes actions taken in accordance with the following requirement of Condition 11.4.2: *The plan shall include mitigation measures to maintain baseline wetland functions for those wetlands that will not be permanently lost*.

For wetlands that will not be permanently lost, wetland function will be maintained through the timing of works (e.g., in winter to minimize ground disturbance), maintenance of hydrology through the installation of culverts during road construction as a matter of practice, and approaches to minimize impacts to wetlands through careful construction practices (see Section 6.3.1). The Wetland Function Assessment tool and the associated wetland monitoring program were designed together to identify impacts to wetlands and wetland functions, which will then inform quantitative wetland compensation objectives (see Section 6.3.2).

6.3.6 Condition 11.4.3

This section summarizes actions taken in accordance with the following requirement of Condition 11.4.3: *The plan shall include an approach to monitor and evaluate any changes to baseline conditions, as defined in condition 11.4.1 and identify improvements based on monitoring data*.

See section 6.3.2 for discussion of the plan for monitoring and evaluating changes to baseline wetland conditions, as defined in condition 11.4.1, and for identifying improvements based on monitoring data.

6.3.7 Condition 11.4.4

This section summarizes actions taken in accordance with the following requirement of Condition 11.4.4: *The plan shall include compensation measures to address the unavoidable loss of wetland areas and functions supporting migratory birds, species at risk, and the current use of lands and resources by Aboriginal people in support of the objective of full replacement of wetlands in terms of area and function*.

Please see Section 6.3.2 for details on the wetland mitigation program and the Wetland Function Assessment tool.

6.3.8 Condition 11.8

This section summarizes actions taken in accordance with the following requirement of Condition 11.8: *The Proponent shall commence the implementation of the compensation measures specified in condition 11.4.4 no later than five years from the initiation of construction.*

Please refer to Section 6.3.2 for details on implementation of wetland compensation measures in 2015, the first year of construction, and ongoing implementation.

6.3.9 Condition 11.9

This section summarizes actions taken in accordance with the following requirement of Condition 11.9: *The Proponent shall implement each component of the plan and provide to the Agency an analysis and summary of the implementation of the plan, as well as any amendments made to the plan in response to the results, on an annual basis during construction and at the end of year 1, 2, 3, 5, 10, 15, 20 and 30 of operation*.

This annual report represents an analysis and summary of the implementation of the plan, as well as amendments made to the plan through the ongoing development of component mitigation and monitoring plans based on survey results and consultation with CWS, MLWRS, and MOECCS.

6.4 Federal Decision Statement Condition 16: Species at Risk Mitigation and Monitoring

This section of the annual report summarizes the programs as implemented in 2023 in accordance with the requirements of FDS condition 16.6.

For context, the complete requirements of FDS condition 16 are listed below.

16. Species at risk, at-risk and sensitive ecological communities and rare plants

16.1. The Proponent shall ensure that potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants are addressed and monitored.

16.2. The Proponent shall develop, in consultation with Environment Canada, a plan setting out measures to address potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants.

16.3. The plan shall include:

- 16.3.1. field work to verify the modeled results for surveyed species at risk and determine the habitat that would be permanently lost, habitat that would be fragmented and habitat that would remain intact for those species, including the Short-eared Owl, the Western Toad and the Myotis Bat species;
- 16.3.2. surveys to determine whether the rare plant species potentially facing extirpation in the Project Activity Zone are found elsewhere in the region;
- 16.3.3. measures to mitigate environmental effects on species at risk and at-risk and sensitive ecological communities and rare plants;
- 16.3.4. conservation measures to ensure the viability of rare plants, such as seed recovery and plant relocation;
- 16.3.5. an approach to avoiding or minimizing the use of herbicides and pesticides in areas that could impact species at risk, at-risk and sensitive ecological communities and rare plants;
- 16.3.6. an approach to monitor and evaluate the effectiveness of mitigation measures and to verify the accuracy of the predictions made during the environmental assessment on species at risk, at-risk and sensitive ecological communities and rare plants; and
- 16.3.7. an approach for tracking updates to the status of listed species identified by the Government of British Columbia, Committee on the Status of Endangered Wildlife in Canada, and the Species at Risk Act, and implementation of additional measures, in accordance with species recovery plans, to mitigate effects of the Designated Project on the affected species should the status of a listed species change during the life of the Designated Project.

16.4. The Proponent shall submit to the Agency and Environment Canada a draft copy of the plan for

	review 90 days prior to initiating construction.
16.5.	The Proponent shall submit to the Agency the final plan a minimum of 30 days prior to initiating construction. When submitting the final plan, the Proponent shall provide to the Agency, an analysis that demonstrates how it has appropriately considered the input, views or information received from Environment Canada.

The requirements of Condition 16.1 and Condition 16.2 are addressed through Condition 16.3. Mitigation and monitoring plans are developed in consultation with the CWS of ECCC through the VWTC (Section 3.1).

6.4.1 Condition 16.3.3

This section summarizes actions taken in accordance with the following requirement of Condition 16.3.3: *The plan shall include measures to mitigate environmental effects on species at risk and at-risk and sensitive ecological communities and rare plants.*

In 2023 the following measures were implemented to mitigate effects on species at risk and at-risk and sensitive ecological communities and rare plants:

- Pre-construction rare plant surveys focussed on the remaining segments of Highway 29 realignment corridors on the north side of the Peace River, access roads on the south side of the Peace River, and on the Area E aggregate extraction site. (Section 6.4.1.1);
- Amphibian mitigation through salvages and dispersal translocation (Section 6.4.1.2);
- Implementation of protection measures for wetland and riparian areas, in which rare plant occurrences are generally concentrated, as required by the CEMP (See Section 6.3.1);
- The Environmental Features Map was updated with 2022 rare plant data on 10 February 2023, when it was available to contractors for use in planning;
- Further development and implementation of the Experimental Rare Plant Translocation program in consultation with MOECCS, MLWRS, and CWS (Sections 7.1.6, 7.5.1 and 7.5.2); and
- Avoidance of bat hibernacula and maternity roosts at Portage Mountain, and the construction and installation of bat boxes on the north side of the Peace River. The 2017 VWMMP Annual Report described how impacts to hibernacula at Portage Mountain are being avoided. Monitoring of bat activity at Portage Mountain began in 2017 for evaluating the effectiveness of mitigation. Ongoing monitoring of bat activity at Portage Mountain at installed bat boxes is described in Section 6.4.3.3.

6.4.1.1 Pre-construction rare plant surveys

Pre-construction rare plant surveys were conducted in 2023 in areas of the planned Project footprint not previously surveyed. The resulting data serve as inputs to the final design of access roads, help inform mitigation to avoid or minimize impacts to rare plant occurrences near construction sites and identify potential propagule sources for the Experimental Rare Plant Translocation Program (see Sections 7.1.6, 7.5.1 and 7.5.2). The first season of pre-construction surveys was completed in the summer and fall of 2015, and those surveys have been ongoing in each year since. The 2023 pre-construction rare plant survey report, which includes methods and results from surveys conducted in 2015 through 2023, is in Appendix 5.

6.4.1.2 Amphibian dispersal mitigation and salvage

Mitigation for minimizing the impacts of the Project on amphibians and amphibian habitat is required of contractors and specified in part in Section 4.17 and Appendix L of the CEMP. Those mitigations include the following:

- Limit vegetation clearing and avoid road construction in identified amphibian breeding and migration areas, where feasible;
- If construction is required adjacent to any identified amphibian breeding and migration areas, implement appropriate barriers and set-back buffers around the sites in accordance with aquatic and riparian protection measures (i.e., retain a 15 m machine-free riparian buffer from the Ordinary High Water Mark of watercourses and waterbodies during clearing, except where worker safety prohibits manual tree falling and vegetation removal methods, and as addressed in a site specific prescription prepared and endorsed by a QEP [see Section 4.5 of the CEMP]; and avoid where feasible, including through the use of disturbance setback buffers);
- Install crossing structures for amphibians and snakes to avoid and reduce injury and mortality to amphibians on roads that cross or are immediately beside wetland or other areas where amphibians or snakes are known to migrate across roads in accordance with Section 8.8 of the VWMMP. Notify BC Hydro of such installations within 5 days of installation; and
- Implement amphibian salvage and translocation procedures as required. Amphibian salvages could be required when avoidance of areas containing metamorphosing tadpoles cannot be avoided, or prior to the destruction of wetlands supporting amphibians (Wildlife Act Permit FJ16-226024, expired December 31, 2023). Amphibian translocation may be required when mass migration events cross access roads and work sites.

It is necessary for each contractor's QEP to conduct amphibian breeding and migration area surveys in advance of ground disturbing activities and alongside active construction roads, where and when appropriate, to determine appropriate mitigation. Revision 5 of the CEMP includes an explicit requirement for each Contractor and its QEP to follow the Western Toad Management Procedure wherever western toads may exist. The Western Toad Management Procedure was developed through extensive consultation with MLWRS, MOECCS and CWS through the VWTC, and can be found in Appendix 6 of the 2017 Annual Report and is Appendix L of the CEMP. This procedure was finalized June 26, 2017, and since that time has been required for inclusion in all contractors' Environmental Protection Plans (EPPs) for works that could impact amphibians. Appropriate amphibian mitigation is monitored by BC Hydro site Environmental Monitors and the Independent Environmental Monitor (IEM) against commitments within EPPs and CEMP requirements to determine and enforce compliance.

The Western Toad Management Procedure is applicable during construction on access roads, the transmission line, and areas within 250 m of wetlands. It requires daily surveys of all access roads and work sites during the 'core dispersal period' of June 1 to August 15. During the 'caution dispersal periods' of April 1 to May 31 and August 16 to September 30, the protocol requires a minimum of weekly surveys, as well as surveys before travelling to site and before any work commences. The protocol includes a stop work procedure at access roads or construction sites if dispersing toads are confirmed within 20 m of those areas, as well as a requirement for installing temporary barrier fences to prevent toads from being exposed to an increased mortality risk. Trapped toads are then to be translocated safely across work areas in the direction of their dispersal.

6.4.2 Condition 16.3.4

This section summarizes actions taken in accordance with the following requirement of Condition 16.3.4: *The plan shall include conservation measures to ensure the viability of rare plants, such as seed recovery and plant relocation*.

The Experimental Rare Plant Translocation (ERPT) program was developed in consultation with MOECCS, MLWRS, and CWS through the VWTC (see Section 7.5.1 and 7.5.2). Collection of seeds began in 2017. Work to collect seeds and salvage rare plants under this program continued in 2023, along with translocation and monitoring (see Section 7.1.6). The 2023 ERPT final report is in Appendix 6.

6.4.3 Condition 16.3.6

This section summarizes actions taken in accordance with the following requirement of Condition 16.3.6: *The plan shall include an approach to monitor and evaluate the effectiveness of mitigation measures and to verify the accuracy of the predictions made during the environmental assessment on species at risk, at-risk and sensitive ecological communities and rare plants.*

6.4.3.1 Migratory Bird Monitoring

Please see Section 6.1.3 for a summary of migratory bird surveys conducted in 2023. These monitoring programs are designed to meet a number of objectives, including to monitor and evaluate the effectiveness of mitigation measures and to verify the accuracy of predictions made during the environmental assessment regarding migratory bird species at risk. Numerous migratory species that have been observed in those surveys are provincially and / or federally listed. The 2023 Annual Report for songbird surveys can be found in Appendix 2.

6.4.3.2 Ground-nesting Raptor Surveys

Ground-nesting raptor surveys were conducted in 2023 to monitor and evaluate the effectiveness of mitigation measures and to verify the accuracy of predictions made during the environmental assessment on ground nesting raptors, such as short-eared owl (see Section 7.9.4.2). Short-eared owl is a ground-nesting raptor that is provincially Blue-listed, is listed as Threatened by COSEWIC, and listed as Special Concern on Schedule 1 of SARA. The 2023 Annual Report for Ground-nesting surveys can be found in Appendix 7.

6.4.3.3 Bat Mitigation and Monitoring

To avoid destroying hibernacula at Portage Mountain that may be used by little brown myotis and northern myotis (both of which are federally listed as Endangered on Schedule 1 of SARA), BC Hydro redesigned the Portage Mountain Quarry to the eastern edge of the License of Occupation area. This relocation achieved a 300 m no activity/no access buffer around the 16 documented potential hibernacula. To avoid disturbance to hibernating bats, BC Hydro has also prohibited blasting at Portage Mountain between September 15 and May 15 (see Section 4.2 of the CEMP); this window was established based on data collected at the hibernacula in 2013 and in consultation with bat biologists. This mitigation is summarized in Section 7.7.3 of this annual report and is described in detail in Appendix 8 of the 2016 Annual Report.

To prevent damaging rock structures associated with the hibernacula, MOE[6] recommends noise levels during blasting be kept below certain thresholds at the hibernacula (see Section 7.7.3). BC Hydro conducted noise modelling for blasting at Portage Mountain, which predicted that noise levels at the hibernacula would be below those thresholds.

BC Hydro monitored the noise and vibration caused by activity at Portage Mountain Quarry in 2018 through 2021, which included blasting for haul road construction and aggregate production. Noise monitoring conducted at the site determined that in 2018, 2019 and 2021, noise and vibration caused by blasting did not exceed thresholds at hibernacula locations, as defined in BC MOE Best Management Practices (BMP) Guidelines for Bats in British Columbia (i.e., air overpressure of less than 150 decibels, shock wave less than 15 p.s.i., and peak particle velocity [PPV] less than 15 mm/second; BC MOE 2016). In 2020, noise monitoring was conducted monthly, and so modelling was used to supplement available data. That modelling of noise and vibration showed that also in 2020 blasting was unlikely to have exceeded the BC BMP thresholds for noise or vibration at important bat habitat. No blasting occurred at Portage Mountain in 2023.

BC Hydro is also conducting year-round monitoring of bat activity at Portage Mountain, with the following objectives:

- confirm that the bat species previously recorded at Portage Mountain remain present during quarry operations;
- evaluate any changes in the use of hibernacula at Portage Mountain through bat activity recorded during the winter and spring-emergence periods;
- evaluate and changes in the use of Portage Mountain by bats by comparing bat activity to previously recorded spring to fall bat activity; and
- emergence counts with bioacoustic surveys to help determine whether maternity roosts are present, and to evaluate the efficacy of spatial setback mitigation from suspected maternity roosts.

Analysis of bat activity data from acoustic detectors and bat emergence counts is challenging due to the high variability inherent in bat activity data, which can make it difficult to confidently identify trends or causal relationships. In addition, relatively few baseline bat activity data were collected before quarry development and operation began.

An analysis of the bat activity data collected at Portage Mountain suggests that quarry construction and operation may have had some limited impacts on bat activity (see Section 6.4.3.3 of the 2021 annual report). Further bat activity monitoring at Portage Mountain is planned to help determine whether any persistent changes in bat activity can be identified now that quarry construction and operation are concluded. The report describing the results of bat activity monitoring at Portage Mountain in 2023 is in Appendix 8.

BC Hydro has constructed and installed 120 bat roost boxes and one large bat house in suitable habitat near the future reservoir and dam site. Monitoring of bat activity at the bat box installation locations is planned to occur annually through construction and the first 10 years of operations of Site C. The report describing the results of bat activity monitoring within the bat boxes in 2023 is in Appendix 9.

In addition, BC Hydro voluntarily constructed three artificial bat hibernacula at the Portage Mountain Quarry site in 2023 by drilling holes at least 3 m deep in rock faces on warm aspects that were inaccessible to predators. Small charges were used within the drill holes to create

[6] BC MOE. 2016. Best Management Practices Guidelines for Bats in British Columbia. Chapter 2: Mine Developments and Inactive Mine Habitats. 68 pp.

rock fractures to provide a range of microclimatic conditions and insulation for overwintering bats. A fourth hibernaculum using a culvert design as per the recommendation of the bat SME, is planned for 2024.

6.4.3.4. Western Toad and Gartersnake Monitoring

The Western Toad and Gartersnake Monitoring Program was developed to identify and describe impacts to western toad and gartersnakes in wetlands downstream of Site C and implemented in 2018 through 2020. Western toad is federally listed as Special Concern under COSEWIC, SARA Schedule 1 – Special Concern, but is considered not at risk in BC. Pre-operations data collection was completed in 2020, and operations data collection is scheduled to begin in 2025.

6.4.3.4. Wetland Function Assessment and Wetland Monitoring

The Wetland Function Assessment has been developed to characterize the impacts of the Project on wetlands in general, and specifically the ecological functions that wetlands provide. A wetland monitoring program was implemented from 2018 to 2022 to monitor and evaluate the effectiveness of wetland mitigation measures and to verify the accuracy of the predictions made during the environmental assessment (see Section 6.3.2). The program ended in 2022, the results of which were reported in the 2022 Annual Report.

6.4.3.5. Downstream Vegetation Monitoring

The Downstream Vegetation Monitoring program was developed to document the response of downstream vegetation, at-risk and sensitive ecosystems, and rare plant occurrences between the dam and the Pine River to changes in the surface water regime during construction and operations. The program was implemented in 2019 and continued in 2020 to complete pre-river diversion (i.e., baseline) data collection. Data collection occurred in 2022 to capture the river diversion period during the mid-point of the diversion period. There was no need to collect data in 2023. Once Project operations commence, surveys will be conducted every 2 years for the first 10 years and then every 5 years for the next 15 years. The Downstream Vegetation Monitoring 2022 annual report was included with the 2022 VWMMP Annual Report.

6.4.4 Condition 16.3.7

This section summarizes actions taken in accordance with the following requirement of Condition 16.3.7: *The plan shall include an approach for tracking updates to the status of listed species identified by the Government of British Columbia, Committee on the Status of Endangered Wildlife in Canada, and the Species at Risk Act, and implementation of additional measures, in accordance with species recovery plans, to mitigate effects of the Designated Project on the affected species should the status of a listed species change during the life of the Designated Project.*

The Conservation Data Center revisions to the ranking of Species at Risk in 2023 was reviewed. The following documents were reviewed to identify changes to rankings of species documented in the LAA during baseline surveys[7]:

- 2023 BC Conservation Status Rank Review and Changes, Vascular Plants
- 2023 BC Conservation Status Rank Review and Changes, Ecological Communities
- 2023 BC Conservation Status Rank Review and Changes, Animals Summary

Species listed on Schedules 1, 2 and 3 of SARA were reviewed to determine if any species occurring in the Project area had been added or had their rankings changed.

Provincially species are assigned to lists based on their Provincial conservation status. Species on the Red and Blue-lists are considered species at risk. Species on the yellow and unknown lists are not considered species at risk. A summary of the lists is provided below and can be accessed at http://www.env.gov.bc.ca/atrisk/help/list.htm:

- **Red-list:** Includes any indigenous species or subspecies that have, or are candidates for, Extirpated, Endangered, or Threatened status in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed. Not all Red-listed taxa will necessarily become formally designated. Placing taxa on these lists flags them as being at risk and requiring investigation.
- **Blue-list:** Includes any indigenous species or subspecies considered to be of Special Concern (formerly Vulnerable) in British Columbia. Taxa of Special Concern have characteristics that make them particularly sensitive or vulnerable to human activities or natural events. Blue-listed taxa are at risk, but are not Extirpated, Endangered or Threatened.
- **Yellow-list:** Includes species that are apparently secure and not at risk of extinction. Yellow-listed species may have red- or blue-listed subspecies.
- **Unknown**: Includes species or subspecies for which the Provincial Conservation Status is unknown due to extreme uncertainty (e.g., S1S4). It will also be 'Unknown' if it is uncertain whether the entity is native (Red, Blue or Yellow), introduced (Exotic) or accidental in B.C. This designation highlights species where more inventory and/or data gathering is needed.

6.4.4.1 Rare Plants

In 2023, there were no changes to the conservation status of plants with potential to occur in the Site C Project area.

6.4.4.2 Wildlife

The SARA status listings for wildlife species likely to occur within the Site C Project area did not change in 2023.

The COSEWIC classifications did not change for wildlife species likely to occur within the Site C Project area.

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[7] Government of British Columbia. 2023. Recent Data Changes. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/conservation-data-centre-updates. Accessed: 7 March 2023.

In August 2023, the BC Conservation Data Centre (CDC) listing changed for three wildlife species with potential to occur in the Site C Project area (Table 5). None of these species are listed under SARA or COSEWIC.

Table 5. BC CDC Status Changes in 2023 for Wildlife Likely to Occur in the Site C Project Area

Common Name	Scientific Name	2022 BC Status	2023 BC Status
White-rumped Sandpiper	*Calidris fuscicollis*	Accidental	Blue
Black Tern	*Chlidonias niger*	Yellow	Blue
Short-billed Dowitcher	*Limnodromus griseus*	Blue	Red

7.0 Mitigation and Monitoring Measures-Environmental Assessment Certificate Conditions

Conditions 9 to 12, 14 to 16, 19, 21, 23, and 24 of the Environmental Assessment Certificate, respectively, set out the mitigation and monitoring requirements for the Project's effects on vegetation and ecological communities and wildlife resources.

7.1 EAC Condition 9

This section of the annual report summarizes the programs implemented in 2023 in accordance with the requirements of Condition 9. For context, the complete requirements of Condition 9 are shown below.

EAC Condition 9

The EAC Holder must develop a Vegetation and Invasive Plant Management Plan to protect ecosystems, plant habitats, plant communities, and vegetation with components applicable to the construction phase.

The Vegetation and Invasive Plant Management Plan must be developed by a QEP.

The Vegetation and Invasive Plant Management Plan must include at least the following:

Invasive Species

- Surveys of existing invasive species populations prior to construction.
- Invasive plant control measures to manage established invasive species populations and to prevent invasive species establishment.

Rare Plants and Sensitive Ecosystems

- The EAC Holder must expand its modelling, including completing field work, to improve identification of rare and sensitive plant communities and aid in delineation of habitats that may require extra care, 90 days prior to any Project activities that may affect these rare or sensitive plant communities
- The EAC Holder must, with the use of a QEP, complete an inventory in areas not already surveyed and use rare plant location information as inputs to final design of access roads and transmission lines. These pre- construction surveys must target rare plants as defined in Section 13.2.2 of the EIS —including vascular plants, mosses, and lichens.
- The EAC Holder must create and maintain a spatial database of known rare plant occurrences in the vicinity of Project components that must be searched to avoid effects to rare plants during construction activities. The database must be updated as new information becomes available and any findings of new rare plant species occurrences must be submitted to Environment Canada

and MOE using provincial data collection standards.

- The EAC Holder must implement construction methods to reduce the impact to rare plants, maximize use of existing access corridors, and construct transmission towers and temporary roads away from wetlands and known rare plant occurrences.
- The EAC Holder must implement construction methods to reduce the impact to rare plants, maximize use of existing access corridors, and construct transmission towers and temporary roads away from wetlands and known rare plant occurrences.
- Protect known occurrences of Tufa seeps, wetlands and rare plants located adjacent to construction areas. Install signage and flagging where necessary, as determined by the QEP, to indicate the boundaries of the exclusion area.
- The EAC Holder will engage the services of a Rare Plant Botanist during construction to design and implement an experimental rare plant translocation program in consultation with MOE using the BC MOE's Guidelines for Translocation of Plant Species at Risk in BC (Maslovat, 2009).

The EAC Holder must provide this draft Vegetation and Invasive Plant Management Plan to Environment Canada, FLNR, MOE, and Aboriginal Groups for review a minimum of 90 days prior to construction and operation phases.

The EAC Holder must file the final Vegetation and Invasive Plant Management Plan with the Environmental Assessment Office (EAO), Environment Canada, FLNR, MOE, and Aboriginal Groups, a minimum of 30 days prior to construction and operation phases.

The EAC Holder must develop, implement and adhere to the final Vegetation and Invasive Plant Management Plan, and any amendments, to the satisfaction of EAO.

7.1.1 Invasive Plant Control

BC Hydro and its contractors adhered to the invasive plant mitigation measures described in Section 4.15 of CEMP and in the Invasive Weed Mitigation and Adaptive Management Plan (IWMAMP). Numerous invasive plant control measures for the Project continued in 2023:

- invasive plant removal through hand pulling;
- biocontrol implementation for toadflax along river road
- on-going inventories of invasive plant locations;
- hydroseeding of exposed slopes across the Project area;
- regular vehicle inspections and cleaning through various methods so that vehicles are clean and free of dirt and invasive plants when transitioning between sites and into the Project area;
- BC Hydro and contractors utilise an operational wash station on site during non-frozen conditions;
- An Invasive Species Management Contractor was sourced by BC Hydro in 2018. That contractor will provide specialized support invasive species management support on the dam site, transmission line, reservoir, Hwy 29 realignment and other off-site locations through 2024.

7.1.2 Inventory areas not already surveyed

This section summarizes actions taken in accordance with the following requirement of Condition 9*: The EAC Holder must, with the use of a QEP, complete an inventory in areas not already surveyed and use rare plant location information as inputs to final design of access roads and transmission lines. These pre- construction surveys must target rare plants as defined in Section 13.2.2 of the EIS —including vascular plants, mosses, and lichens.*

Please see Section 6.4.1.1 for pre-construction rare plant surveys conducted in areas not already surveyed. Rare plant location data collected in 2023 was used to update the Environmental Features Map for contractors to access in their planning so that impacts to rare plants could be mitigated.

7.1.3 Spatial database of known rare plant occurrences

This section summarizes actions taken in accordance with the following requirement of Condition 9*: The EAC Holder must create and maintain a spatial database of known rare plant occurrences in the vicinity of Project components that must be searched to avoid effects to rare plants during construction activities. The database must be updated as new information becomes available and any findings of new rare plant species occurrences must be submitted to Environment Canada and MOE using provincial data collection standards.*

The Site C Environmental Features Database and Environmental Features Map was updated with the 2022 rare plant data on 10 February 2023, when it was available to contractors for use in planning.

After the 2023 field season had ended, data was compiled and verified and submitted to the BCCDC. This dataset contained all the new rare plant occurrences found during 2023, as well as any updates and extensions to previously reported occurrences. The data was provided in a spatial format compatible with BCCDC submission requirements. Voucher specimens were prepared based on MOECCS guidelines (MOECCS 2018) and submitted to the UBC herbarium.

7.1.4 Rare plant avoidance

This section summarizes actions taken in accordance with the following requirement of Condition 9*: The EAC Holder must implement construction methods to reduce the impact to rare plants, maximize use of existing access corridors, and construct transmission towers and temporary roads away from wetlands and known rare plant occurrences.*

General mitigation to minimize impacts to wetlands, where rare plants are often concentrated is described in Section 6.3.1.

Rare plant location data collected in 2022 were used to update the Environmental Features Map for BC Hydro and contractors to access in their planning so that impacts to known occurrences of rare plants could be mitigated in 2023.

The way that BC Hydro fulfilled this part of Condition 9 during the transmission line design phase was described in the 2015 annual report. Tower types selected are capable of supporting longer spans of conductor than those originally planned, which will reduce the overall number of towers required. Tower pad placement has been adjusted to minimize impacts to wetlands within engineering constraints. As a result, the total number of towers was reduced from 433 in the conceptual design down to 409 in the current design. The number of wetlands impacted was 102 in the conceptual design and is 64 in the current design. Occurrences of rare plants have been avoided through transmission line design and tower placement to the degree feasible.

Further practices for avoidance of rare plant occurrences are described in Section 4.15 of the CEMP. All known rare plant occurrences are stored in the Site C Environmental Features Database and displayed on the Environmental Features Map (see Section 7.1.3). Contractors are required to avoid impacting rare plant occurrences, where feasible. Where complete avoidance is not feasible, contractors are required to employ measures to reduce adverse effects, such as by timing construction activities in winter months and frozen ground conditions, placing ramps or matts over occurrences to reduce soil compaction, using rubber-tired equipment, and implementing designated travel routes to and from work sites. Additional mitigation for rare plant occurrences that cannot be avoided is addressed through the Experimental Rare Plant Translocation program, in which rare plant propagules are collected, propagated, out-planted and monitored (see Sections 7.1.6, 7.5.1 and 7.5.2).

7.1.5 Protect tufa seeps, wetlands and rare plants located adjacent to construction areas

This section summarizes actions taken in accordance with the following requirement of Condition 9*: Protect known occurrences of Tufa seeps, wetlands and rare plants located adjacent to construction areas. Install signage and flagging where necessary, as determined by the QEP, to indicate the boundaries of the exclusion area.*

Mitigation to minimize impacts to wetlands and rare plants adjacent to construction areas is described in the CEMP, and further described in detail in Sections 6.3.1 and 6.3.3 of this report for tufa seeps and wetlands, and Section 7.1.4 for rare plants.

Tufa seeps are present on the south bank of the eastern reservoir, where clearing occurred in 2019. Mitigation to minimize impacts on the tufa seep consisted of no ground equipment within the feature, and trees were directionally felled away from the tufa seep to the degree feasible. Further details on tufa seep mitigation measures were described in the 2022 VWMMP Annual Report. No tufa seeps were affected by construction activities in 2023.

7.1.6 Experimental Rare Plant Translocation Program

This section summarizes actions taken in accordance with the following requirement of Condition 9: *The EAC Holder will engage the services of a Rare Plant Botanist during construction to design and implement an experimental rare plant translocation program in consultation with MOE using the BC MOE's Guidelines for Translocation of Plant Species at Risk in BC (Maslovat, 2009).*

The Experimental Rare Plant Translocation program was developed in consultation with MOECCS, MLWRS and CWS through the VWTC, and is described in detail in Section 7.5.1. Collection of seeds began in 2017. Work to collect seeds and salvage rare plants under this program continued in 2023, along with translocation and monitoring. The report detailing the results of the 2023 field program is Appendix 6.

7.3 EAC Condition 11

This section of the annual report summarizes the programs implemented in 2023 in accordance with the requirements of Condition 11.

For context, the complete requirements of Condition 11 are shown below.

EAC Condition 11
EAC Holder must compensate for the loss of rare and sensitive habitats and protect occurrences of rare plants by developing, or funding the development and implementation of a compensation program, during construction, that includes: • Assistance (financial or in-kind) to the managing organization of suitable habitat enhancement

projects in the RAA (RAA as defined in the amended EIS).
- Direct purchase of lands in the RAA and manage these lands and suitable existing properties owned by the EAC Holder to enhance or retain rare plant values where opportunities exist.

The EAC Holder must engage with FLNR, MOE and Aboriginal Groups with regard to the development of the compensation program.

7.3.1 Habitat Enhancement Projects in the Regional Assessment Area (RAA)

This section summarizes actions taken in accordance with the following requirement of Condition 11: *EAC Holder must compensate for the loss of rare and sensitive habitats and protect occurrences of rare plants by developing, or funding the development and implementation of a compensation program, during construction, that includes assistance (financial or in-kind) to the managing organization of suitable habitat enhancement projects in the RAA (RAA as defined in the amended EIS).*

Habitat enhancement activities to compensate for the loss of rare and sensitive habitats and for protecting occurrences of rare plants are being conducted through Ducks Unlimited Canada for wetland compensation activities (Section 6.3.2), and Ecologic Consultants through the Saulteau-EBA Environmental Services Joint Venture for the Experimental Rare Plant Translocation Program (Section 7.1.6).

7.3.2 Direct purchase of lands in the RAA to enhance or retain rare plant values

This section summarizes actions taken in accordance with the following requirement of Condition 11: *EAC Holder must compensate for the loss of rare and sensitive habitats and protect occurrences of rare plants by developing, or funding the development and implementation of a compensation program, during construction, that includes direct purchase of lands in the RAA and manage these lands and suitable existing properties owned by the EAC Holder to enhance or retain rare plant values where opportunities exist.*

In 2014 BC Hydro purchased the Marl Fen property, located outside Hudson's Hope. This property supports several rare plant species. This property is being managed to maintain rare plants along with other wildlife and vegetation values. Results of surveys documenting species that occur within the property are provided in the 2015 Annual Report of the VWWMP.

7.3.3 Engaging with MLWRS, MOECCS and Indigenous Groups

This section summarizes actions taken in accordance with the following requirement of Condition 11: *The EAC Holder must engage with FLNR, MOE and Aboriginal Groups with regard to the development of the compensation program.*

BC Hydro continues to engage with MLWRS and MOECCS through the VWTC regarding the development of the compensation program for the loss of rare and sensitive habitats and to protect occurrences of rare plants. BC Hydro continues to engage with Indigenous Groups through ongoing communications, such as direct requests for assistance in identifying appropriate wetland compensation opportunities. In addition, BC Hydro engages with Indigenous Groups through regularly scheduled permitting and environmental forums. Those forums cover subjects that included rare plants, plants of traditional importance, wetlands, and expected Site C construction impacts on beavers.

7.4 EAC Condition 12

This section of the annual report summarizes the programs implemented in 2023 in accordance with the requirements of Condition 12.

Details regarding the Wetland Mitigation and Compensation Plan and wetland mapping are described in Section 7.4.1 and 7.4.1.1, respectively. Additional details regarding maintaining hydrological balance at wetlands, sedimentation barriers, stormwater management, implementation of approved work practices and Develop with Care, are presented in Section 7.3 of the 2017 VWMMP Annual Report.

For context, the requirements of Condition 12 are shown below.

EAC Condition 12

The EAC Holder must develop a Wetland Mitigation and Compensation Plan. The Wetland Mitigation and Compensation Plan must include an assessment of wetland function lost as a result of the Project that is important to migratory birds and species at risk (wildlife and plants). The Wetland Mitigation and Compensation Plan must be developed by a QEP with experience in wetland enhancement, maintenance and development.

The Wetland Mitigation and Compensation Plan must include at least the following:

- Information on location, size and type of wetlands affected by the Project;
- If roads cannot avoid wetlands, culverts will be installed under access roads to maintain hydrological balance, and sedimentation barriers will be installed;
- Stormwater management will be designed to control runoff and direct it away from work areas where excavation, spoil placement, and staging activities occur.

Develop, with the assistance of a hydrologist, site-specific measures prior to construction to reduce changes to the existing hydrologic balance and wetland function during construction of the Jackfish Lake Road and Project access roads and transmission line.

- All activities that involve potentially harmful or toxic substances, such as oil, fuel, antifreeze, and concrete, must follow approved work practices and consider the provincial BMP guidebook Develop with Care (BC Ministry of Environment 2012 or as amended from time to time).
- A defined mitigation hierarchy that prioritizes mitigation actions to be undertaken, including but not limited to:
    - Avoid direct effects where feasible;
    - Minimize direct effects where avoidance is not feasible;
    - Maintain or improve hydrology where avoidance is not feasible;
    - Replace like for like where wetlands will be lost, in terms of functions and compensation in terms of area;
    - Improve the function of existing wetland habitats; and
    - Create new wetland habitat

The EAC Holder must monitor construction and operation activities that could cause changes in wetland functions.

The EAC Holder must provide this draft Wetland Mitigation and Compensation Plan to Environment Canada, FLNR, MOE, Aboriginal Groups, Peace River Regional District and District of Hudson's Hope for review a minimum of 90 days prior to any activity affecting the wetlands.

The EAC Holder must file the final Wetland Mitigation and Compensation Plan with EAO, Environment Canada, FLNR, MOE, Peace River Regional District, District of Hudson's Hope and Aboriginal Groups, a minimum of 30 days prior to any activity affecting the wetlands.

The EAC Holder must develop, implement and adhere to the final Wetland Mitigation and Compensation Plan, and any amendments, to the satisfaction of EAO.

7.4.1 Wetland Mitigation and Compensation Plan

Condition 12 requires: *The EAC Holder must develop a Wetland Mitigation and Compensation Plan. The Wetland Mitigation and Compensation Plan must include an assessment of wetland function lost as a result of the Project that is important to migratory birds and species at risk (wildlife and plants). The Wetland Mitigation and Compensation Plan must be developed by a QEP with experience in wetland enhancement, maintenance and development.*

Please see Section 6.3 for a description of the components of the Wetland Mitigation and Compensation Plan:

- Section 6.3.1, 6.3.3 and 6.3.5 describe mitigation to avoid or minimize impacts to wetlands to the degree feasible.
- Section 6.3.2 describes the status of wetland compensation plan development, the wetland monitoring program and the Wetland Function Assessment Tool, which combined represent the measurement and compensation of wetland impacts.

7.4.1.1 Information on location, size and type of wetlands affected by the Project

This section summarizes actions taken in accordance with the following requirement of Condition 12: *Information on location, size and type of wetlands affected by the Project.*

Three spatial datasets are available that describe the location, size and type of wetlands that may be affected by the Project: TEM habitat mapping; detailed wetland mapping; and a dataset produced by Maple Leaf Forestry. The TEM was generated in and around the Project Activity Zone (PAZ) to encompass the Peace River, the transmission line, and other sites within the PAZ. Polygons in the TEM were produced at a 1:20,000 scale, delineated using aerial photography, characterized with aerial photography combined with Vegetation Resources Inventory (VRI) forest cover mapping, and ground-truthed using field sampling. The TEM was used to generate estimates of wetland area to be affected by construction in the PAZ in the EIS and is being updated based on the results of wetland monitoring.

Detailed wetland mapping was created by BC Hydro to be finer scale wetland mapping than the TEM data. Within a TEM polygon, wetland boundaries were delineated using aerial photos that were either at a 1:5,000 or 1:15,000 scale. This allowed for greater detail to delineate the wetland edge. The detailed wetland mapping was completed along the transmission line corridor and the Peace River. It was delineated by first identifying all TEM polygons classified as wetland habitat. Using large scale aerial photographs, the boundaries of any wetland that fell within a TEM wetland polygon were then delineated and the habitat type of the TEM wetland polygon was assigned to the newly delineated wetland(s). In some cases, the TEM wetland was divided up into several smaller wetlands while in others the edge of the TEM wetland was only modified based on the higher detail aerial photographs used. Also, in some cases, wetlands have been delineated outside of TEM wetland polygons. A Field-Truthing-Required (FTR) label was assigned to any wetland where wetland classification needed refining. Because the detailed wetland mapping polygons follow wetland edge, this GIS dataset is useful for characterizing wetlands that may be affected.

In October 2017, Maple Leaf Forestry Ltd. conducted an assessment and classification of wetlands impacted by the transmission line RoW. This consisted of field visits to identify all the wetlands in the RoW, categorize them into a wetland type, and delineate the boundaries of the wetland. Wetlands were categorized into the same wetland types as in the TEM while also classified into a Wetland Riparian Class of the Forest Practices and Planning Regulation (FPPR) under the Forest and Range Practices Act (FRPA). All wetlands in the transmission line were classified as W1, W3, W5, or a non-classified wetland. The Wetland Riparian Class was used to identify the minimum riparian management area width, riparian reserve zone width and riparian management zone width for the wetland. Because the Maple Leaf Forestry dataset has field-verified wetland edges and type, there is a greater level of accuracy associated with this dataset; however, wetland mapping and characterization was only conducted along the transmission line RoW, and therefore its usefulness for characterizing wetlands that may be affected by the Project is limited.

Although each dataset has its limitations, the TEM, detailed and Maple Leaf wetland habitat mapping can be used in association with each other. Additional wetland delineation is being done through the ongoing wetland monitoring program (Section 6.3.2).

7.5 EAC Condition 14

This section of the annual report summarizes the programs as implemented in 2023 in accordance with the requirements of Condition 14.

For context, the complete requirements of Condition 14 are shown below.

EAC Condition 14

The EAC Holder must develop a Vegetation and Ecological Communities Monitoring and Follow-up Program for the construction phase and first 10 years of the operations phase. The Vegetation and Ecological Communities Monitoring and Follow-up Program must be developed by a QEP.

The Vegetation and Ecological Communities Monitoring and Follow-up Program must include at least the following:

- Definition of the study design for the rare plant translocation program (see condition 9).
- Plan for following-up monitoring of any translocation sites to assess the survival and health of translocated rare plant species, under the supervision of a Rare Plant Botanist.
- Measurement criteria, including vegetation growth, persistence of rare plants and establishment / spread of invasive plant species, and associated monitoring to document the effectiveness of habitat enhancement and possible compensation programs.

The Vegetation and Ecological Communities Monitoring and Follow-up Program reporting must occur annually during construction and the first 10 years of operations, beginning 180 days following commencement of construction.

7.5.1 Definition of the study design for the Experimental Rare Plant Translocation Program

As outlined in the VWMPP, the study design for the Experimental Rare Plant Translocation program will follow a five-step approach, as outlined in Maslovat (2009)[8]. The goals of the experimental rare plant translocation program are to contribute to the following:

- the viability of target rare plant species through propagule collection, propagation and translocation; and
- the field of plant translocation based on the findings from the seeding, propagation, translocation, management, and monitoring measures.

The primary objective of the ERPT is to establish new populations or augment extant populations of target rare plant species using established and, where necessary, experimental techniques.

The ERPT program also has the following secondary objectives:

- support the conservation of the target species by promoting a self-sustaining population;
- maintain local genetic diversity of target species;
- re-establish individuals of target species in high-risk areas into secure, analogous habitat; and
- produce a secondary supply of viable plant stock in the case that supplementing translocated populations is required.

There are four strategies that will be employed in achieving the goals and objectives of the program:

1. Translocate rare plant species through plant salvage, collection of vegetative propagules, and/or seeds from populations that will or may be lost (e.g., lost due to clearing activities or creation of the reservoir).
2. Document the survival of the translocated rare plants through population monitoring at re-location sites through the Site C construction period and up to the first 10 years of the operations phase.
3. Manage translocated populations as needed depending on the results of monitoring.
4. Improve the theory and practice of rare plant translocation and increase knowledge of the biology and ecology of targeted rare plant species.

The results of the study will be made publicly available as part of the annual Vegetation and Wildlife Mitigation and Monitoring Program report so that learnings are accessible to others, thereby adding to the relevant knowledge base and improving the theory/practice of rare plant translocation. Details of the Experimental Rare Plant Translocation program activities in 2023 is presented in Appendix 5.

The program at its current state of development consists of four main phases over eight years of study (2016 to 2023):

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[8] Maslovat, C. 2009. Guidelines for translocation of plant species at risk in British Columbia. British Columbia Ministry of Environment, Victoria, BC.

1. **Literature review and program development (2016-2023).** The literature review and program development is underway and will continue throughout the duration of the ERPT program. A review of existing guidance, methodologies, and results of previous rare plant translocation projects worldwide is ongoing. The lessons learned through these studies and analyses are being used to inform the structure and methods of the ERPT program.
2. **Propagule collection (2017 to 2023).** The standards for collecting and storing propagules for *ex situ* conservation (e.g., timing, sampling, labelling, cleaning, processing, stratification, sowing, and provenance) incorporate guidance outlined in Maslovat (2009) and by the European Native Seed Conservation Network (ENSCONET; 2009)[9]. The program is designed to collect seeds and cuttings or whole plants and to characterize the site conditions at the source locations. The level of risk to each plant population is being used to prioritize sites for the collection program and will be used for future collection activities, as appropriate. The level of risk is determined based on the expected clearing date, rarity of the plant, and predicted propagule collection timing.

   Propagule collection is occurring throughout the growing season and takes into consideration local plant phenology and propagation. Field teams are conducting multiple site visits to collect seeds on a number of occasions as appropriate based on seed availability and readiness.
3. **Ex-situ propagation (2017 to 2023).** This phase of the ERPT Program involves the evaluation of methods and implementation of seed cleaning, drying, storage, stratification, and ex-situ propagation for each individual taxon. Depending on the species and seed type, seeds are either being dried or cleaned following collection to ensure maximum viability. Cleaning includes the removal of waste material from the seed itself and involves the use of sieves, hand separation, and water baths and drying, as appropriate. Stratification is conducted as needed, whereby seeds are treated with cold or moist heat to simulate natural germination conditions. Stratification is the term for the series of controlled external conditions a seed is exposed to in order to break dormancy, and is designed to emulate the environmental conditions that a seed would be exposed to in nature. Many (but not all) seeds require stratification to break seed dormancy and permit germination. Some seeds also require a pre-treatment, such as mechanical or acid scarification, to weaken the seed coat prior to stratification. Seeds that do not require stratification are stored until spring. Propagation methods for asexual and sexual propagation for each species are being investigated in the context of the ecological conditions observed at the source populations.
4. **Translocation implementation (2018 to 2024).** The detailed methods for translocation implementation are being refined based on data collected during field activities. Translocation implementation involves site selection, site preparation and seeding and/or planting at recipient sites. Efforts will be made to determine if any site preparation (for intact habitats) or site engineering (for restoration sites) is required before translocation and to identify if habitat manipulation after the translocation will be required. Recipient sites will be prepared as necessary prior to the translocation, including invasive plant species removal (and implementation of steps to minimize introduction during the translocation process), soil amendment, and sculpting microcatchments. Specific planting techniques for founder plants (i.e., those plants

[9] ENSCONET. 2009. Seed Collecting Manual for Wild Species. Main editors: Royal Botanic Gardens (UK) & Universidad Politécnica de Madrid (Spain). Edition 1: 17 March 2009.

initially transplanted at a recipient site) are being developed for each species. The specific timing windows for planting will be determined based on the plant phenology, the development stage of the propagated plants, and the local weather and soil moisture conditions. Initial translocation occurred in September 2018. Additional planting was completed annually from 2019 through 2023. Planting efforts are incorporating the key findings from previous planting efforts. Some stock is being withheld from planting as insurance should inclement conditions negatively affect the initial out-planting stock.

5. **Post-translocation care, maintenance and monitoring (2018 to 2035).** Post-translocation care, maintenance, and monitoring commences immediately after each translocation event is completed. Post-translocation plant care and site management assesses the survival of translocated populations and addresses factors affecting the survival or health of the translocated plants. The first two to three years of follow-up site visits and data collection (i.e., short-term monitoring) will inform the frequency and level of effort required for post-translocation care and additional monitoring in subsequent years (i.e., long-term monitoring). Translocated populations that are achieving identified targets will still require long-term monitoring but may require less frequent follow-up visits than populations that are not achieving key metrics and require more active management. Monitoring the success or failure of the methods will assist in identifying opportunities for improvement within an adaptive management framework. This information can also help to inform other translocation projects, thereby improving the overall success of rare plant translocation as a tool for biodiversity conservation.

7.5.2 Plan for monitoring translocations

Experimental Rare Plant Translocation Program monitoring will document a suite of parameters designed to evaluate the efficacy of translocation methods in relation to the stated objectives of the program. All actions associated with the translocation (see Section 7.5.1) will be fully documented to retain as much information as possible on the pathway of a given plant (e.g., from seed collection to planting) to facilitate post-hoc assessments of success. Specifically, the monitoring program will measure, document, and evaluate the following:

1. the efficacy of the methods used to a) characterize donor and recipient sites, b) collect and store plant propagules, c) conduct ex-situ propagation; and d) translocate the rare plant species from the host site to the recipient sites;
2. the efficacy of the techniques used for managing the translocated plant propagules (e.g. site preparation, watering, weeding, fertilizing);
3. the survival of the translocated rare plant species through monitoring of population size, extent, threats, resilience, and persistence; and
4. the success of follow up procedures applied to address any declines in survival or fitness of the translocated plants.

7.5.3 Measurement criteria for effectiveness monitoring of habitat enhancement and compensation programs

Please see Section 7.5.2 for how the effectiveness of the rare plant translocation program will be measured.

7.6 EAC Condition 15

This section of the annual report summarizes the programs implemented in 2023 in accordance with the requirements of Condition 15.

For context, the complete requirements of Condition 15 are shown below.

EAC Condition 15 The EAC Holder must develop a Wildlife Management Plan. The Wildlife Management Plan must be developed by a QEP. The Wildlife Management Plan must include at least the following: • Field work, conducted by a QEP, to verify the modelled results for surveyed species at risk and determine, with specificity and by ecosystem, the habitat lost or fragmented for those species. The EAC Holder must use these resulting data to inform final Project design and to develop additional mitigation measures, as needed, as part of the Wildlife Management Plan, in consultation with Environment Canada and FLNR. • Measures to avoid, if feasible, constructing in sensitive wildlife habitats. If avoiding sensitive wildlife habitats is not feasible, condition 16 applies. • If sensitive habitats, such as wetlands, are located immediately adjacent to any work site, buffer zones must be established by a QEP to avoid direct disturbance to these sites. • Protocol for the application of construction methods, equipment, material and timing of activities to mitigate adverse effects to wildlife and wildlife habitat. • Protocol to ensure that lighting is focused on work sites and away from surrounding areas to manage light pollution and disturbance to wildlife. If lighting cannot be directed away from surrounding areas, the EAC Holder must ensure additional mitigation measures are implemented to reduce light pollution, including light shielding. • A mandatory environmental training program for all workers so that they are informed that hunting in the vicinity of any work site/Project housing site is strictly prohibited for all workers. The EAC Holder must ensure that all workers are familiar with the Wildlife Management Plan. The EAC Holder must submit this draft Wildlife Management Plan to Environment Canada, FLNR, MOE and Aboriginal Groups for review a minimum of 90 days prior to the commencement of construction. The EAC Holder must file the final Wildlife Management Plan with EAO, Environment Canada, FLN, MOE and Aboriginal Groups, a minimum of 30 days prior to commencement of construction. The EAC Holder must develop, implement and adhere to the final Wildlife Management Plan, and any amendments, to the satisfaction of EAO.

7.6.1 Measures to avoid, if feasible constructing in sensitive wildlife habitats

This section summarizes actions taken in accordance with the following requirement of Condition 15: *Measures to avoid, if feasible, constructing in sensitive wildlife habitats. If avoiding sensitive wildlife habitats is not feasible, condition 16 applies.*

Measures to avoid impacts to sensitive wildlife habitats are described in Section 4.17 of Revision 5 of the CEMP:

- Avoid construction activity within Important Wildlife Areas, including designated setback buffers determined by a QEP, where feasible. Important Wildlife Areas are defined in the

CEMP as habitat areas that animals use around the same time each year, such as the following:
    - wetlands;
    - snake hibernacula;
    - bat hibernacula;
    - sharp-tailed grouse leks;
    - beaver lodges, dams and food caches;
    - active furbearer and large carnivore den sites;
    - active bird nests;
    - mineral licks;
    - habitat used by ungulates for winter range; and
    - amphibian breeding sites and migration routes.
- Except within the dam site area, on designated access roads and during clearing, construction activities are prohibited within 15 m of the Ordinary High Water Mark of streams or wetlands, unless the activity was described in the EIS and is accepted by BC Hydro (CEMP Section 4.5);
- Guidance to minimize impacts to raptor nests;
- Protocol for conducing sharp-tailed grouse lek monitoring and a decision tree for various lek activity scenarios to minimize impacts to sharp-tailed grouse leks (see also Appendix 7 of the 2016 Annual Report); and
- Measures for minimizing impacts to amphibian breeding and migration areas (see also Section 6.4.1.2).

7.6.2 Setback buffers to avoid direct impacts to sensitive habitats

This section summarizes actions taken in accordance with the following requirement of Condition 15*: If sensitive habitats, such as wetlands, are located immediately adjacent to any work site, buffer zones must be established by a QEP to avoid direct disturbance to these sites*

As specified above in Section 7.6.1, Revision 5 of the CEMP (Section 4.17), construction activity is to be avoided within Important Wildlife Areas, including in designated setback buffers as determined by a QEP, where feasible. Wetland avoidance measures are discussed further in Section 6.3.1.

Procedures for determining appropriate situation- and species-specific disturbance setback buffers to be applied around locations where bird nests are present are discussed in Section 6.1.1 (migratory birds).

7.6.3 Mitigation of adverse effects to wildlife and wildlife habitat

This section summarizes actions taken in accordance with the following requirement of Condition 15*: Protocol for the application of construction methods, equipment, material and timing of activities to mitigate adverse effects to wildlife and wildlife habitat.*

Mitigation of adverse effects to wildlife is discussed in Sections 7.6.1 and 7.6.2. Section 6.4.1.2 provides a summary of mitigation applied to minimize adverse impacts to amphibians. Revisions 5 and 6 of the CEMP (Section 4.17) specify that, where feasible, vegetation clearing will take place during Peace Region terrestrial wildlife least-risk windows. Least risk timing windows for wildlife are described in Table 5 of the CEMP.

Where clearing outside of least-risk timing windows cannot be avoided, pre-clearing surveys are required, with disturbance setback buffers determined by a QEP.

7.6.4 Protocol to ensure that lighting is focused on work sites

This section summarizes actions taken in accordance with the following requirement of Condition 15*: Protocol to ensure that lighting is focused on work sites and away from surrounding areas to manage light pollution and disturbance to wildlife. If lighting cannot be directed away from surrounding areas, the EAC Holder must ensure additional mitigation measures are implemented to reduce light pollution, including light shielding.*

Section 4.17 of the CEMP requires contractors to focus lighting on work sites and away from surrounding areas to minimize light. CEMP requirements are audited by site Environmental Monitors and the Independent Environmental Monitor to determine and enforce compliance.

7.6.5 Environmental training of workers

This section summarizes actions taken in accordance with the following requirement of Condition 15*: A mandatory environmental training program for all workers so that they are informed that hunting in the vicinity of any work site/Project housing site is strictly prohibited for all workers. The EAC Holder must ensure that all workers are familiar with the Wildlife Management Plan.*

All workers are required to attend both a BCH orientation and a contractor specific orientation prior to starting work on-site. A component of these training sessions is environmental training for workers. Completion of these sessions is required prior to the issuance of site access cards for BC Hydro employees and contractors.

7.7 EAC Condition 16

This section of the annual report summarizes the programs implemented in 2023 in accordance with the requirements of Condition 16.

For context, the complete requirements of Condition 16 are shown below.

EAC Condition 16

If loss of sensitive wildlife habitat or important wildlife areas cannot be avoided through Project design or otherwise mitigated, the EAC Holder must implement the following measures, which must be described in the Vegetation and Wildlife Mitigation and Monitoring Plan.

The Vegetation and Wildlife Mitigation and Monitoring Plan must include the following compensation measures:

- Compensation options for wetlands must include fish-free areas to manage the effects of fish predation on invertebrate and amphibian eggs and larvae and young birds.
- Mitigation for the loss of snake hibernacula, artificial dens must be included during habitat compensation.
- Management of EAC Holder-owned lands adjacent to the Peace River suitable as breeding habitat for Northern Harrier and Short-eared Owl.
- Establishment of nest boxes for cavity-nesting waterfowl developed as part of wetland mitigation and compensation plan, and established within riparian vegetation zones established along the reservoir on BC Hydro-owned properties.
- A design for bat roosting habitat in HWY 29 bridges to BC Ministry of Transportation and Infrastructure (MOTI) for consideration into new bridge designs located within the Peace River valley.

- Following rock extraction at Portage Mountain, creation of hibernating and roosting sites for bats.
- Creation of natural or artificial piles of coarse woody debris dispersed throughout the disturbed landscape to maintain foraging areas and cold-weather rest sites, and arboreal resting sites, for the fisher population south of the Peace River.

The EAC Holder must provide this draft Vegetation and Wildlife Mitigation and Monitoring Plan to Environment Canada, FLNR, MOE, and Aboriginal Groups for review a minimum of 90 days prior to the commencement of construction.

The EAC Holder must file the final Vegetation and Wildlife Mitigation and Monitoring Plan with EAO, Environment Canada, FLNR MOE, and Aboriginal Groups, a minimum of 30 days prior to commencement of construction.

The EAC Holder must develop, implement and adhere to the final Vegetation and Wildlife Mitigation and Monitoring Plan, and any amendments, to the satisfaction of EAO.

7.7.1 Wetland compensation that includes fish-free areas

As of the end of 2023, BC Hydro has purchased one property for wetland compensation (i.e., the Marl Fen property) and has constructed or saved from imminent loss 245 ha across five wetlands that are all fish-free. Further wetland compensation opportunities are being explored for development and will include additional fish-free areas.

7.7.2 Mitigation for the loss of snake hibernacula

Six artificial hibernacula for gartersnake overwintering were constructed in 2020 on the north side of the Peace River. In 2023, one additional snake den was constructed near Cache Creek. Occupancy monitoring of the constructed snake hibernacula occurred from 2021 to 2023. Two hibernacula were considered to be occupied in 2022: Snake Den 21.4 (Dam View), and Snake Den48 (Wilder Creek) and a shed snakeskin was found beneath a patio stone within 10 m of the entrance to Snake Den 21.4. However, no signs of snake use of the den sites were observed in 2023. The report detailing monitoring of the artificial snake dens in 2023 is in Appendix 10.

7.7.3 Nest boxes for cavity-nesting waterfowl

Thirteen different nest box designs were constructed to accommodate 21 species of cavity nesting birds, with some box designs intended to support multiple species. Between 2017 and 2022, 277 nest boxes were installed on trees and structures on BC Hydro owned and managed lands, and on private lands where permission was granted. Nest boxes were strategically placed along the reservoir shoreline in areas determined to be most beneficial to each species group, while also considering availability of land and suitable access for installation and future mitigation effectiveness monitoring.

Monitoring of nest boxes began in the breeding season of 2020 and continued in 2023. The Cavity Nesting Mitigation and Monitoring Program 2023 Annual Report is in Appendix 11.

7.7.4 Creation of Wildlife Trees

Between 2022-2023, 300 wildlife trees have been created or enhanced at the Site C project area by fungal inoculation and mechanical stem manipulation (e.g., tree girdling and topping) to enhance cavity-causing decay and followed up by effectiveness monitoring (medium-term strategy for primary cavity excavators). This will increase nesting, roosting, and denning habitat supply for cavity-dwelling wildlife over multiple time scales such as woodpeckers, owls, migratory passerines, kestrels, squirrels, bats, and furbearers.

The Wildlife Tree Habitat Enhancement 2023 Final Report is in Appendix 12.

7.7.5 A design for bat roosting habitat in HWY 29 bridges

This section summarizes actions taken in accordance with the following requirement of Condition 16: *A design for bat roosting habitat in HWY 29 bridges to BC Ministry of Transportation and Infrastructure (MOTI) for consideration into new bridge designs located within the Peace River valley.*

During baseline surveys bats were documented using the Farrell Creek, Halfway River and Cache Creek bridges as night roosts. These three (3) bridges and the bridge at Lynx Creek will be inundated by the reservoir. New bridges were constructed at these locations.

BC Hydro had previously reached an agreement with MOTI to install bat roost structures on newly constructed bridges along re-aligned sections of Highway 29 to offset the losses of night roosts on existing bridges. However, on 25 October 2018, BC Hydro received notification from the Regional Manager of Environmental Services, MOTI, that MOTI no longer supports the placement of bat roosting boxes on bridges. Therefore, bat boxes were not integrated into the designs of any new bridges, including those at Farrell Creek, Halfway River, Cache Creek and Lynx Creek.

7.7.6 Creation of hibernating and roosting sites for bats

This section summarizes actions taken in accordance with the following requirement of Condition 16: *Following rock extraction at Portage Mountain, creation of hibernating and roosting sites for bats.*

In February of 2016 the BC Ministry of Environment released Best Management Practices Guidelines for Bats in British Columbia “Bat BMPs”[10]. These guidelines recommend that a 100 m buffer be established around the core area of bat habitat, which for Portage Mountain is defined as all the suspected hibernacula entrances that had been documented. Within this 100 m, no activities that modify the above or below ground habitat are allowed. The guidelines also recommend a 1 km special management zone, within which blasting activities are permitted if the following can be achieved:

- No blasting to occur between October and May;
- Blasting must be conducted within the following parameters (to avoid damage to the rock structures associated with the hibernacula):
    - the sound concussion is less than 150 dB;
    - the shock wave is less than 15 p.s.i.; and
    - the peak particle velocity is less than 15 mm/s.

To avoid impacting the hibernacula at Portage Mountain that are being used by little brown myotis and northern myotis, BC Hydro moved the quarry to the eastern edge of the License of Occupation area prior to the commencement of construction activities. This relocation achieved a 300 m buffer around 16 documented hibernacula, where no activities or access were permitted. This mitigation is described in detail in Appendix 8 of the 2016 Annual Report.

[10] BC MOE. 2016. Best Management Practices Guidelines for Bats in British Columbia. Chapter 2: Mine Developments and Inactive Mine Habitats. 68 pp.

To avoid disturbance to hibernating bats, BC Hydro has also prohibited blasting at Portage Mountain between September 15 and May 15 (see Section 4.2 of the CEMP); this window was based on data collected at the hibernacula in 2013 and in consultation with bat biologists (see the 2016 Annual Report).

For planned activities at Portage Mountain Quarry, noise modelling was conducted, from which it was determined that at 300m:

- the sound concussion would be 120 dB (below BMP limit of 150 dB);
- the shock wave would be 0.002 p.s.i (1 kPa) and (below BMP limit of 15 p.s.i (104 kPa); and
- the peak particle velocity would be 2.84 mm/s (below BMP limit of 15 mm/s).

As described in Section 6.4.3.3, BC Hydro monitored the noise and vibration caused by activity at Portage Mountain Quarry in 2018, 2019 and 2021, and found that blasting within the re-designed quarry boundaries did not exceed the thresholds for noise and vibration defined within the BC MOE Best Management Practices Guidelines for Bats in British Columbia (i.e., air overpressure of less than 150 decibels, shock wave less than 15 p.s.i., and peak particle velocity (PPV) less than 15 mm/second; BC MOE 2016). Noise and vibration modelling were used to supplement available data to determine that also in 2020 blasting likely did not exceed the BC BMP thresholds for noise or vibration at important bat habitat. No blasting occurred at Portage Mountain in 2023. As described in Section 6.4.3.3, BC Hydro is also conducting year-round monitoring of bat use at Portage Mountain.

Through the broader Site C bat mitigation and monitoring program, BC Hydro has constructed and installed 120 bat roost boxes and one large bat house in suitable habitat near the future reservoir and dam site. Monitoring of bat activity at the bat box installation locations is planned to occur annually through construction and the first 10 years of operations of Site C. The report describing the results of bat activity monitoring within the bat boxes in 2023 is in Appendix 9.

7.7.7 Resting sites for Fisher

This section summarizes actions taken in accordance with the following requirement of Condition 16: *Creation of natural or artificial piles of coarse woody debris dispersed throughout the disturbed landscape to maintain foraging areas and cold-weather rest sites, and arboreal resting sites, for the fisher population south of the Peace River.*

A total of 98 coarse woody debris (CWD) piles to maintain foraging areas and cold-weather rest sites for fisher have been created within the dam site area, along the transmission line, and along the cleared edge of Ice Bridge Road towards Area E. Signs were installed at CWD piles to indicate that they were designated fisher habitat and to prevent their inadvertent disturbance by construction activities.

In addition to CWD piles, BC Hydro constructed and installed 88 fisher den boxes between 2018 and 2020 to help mitigate the loss of denning habitat due to reservoir clearing. In 2023, all 88 den boxes were monitored by visiting all den boxes to install game cameras, checking and replacing hair snaggers at the box entrances, and applying lure at the structures to help attract fishers (February – March 2023). A total of 106,946 photographs were reviewed from the 2023 reproductive season (March – July) with fishers detected at eight den boxes. However, no prolonged use or evidence of reproduction was observed in 2023. Details of the fisher monitoring program is in Appendix 13.

7.8 EAC Condition 19

This section of the annual report summarizes the programs implemented in 2023 in accordance with the requirements of Condition 19.

For context, the complete requirements of Condition 19 are shown below.

EAC Condition 19
The EAC Holder must use reasonable efforts to avoid and reduce injury and mortality to amphibians and snakes on roads adjacent to wetlands and other areas where amphibians or snakes are known to migrate across roads including locations with structures designed for wildlife passage. The EAC Holder must consult with Environment Canada, FLNR and MOE with regard to the size and number of the proposed structures prior to construction.

Appropriate amphibian mitigation is monitored by BC Hydro site Environmental Monitors and the Independent Environmental Monitor against commitments within EPPs to determine and enforce compliance. Amphibian mitigation activities are summarized in Section 6.4.1.2. Work sites are being regularly monitored during the spring and summer for western toad migration and dispersal, as per the Western Toad Management Procedure. Western toad movement patterns have not yet resulted in mass movements across access roads such that specific structures designed for amphibian passage have been required. However, due to specific concerns regarding western toad mitigation at Portage Mountain Quarry during a BC Environmental Assessment Office (EAO) inspection in 2016, a suitable location for installation of an amphibian crossing structure was identified based on a habitat assessment and observations of western toad movement patterns. A 15 m long 1,000 mm diameter culvert was installed along the access road to Portage Mountain, following guidance described in *Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia. A companion document to Develop with Care* (BC MFLNRO and BC MOE 2014).

7.9 EAC Condition 21

This section of the annual report summarizes the programs implemented in 2023 in accordance with the requirements of Condition 21.

For context, the complete requirements of Condition 21 are shown below.

EAC Condition 21
The EAC Holder must ensure that measures implemented to manage harmful Project effects on wildlife resources are effective by implementing monitoring measures detailed in a Vegetation and Wildlife Mitigation and Monitoring Plan. The Vegetation and Wildlife Mitigation and Monitoring Plan must be developed by a QEP. The Vegetation and Wildlife Mitigation and Monitoring Plan must include at least the following: • Monitor Bald Eagle nesting populations adjacent to the reservoir, including their use of artificial nest structures. • Monitor waterfowl and shorebird populations and their use of natural wetlands, created wetlands, and artificial wetland features. • Monitor amphibian use of migration crossing structures installed along Project roads. • Survey songbird and ground-nesting raptor populations during construction and operations. • Survey the distribution of western toad and garter snake populations downstream of the Site C dam to the Pine River. • Require annual reporting during the construction phase and during the first 10 years of operations to

EAO, beginning 180 days following commencement of construction.

The EAC Holder must provide this draft Vegetation and Wildlife Mitigation and Monitoring Plan to FLNR, MOE, Environment Canada and Aboriginal Groups for review a minimum of 90 days prior to the commencement of construction.

The EAC Holder must file the final Vegetation and Wildlife Mitigation and Monitoring Plan must with EAO, FLNR, MOE, Environment Canada and Aboriginal Groups a minimum 30 days prior to the commencement of construction.

The EAC Holder must develop, implement and adhere to the final Vegetation and Wildlife Mitigation and Monitoring Plan, and any amendments, to the satisfaction of EAO.

7.9.1 Monitoring of Bald Eagle nesting populations

Known bald eagle nest locations along the Peace River and at natural wetlands adjacent to the Site C transmission line right-of-way were surveyed by helicopter over three days in May and June 2023. A summary of the methods and results of bald eagle nest aerial monitoring in 2023 is presented in Appendix 14.

7.9.2 Monitoring waterfowl and shorebird populations

This section summarizes actions taken in accordance with the following requirement of Condition 21: *Monitor waterfowl and shorebird populations and their use of natural wetlands, created wetlands, and artificial wetland features.*

A summary of the waterbird survey program is presented in Section 6.1.3.4 and Waterbirds Follow-up Monitoring 2023 Annual Report can be found in Appendix 4.

7.9.3 Monitor amphibian use of migration crossing structures installed along Project roads

This section summarizes actions taken in accordance with the following requirement of Condition 21: *Monitor amphibian use of migration crossing structures installed along Project roads*.

A 15 m long 1,000 mm diameter culvert has been installed along the access road to Portage Mountain, following guidance described in *Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia. A companion document to Develop with Care* (BC MFLNRO and BC MOE 2014). Monitoring of amphibian use of the crossing structure was conducted following the requirements of the Site C Western Toad Management Procedure. Western toad activity along the area around the access road in general has been low, and no western toad use of the crossing structure has yet been documented.

7.9.4 Survey songbird and ground-nesting raptor populations during construction and operations

This section summarizes actions taken in accordance with the following requirement of Condition 21: *Survey songbird and ground-nesting raptor populations during construction and operations.*

7.9.4.1 Songbirds

A summary of the songbird monitoring program is presented in Section 6.1.3.1 and the Breeding Bird Follow-up Monitoring – Songbirds 2023 Annual Report can be found in Appendix 2.

7.9.4.2 Ground-nesting raptors

Ground nesting raptor surveys in 2023 were conducted at cleared portions of the Site C reservoir. Ground nesting raptor surveys were completed up to four times per site over May and June 2023 to capture early, middle, and late stages of their breeding season. The ground-nesting raptor monitoring 2023 annual report can be found in Appendix 7.

7.9.5 Annual reporting beginning 180 days following commencement of construction

This section summarizes actions taken in accordance with the following requirement of Condition 21: *Require annual reporting during the construction phase and during the first 10 years of operations to EAO, beginning 180 days following commencement of construction.*

Submission of this report satisfies the requirement this portion of Condition 21 for 2023 during the construction phase of the Site C Clean Energy Project.

7.10 Status of listed species

This section of the annual report summarizes the programs implemented in 2023 in accordance with the requirements of Condition 23. For context, the complete requirements of Condition 23 are shown below.

EAC Condition 23
The EAC Holder must maintain current knowledge of Project effects on the status of listed species by tracking updates for species identified by the Province, the Committee on the Status of Endangered Wildlife in Canada, and the Species at Risk Act. Should the status of a listed species change for the worse during the course of the construction of the Project due to Project activities, the EAC Holder, must work with Environment Canada FLNR and MOE to determine if any changes to the associated management plans or monitoring programs are required to mitigate effects of the Project on affected listed species.

7.10.1 Rare Plants

Please see Section 6.4.4.1 for a summary of ranking changes to rare plants.

7.10.2 Wildlife

Please see Section 6.4.4.2 for a summary of ranking changes to wildlife.

7.11 Ungulate Winter Range

The complete requirements of Condition 23 are shown below.

EAC Condition 24
The EAC Holder must identify suitable lands for ungulate winter range by the end of the first year of construction, on BC Hydro-owned lands, or Crown lands, in the vicinity of the Project in consultation with FLNR. If FLNR determines that identified winter range is required, the EAC Holder must identify and maintain suitable BC Hydro- owned lands for ungulate winter range to the satisfaction of FLNR and for the length of time determined by FLNR.

The plan for the identification, retention and maintenance of ungulate winter range was developed through the VWTC and determined to be complete by the Comptroller of Water Resources in 2016. After reservoir filling, it is anticipated that lands identified by BC Hydro as ungulate winter range for elk and deer will total about 515 ha at commencement of operation. A summary of these lands and maps and their locations were provided in the June 5, 2015 VWMMP. These lands are on the north bank of the Peace River between the Halfway River to the west and the dam site to the east.

MLWRS is in the process of identifying appropriate lands for moose winter range as mitigation for expected Project impacts on moose habitat. BC Hydro has provided $10,000 to MLWRS to support the Indigenous consultation necessary to identify and protect appropriate moose winter range.

4.0 References

BC Hydro. 2022. Vegetation and Wildlife Mitigation and Monitoring Plan 2022 Annual Report, Site C Clean Energy Project, 30 March 2022. Available at: https://www.sitecproject.com/sites/default/files/Vegetation-and-Wildlife-Mitigation-and-Monitoring-Plan-2022-Annual-Report-Part-1.pdf.

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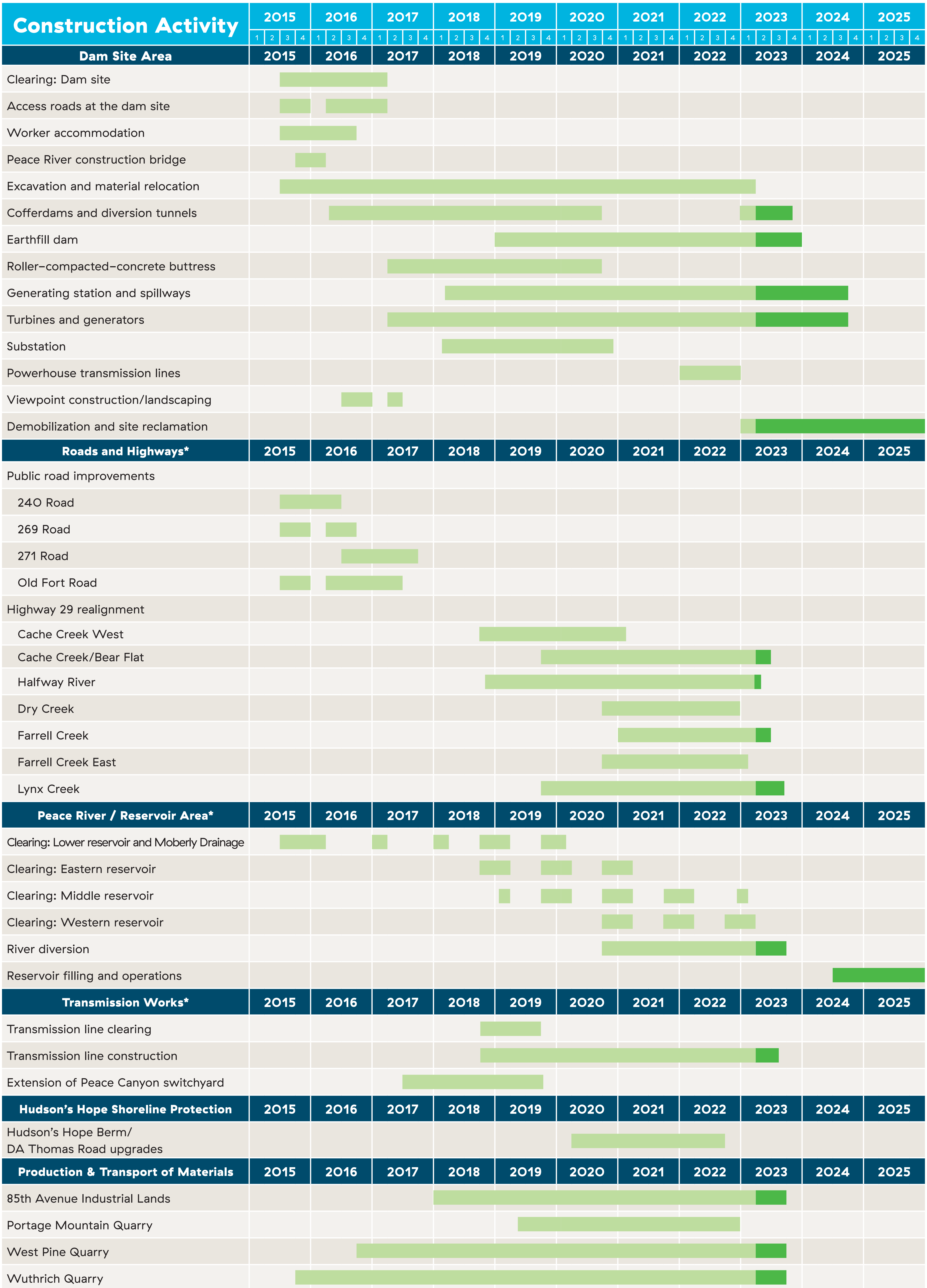
https://a100.gov.bc.ca/pub/eirs/finishDownloadDocument.do;jsessionid=8120EEA29A5E1D4AF9BB59918A15A4E2?subdocumentId=8321.

Appendix 1. Site C Clean Energy Project Construction Schedule

Site C Construction Schedule

January 2024
CS-4270



The construction schedule is indicative only and subject to change. The purpose of the schedule is to illustrate the general sequence of construction activities, but the dates and schedule may change.

* Timelines do not include site preparation or wood disposal.

BC Hydro
Power smart

Appendix 2. Breeding Bird Follow-up Monitoring - Songbirds 2023 Annual Report

Site C Clean Energy Project
Breeding Bird Follow-up Monitoring - Songbirds
2023 Annual Report



PRESENTED TO

British Columbia Hydro and Power Authority

MARCH 11, 2024
ISSUED FOR USE
FILE: 704-ENW.PENW03042-02.SONG23.

Saulteau EBA Environmental Services Joint Venture
Suite 1000 – 10th Floor, 885 Dunsmuir Street
Vancouver, BC V6C 1N5 CANADA
Tel 604.685.0275 Fax 604.684.6241

Site C Clean Energy Project
Breeding Bird Follow-up Monitoring - Songbirds
2023 Annual Report

FILE: 704-ENW.PENW03042-02.SONG23
March 11, 2024

PRESENTED TO

Site C Clean Energy Project
BC Hydro and Power Authority
P.O. Box 49260
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Prepared by:

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Jeff Matheson, M.Sc., R.P.Bio., P.Biol.
Senior Biologist

EXECUTIVE SUMMARY

Saulteau EBA Environmental Services Joint Venture (SEES JV) completed breeding bird point count surveys in the area of British Columbia Hydro and Power Authority's (BC Hydro) Site C Clean Energy Project ("Site C", the Project) in spring and summer 2023. The surveys were part of BC Hydro's Breeding Bird Follow-up Monitoring Program for songbirds [1]. Songbirds are passerines, hummingbirds, swifts, doves, kingfisher, and pigeons (i.e., all members of the orders *Passeriformes*, *Apodiformes*, *Columbiformes*, and *Coraciiformes*). Songbird baseline surveys were conducted in 2006, 2008, 2011 and 2012. Surveys were again conducted in 2016 through 2023 as part of the follow-up monitoring program. This report describes the methods used to conduct the 2023 surveys and a summary of the results.

Surveys were conducted June 3 - 26, 2023 at 102 stations in the Peace River Valley and around the Project footprint. Each station was surveyed two times to maximize the detection of early and late breeders. Birds were surveyed using unlimited-radius point counts.

A total of 86 bird species were detected, of which 73 were songbirds. Six species listed under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the *Species at Risk Act* (SARA) and/or British Columbia's Red and Blue lists were observed during the surveys. The median number of songbird species detected per point count survey was 9.5 (range 3 to 20).

Surveys conducted in 2023 represent a continuation in monitoring of semi-permanent monitoring stations that will be monitored through to 10 years post-construction.

[1] Woodpecker and Common Nighthawk surveys are also included under BC Hydro's Breeding Bird Follow-up Monitoring Program.

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1.0 INTRODUCTION

Saulteau EBA Environmental Services Joint Venture (SEES JV) completed breeding bird point count surveys in the area of British Columbia Hydro and Power Authority's (BC Hydro) Site C Clean Energy Project ("Site C", the Project) in spring and summer 2023. The surveys were part of BC Hydro's Breeding Bird Follow-up Monitoring Program for Songbirds[2]. Songbirds are passerines, hummingbirds, swifts, doves, kingfisher, and pigeons (i.e., all members of the orders *Passeriformes*, *Apodiformes*, *Columbiformes*, and *Coraciiformes*). Songbird baseline surveys were conducted in 2006, 2008, 2011 and 2012. Surveys were again conducted in 2016, 2017, 2018, 2019, 2020, 2021, 2022 and 2023 as part of the follow-up monitoring program.

The objectives of the Breeding Bird Follow-up Monitoring Program for songbirds are to:

1. Determine the distribution and abundance of songbirds within habitat lost or otherwise affected by the Project to verify the predictions made in the Environmental Impact Statement (EIS).
2. Identify species-habitat relationships to help identify areas for offsetting impacts.
3. Conduct effectiveness monitoring to determine the degree to which mitigation areas offset impacts to songbirds and their habitat and determine further songbird mitigation requirements.
4. Determine changes to the songbird community in the Peace River valley (to 10 years post-construction).

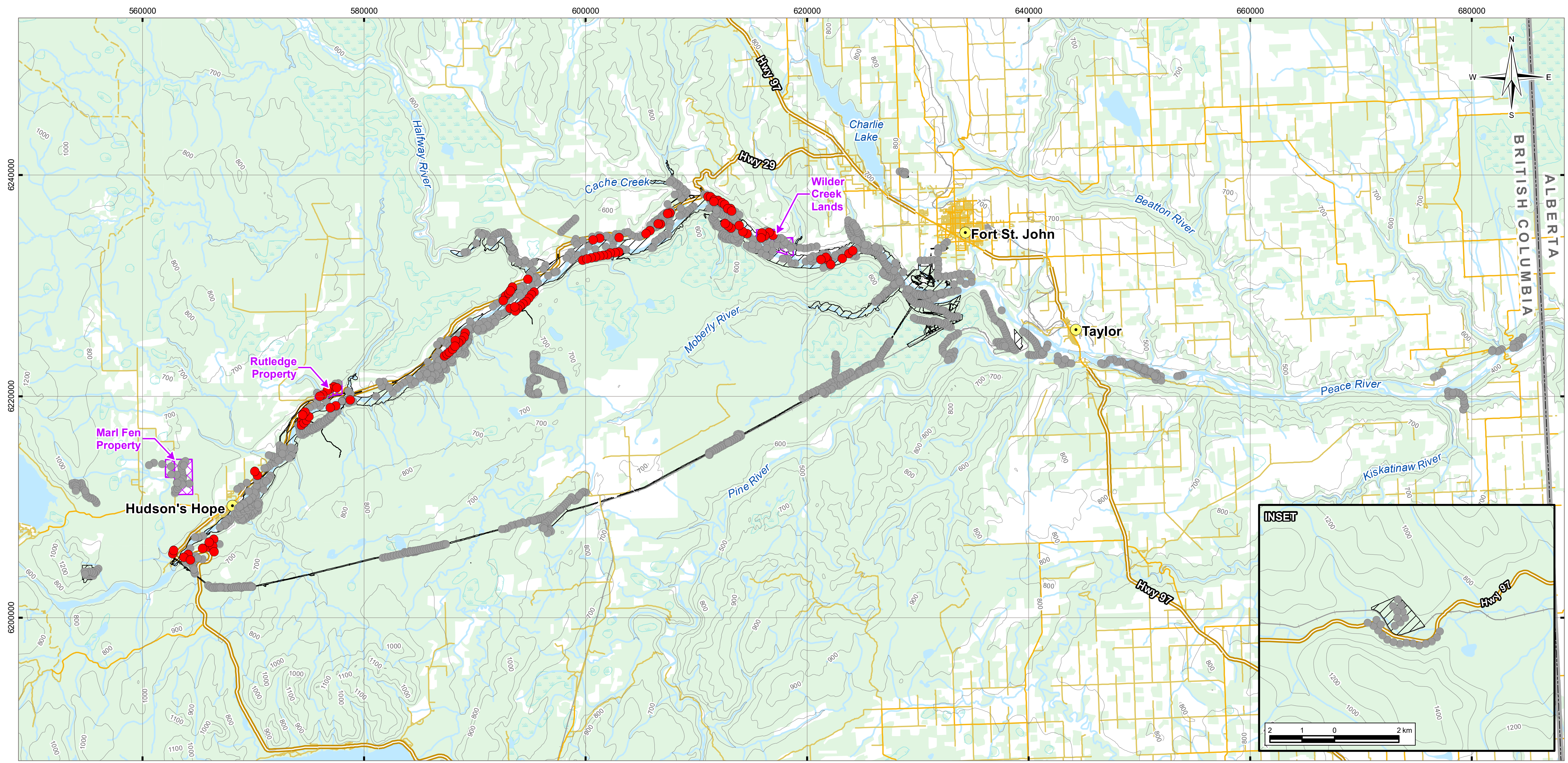
The annual report prepared in 2019 (SEES JV 2019) provided an analysis of the data collected 2006-2019 in support of objectives 1 and 2. Mitigation areas (currently the Marl Fen, Rutledge and Wilder Creek properties) were comprehensively surveyed in 2016 and 2017. BC Hydro intends to conduct the next comprehensive surveys of the mitigation properties when the reservoir has been inundated or when there are land-use changes or habitat modification in the mitigation properties, whichever occur first. The point count data obtained from surveys in 2023 were primarily in support of objective 4 and will form part of the long-term monitoring data to assess changes in the songbird community over time (baseline to 10 years post-construction).

2.0 METHODS

2.1 Survey Locations

Point counts for the baseline and the follow-up monitoring programs have been conducted throughout the Peace River valley (and its tributaries) and in the adjacent plateau areas, both inside and outside the Project footprint (Figure 1). Clearing of the dam site area was completed in 2016. Clearing of the reservoir commenced in 2017 and incrementally progressed westward from the dam site in each year. By May 2021, most portions of the reservoir footprint along the Peace River from the dam site to the mouth of the Halfway River, including the Moberly River and Cache Creek reservoir footprints, and some islands west of the Halfway River had been cleared. The Watson Slough area along Highway 29 was cleared over the winter of 2022/2023. Point counts in 2023 were predominantly located outside the reservoir footprint, though a small number were in cleared portions of the footprint, including the recently cleared Watson Slough area (Figures 2a to 2d; Appendix A).

[2] Woodpecker and Common Nighthawk surveys are also included under BC Hydro's Breeding Bird Follow-up Monitoring Program.

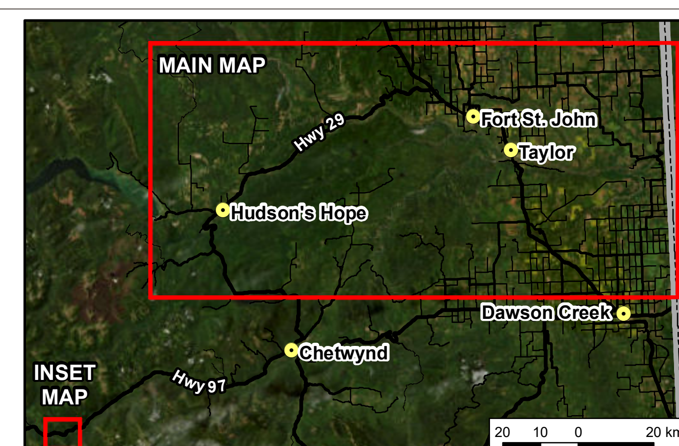


LEGEND

Songbird Survey Locations

Survey Year

- 2023
- 2006 to 2022
- Project Footprint
- Potential Mitigation Property
- Populated Place
- Highway
- Main Road
- Local Road
- Resource/Recreational Road
- Railway
- Residential Area
- Contour (100 m)
- Watercourse
- Waterbody
- Wetland
- Wooded Area
- Provincial Boundary



NOTES
Base data source: CanVec 1:250,000.

STATUS
ISSUED FOR REVIEW

SITE C SONGBIRD 2023 ANNUAL REPORT

Songbird Survey Locations

PROJECTION	DATUM
UTM Zone 10	NAD83

Scale: 1:350,000
5 2.5 0 5
Kilometres

FILE NO.
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OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	YL	EH	0

DATE	PROJECT NO.
August 17, 2023	ENW.PENW03042-02

CLIENT
BC Hydro
Power smart

TETRA TECH

Figure 1

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Surveys conducted in 2023 represent a continuation of monitoring at the semi-permanent monitoring stations established in 2020. In 2020, 97 semi-permanent monitoring stations were established at randomly located points within the Peace River valley. Each station was located in accessible areas (slopes that can be traversed on foot) and stratified by bird habitat class in proportion to the mapped area of each class in the Peace River valley (Table 1). Bird habitat classes were derived from the detailed ecosystem units used in the Terrestrial Ecosystem Mapping and are generalized groups of similar ecosystems. Candidate locations were then manually adjusted to be 100 m from a habitat edge (e.g., forest-wetland transition) where possible and some locations were linked to form a sequence of survey locations that can be visited on foot.

Table 1: Bird Habitat Classes Derived from Terrestrial Ecosystem Mapping

Coniferous-shrub	Deciduous-mature forest	Wetland-graminoid
Coniferous-young forest	Riparian-mixed shrub	Wetland-shrub
Coniferous-mature forest	Riparian-mixed young forest	Dry slopes-grassland
Deciduous-shrub	Riparian-mixed mature forest	Dry slopes-shrubland
Deciduous-young forest	Fen/bog-shrub	Cultivated

To allow for sampling of all bird habitat classes, some stations were located within uncleared portions of the footprint west of the Halfway River for bird habitat classes that do not exist outside the footprint (e.g., riparian forest that currently only exists in the valley bottom footprint). Additionally, some survey stations were located within the Rutledge and Wilder Creek mitigation properties located within the Peace River valley.

2.2 Point Count Surveys

Point counts were conducted on June 3 - 26, 2023 by two teams. Each team was composed of a biologist with songbird survey experience and an assistant (Appendix B). Each station was surveyed (visited) two times, with at least two weeks between visits, to maximize the detection of early and late breeders.

Point count survey methodology was adapted from the Resource Inventory Standards Committee (RISC) *Inventory Methods for Forest and Grassland Songbirds* (RISC 1999). Surveyors conducted unlimited-radius point counts with distance-to-detection intervals set at 0-50 m, 51-100 m and >100 m. Each point count survey was conducted over ten minutes and bird detections were recorded in three intervals: 0-3 minutes, 3-5 minutes and 5-10 minutes. Point counts took place from sunrise to approximately four hours after sunrise, and only during acceptable weather conditions for songbird surveys (Table 2). After arriving at each station, the surveyor waited one minute, then commenced the 10-minute survey period and recorded all birds seen and/or heard. Data were recorded on a modified version of the RISC Songbird Point Count data form (RISC 1999).

Table 2: Acceptable and Unacceptable Weather Conditions for Songbird Surveys (RISC 1999)

	Acceptable	Unacceptable
Wind	▪ Beaufort 0 (< 2 km/hr). Calm. ▪ Beaufort 1 (2-5 km/hr). Light air. ▪ Beaufort 2 (6-12 km/hr). Light breeze, leaves rustle.	▪ Beaufort 3 (12-19 km/hr). Gentle breeze, leaves and twigs constantly move. ▪ Beaufort 4 (20-29 km/hr). Moderate breeze, small branches move, dust rises. ▪ Beaufort 5 (30-39 km/hr). Fresh breeze, small trees sway. ▪ Beaufort > 5
Precipitation	▪ None ▪ Fog ▪ Misty drizzle ▪ Drizzle	▪ Light rain ▪ Hard rain ▪ Snow
Temperature	▪ > 3 ºC during the breeding season in central & northern interior of BC	▪ < 3 ºC during the breeding in central & northern interior of BC

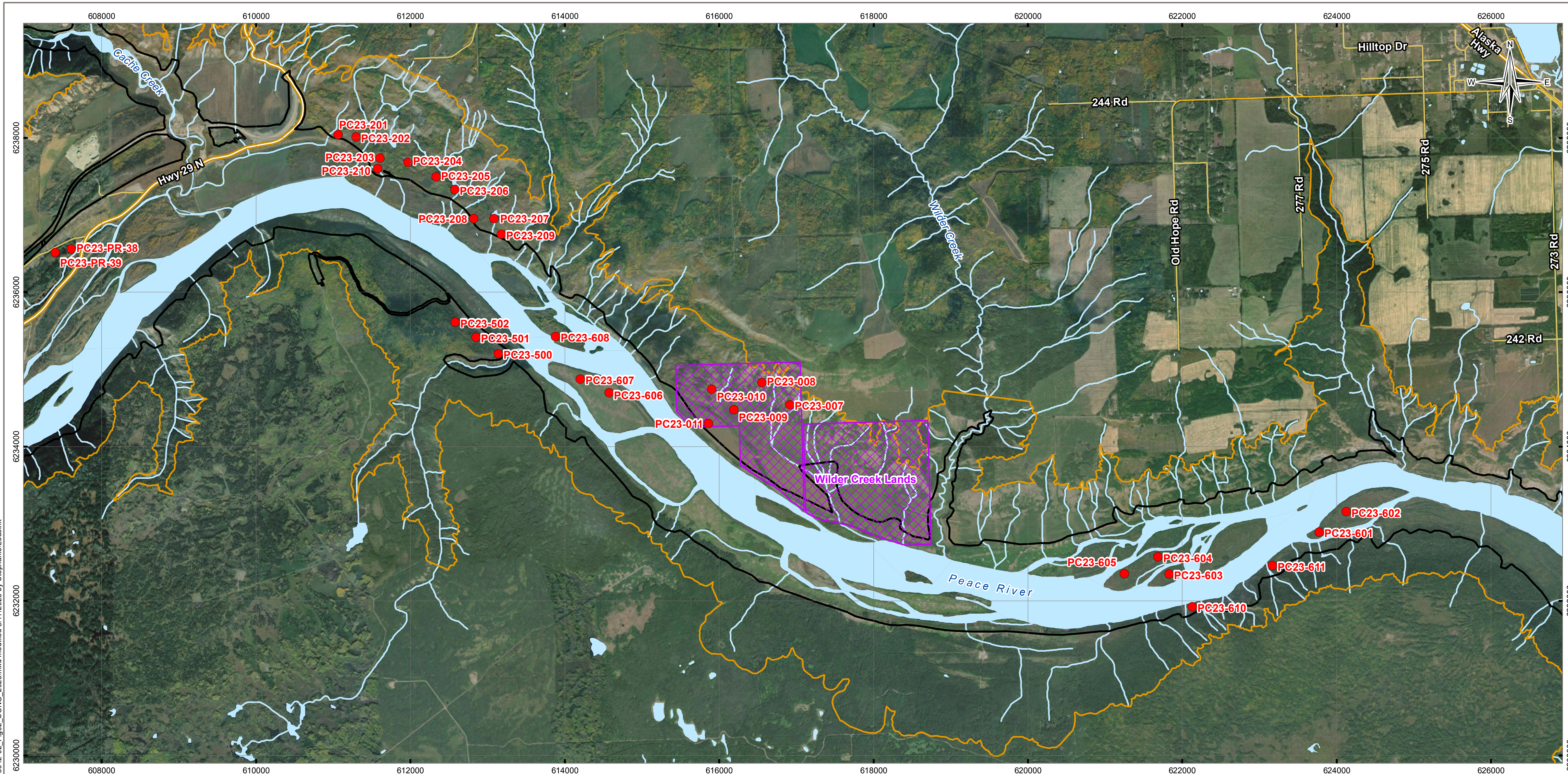
Incidental observations were recorded when non-songbird species were observed during surveys, or when any bird species at risk were observed outside of survey stations (e.g., when surveyors were traveling between stations) or survey periods (e.g. before or after daily observations have started/finished). For each incidental observation, date, time, GPS location, gender, behavior and habitat were recorded.

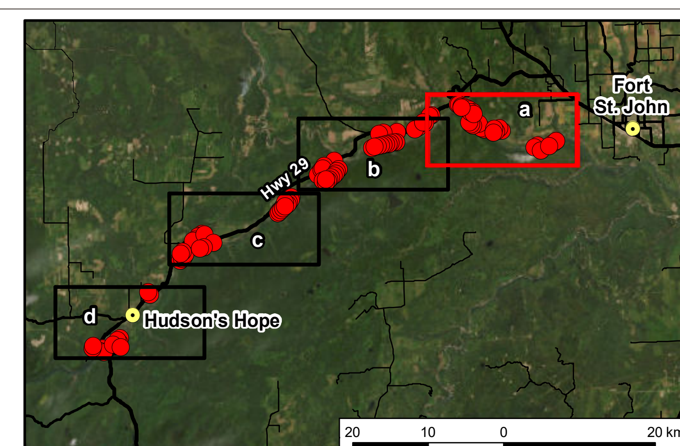
For the purpose of this report, bird species at risk include:

(1) Species considered endangered, threatened or special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC);

(2) Species considered endangered, threatened or special concern under *Species at Risk Act* (SARA); and/or

(3) Species listed as red (endangered, threated) or blue (special concern) on the BC List.





LEGEND

- 2023 Songbird Survey Location
- Project Footprint
- Potential Mitigation Property
- Peace River Valley
- Highway
- Main Road
- Local Road
- Watercourse
- Waterbody

NOTES
Base data source:
CanVec 1:50,000 (2019)
Imagery from ESRI; Maxar

STATUS
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SITE C SONGBIRD 2023 ANNUAL REPORT

2023 Songbird Survey Locations

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC Hydro Power smart

Scale: 1:50,000

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Kilometres

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TETRA TECH

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	BB	EH	0

DATE	PROJECT NO.
August 17, 2023	ENW.PENW03042-02

Figure 2a

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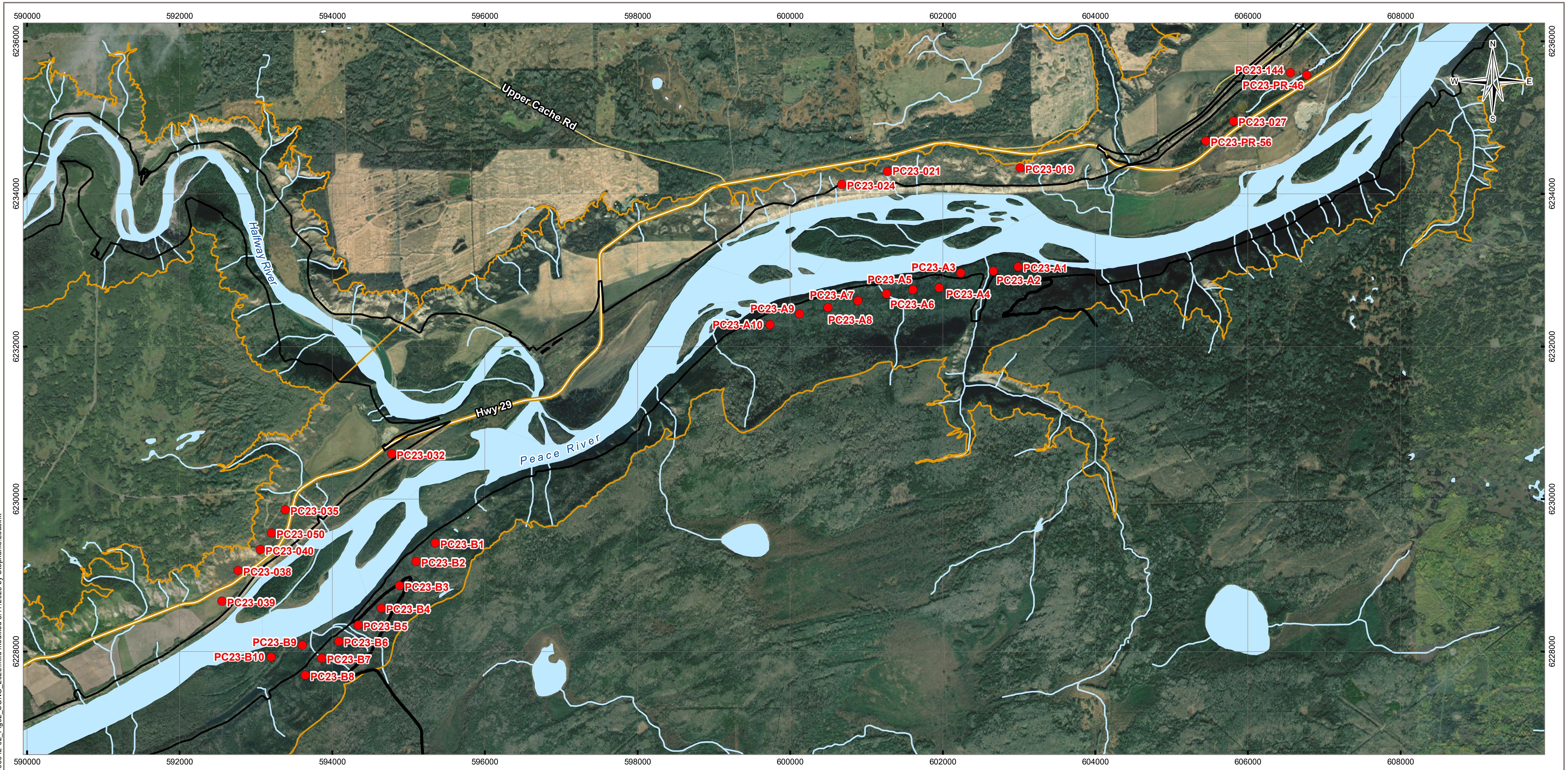

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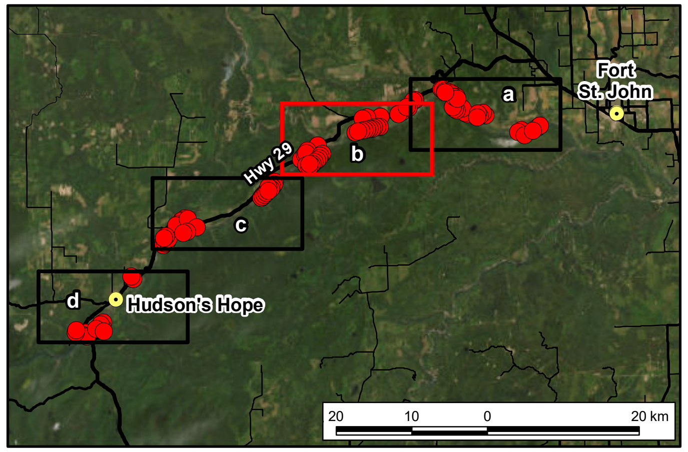
LEGEND

- 2023 Songbird Survey Location
- Project Footprint
- Peace River Valley
- Highway
- Local Road
- Watercourse
- Waterbody



NOTES
Base data source:
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Imagery from ESRI; Maxar

STATUS
ISSUED FOR REVIEW

SITE C SONGBIRD 2023 ANNUAL REPORT

2023 Songbird Survey Locations

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC Hydro Power smart

Scale: 1:50,000
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Kilometres

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DATE	PROJECT NO.			
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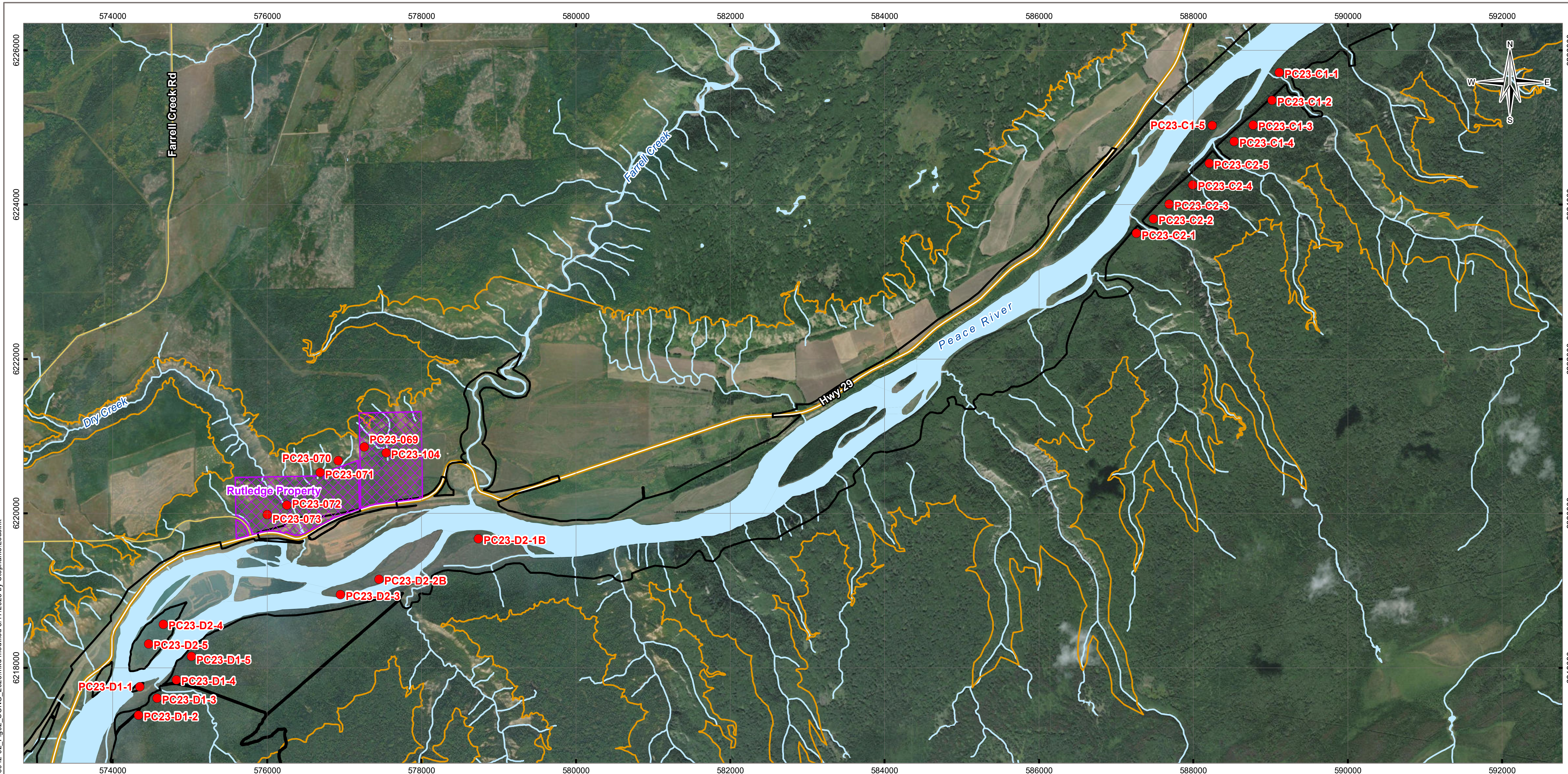
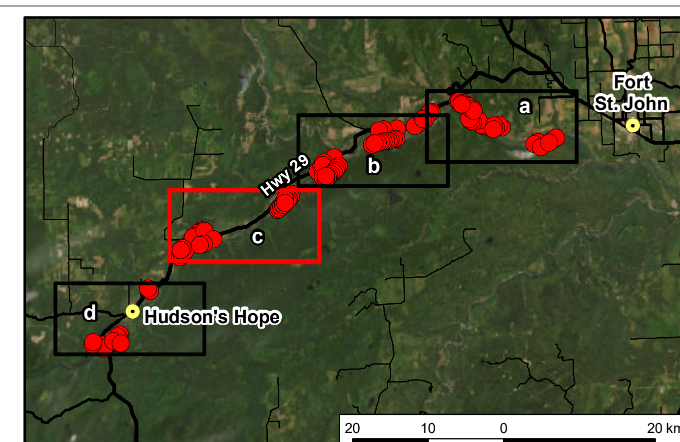
Figure 2b



LEGEND

- 2023 Songbird Survey Location
- Project Footprint
- Potential Mitigation Property
- Peace River Valley
- Highway
- Local Road
- Watercourse
- Waterbody



NOTES
Base data source:
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Imagery from ESRI; Maxar

STATUS
ISSUED FOR REVIEW

SITE C SONGBIRD
2023 ANNUAL REPORT

2023 Songbird Survey Locations

PROJECTION: UTM Zone 10	DATUM: NAD83	CLIENT: BC Hydro Power smart
Scale: 1:50,000 (1 0.5 0 1 Kilometres)		TETRA TECH
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OFFICE: Tt-VANC	DWN: SL; CKD: BB; APVD: EH; REV: 0	Figure 2c
DATE: August 17, 2023	PROJECT NO.: ENW.PENW03042-02	

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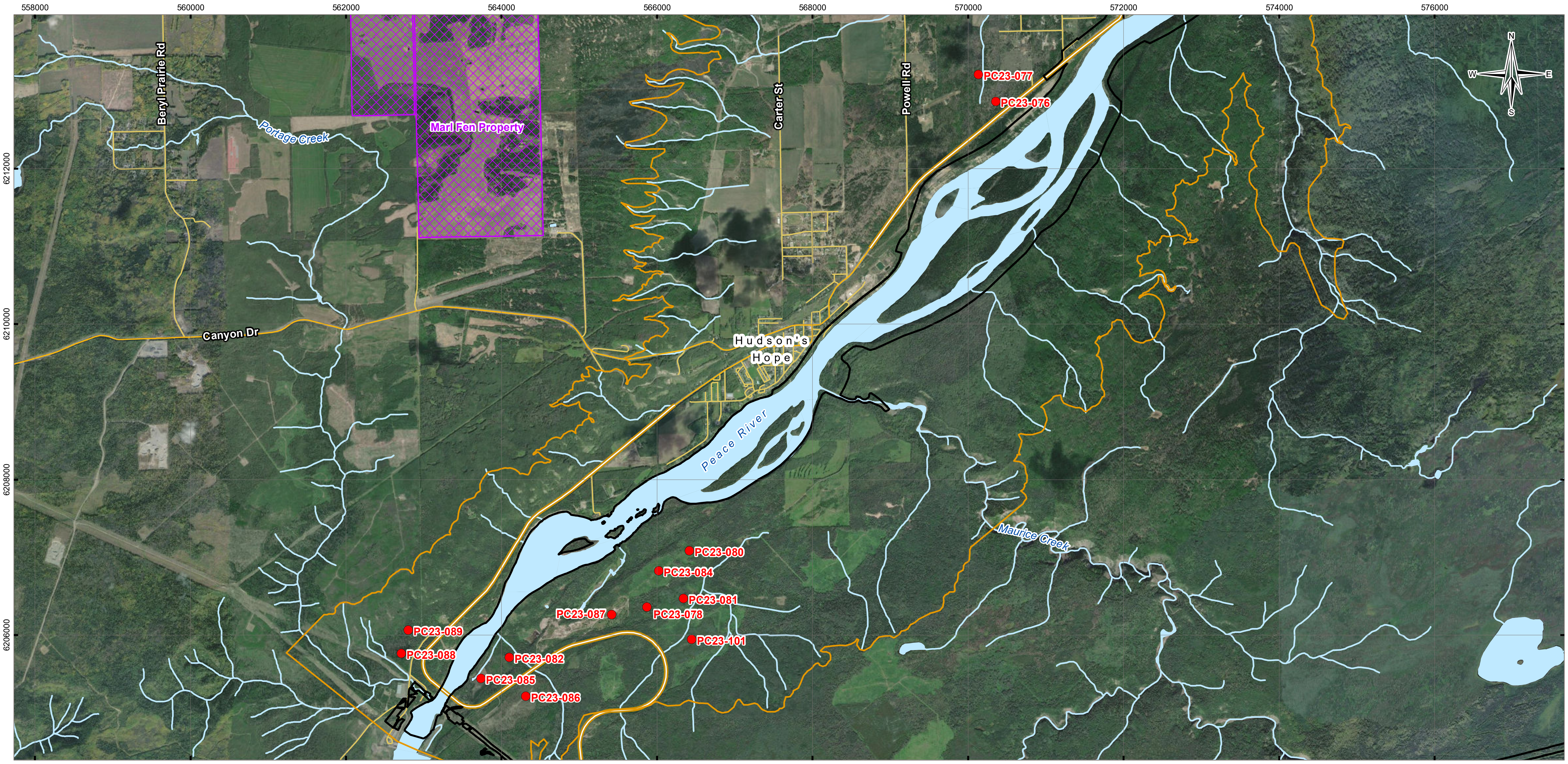

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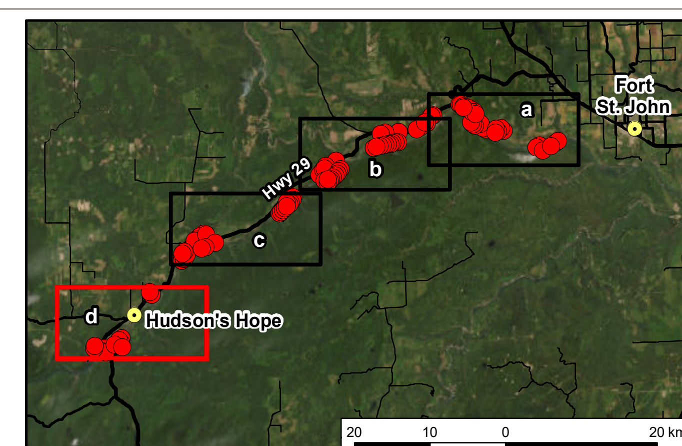
- 2023 Songbird Survey Location
- Project Footprint
- Potential Mitigation Property
- Peace River Valley
- Highway
- Main Road
- Local Road
- Watercourse
- Waterbody



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Imagery from ESRI; Maxar

STATUS
ISSUED FOR REVIEW

SITE C SONGBIRD 2023 ANNUAL REPORT

2023 Songbird Survey Locations

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC Hydro Power smart

Scale: 1:50,000
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Kilometres

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DATE	PROJECT NO.			
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Figure 2d

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3.0 RESULTS

Surveys were conducted at 102 point count stations within 15 bird habitat classes (Table 3; Figures 2a to 2d; Appendix A). A total of 204 surveys were conducted in 2023.

Table 3: Point Count Stations and Surveys Conducted in 2023 by Bird Habitat Class

Bird Habitat Class	Stations	Surveys
Coniferous-shrub	5	10
Coniferous-young forest	8	16
Coniferous-mature forest	16	32
Deciduous-shrub	13	26
Deciduous-young forest	13	26
Deciduous-mature forest	12	24
Riparian-mixed shrub	7	14
Riparian-mixed young forest	3	6
Riparian-mixed mature forest	1	2
Fen/bog-shrub	2	4
Wetland-graminoid	3	6
Wetland-shrub	5	10
Dry slopes-grassland	2	4
Dry slopes-shrubland	8	16
Cultivated	4	8
Total	**102**	**204**

Surveys were conducted in appropriate weather conditions. Temperature ranged from 4.0 ºC to 26.6 ºC, wind speed was generally between zero and two on the Beaufort scale (there were seven surveys where winds gusted as high as 3 on the Beaufort scale), and all surveys were conducted in the absence of precipitation (Appendix A).

A total of 86 bird species were detected, of which 73 were songbirds (Table 4). Six species listed under COSEWIC, SARA and/or British Columbia's Red and Blue lists were observed during the surveys. The median number of songbird species detected per point count survey was 9.5 (ranging from 3 to 20). Other bird species not classified as songbirds were recorded as incidental observations and are listed in Appendix C.

Table 4: Bird Species Observed During The 2023 Point Count Surveys, Listed In Taxonomic Order

English Name	Scientific Name	BC List	COSEWIC	SARA Status	Survey Detections
Mourning Dove	*Zenaida macroura*	Yellow	-	-	1
Northern Flicker*	*Colaptes auratus*	Yellow	-	-	16
Downy Woodpecker*	*Dryobates pubescens*	Yellow	-	-	5
Hairy Woodpecker*	*Dryobates villosus*	Yellow	-	-	3
Pileated Woodpecker*	*Dryocopus pileatus*	Yellow	-	-	4
American Three-toed Woodpecker*	*Picoides dorsalis*	Yellow	-	-	2
Yellow-bellied Sapsucker*	*Sphyrapicus varius*	Yellow	-	-	26
Olive-sided Flycatcher	*Contopus cooperi*	Yellow	Special Concern	Special Concern	5
Western Wood-Pewee	*Contopus sordidulus*	Yellow	-	-	42
Alder Flycatcher	*Empidonax alnorum*	Yellow	-	-	90
Pacific-slope Flycatcher	*Empidonax difficilis*	Yellow	-	-	6
Hammond's Flycatcher	*Empidonax hammondii*	Yellow	-	-	1
Least Flycatcher	*Empidonax minimus*	Yellow	-	-	178
Eastern Kingbird	*Tyrannus tyrannus*	Yellow	-	-	5
Warbling Vireo	*Vireo gilvus*	Yellow	-	-	33
Red-eyed Vireo	*Vireo olivaceus*	Yellow	-	-	269
Philadelphia Vireo	*Vireo philadelphicus*	Yellow	-	-	3
Blue-headed Vireo	*Vireo solitarius*	Yellow	-	-	17
American Crow	*Corvus brachyrhynchos*	Yellow	-	-	37
Common Raven	*Corvus corax*	Yellow	-	-	9
Blue Jay	*Cyanocitta cristata*	Yellow	-	-	2
Canada Jay	*Perisoreus canadensis*	Yellow	-	-	6
Black-billed Magpie	*Pica hudsonia*	Yellow	-	-	3
Cedar Waxwing	*Bombycilla cedrorum*	Yellow	-	-	100
Black-capped Chickadee	*Poecile atricapillus*	Yellow	-	-	20
Boreal Chickadee	*Poecile hudsonicus*	Yellow	-	-	3
Bank Swallow	*Riparia riparia*	Yellow	Threatened	Threatened	30
Violet-green Swallow	*Tachycineta thalassina*	Yellow	-	-	13
Ruby-crowned Kinglet	*Corthylio calendula*	Yellow	-	-	16
Golden-crowned Kinglet	*Regulus satrapa*	Yellow	-	-	15
Marsh Wren	*Cistothorus palustris*	Yellow	-	-	8
Rock Wren	*Salpinctes obsoletus*	Yellow	-	-	1
Red-breasted Nuthatch	*Sitta canadensis*	Yellow	-	-	32
House Wren	*Troglodytes aedon*	Yellow	-	-	11
Gray Catbird	*Dumetella carolinensis*	Yellow	-	-	17
Hermit Thrush	*Catharus guttatus*	Yellow	-	-	36

English Name	Scientific Name	BC List	COSEWIC	SARA Status	Survey Detections
Swainson's Thrush	*Catharus ustulatus*	Yellow	-	-	154
American Robin	*Turdus migratorius*	Yellow	-	-	145
Purple Finch	*Haemorhous purpureus*	Yellow	-	-	5
White-winged Crossbill	*Loxia leucoptera*	Yellow	-	-	5
Pine Siskin	*Spinus pinus*	Yellow	-	-	11
Canada Warbler	*Cardellina canadensis*	Blue	Special Concern	Threatened	15
Wilson's Warbler	*Cardellina pusilla*	Yellow	-	-	2
Mourning Warbler	*Geothlypis philadelphia*	Yellow	-	-	8
Common Yellowthroat	*Geothlypis trichas*	Yellow	-	-	64
Orange-crowned Warbler	*Leiothlypis celata*	Yellow	-	-	36
Tennessee Warbler	*Leiothlypis peregrina*	Yellow	-	-	6
Black-and-white Warbler	*Mniotilta varia*	Yellow	-	-	28
Northern Waterthrush	*Parkesia noveboracensis*	Yellow	-	-	18
Ovenbird	*Seiurus aurocapilla*	Yellow	-	-	115
Yellow-rumped Warbler	*Setophaga coronata*	Yellow	-	-	95
Magnolia Warbler	*Setophaga magnolia*	Yellow	-	-	31
Yellow Warbler	*Setophaga petechia*	Yellow	-	-	217
American Redstart	*Setophaga ruticilla*	Yellow	-	-	54
Blackpoll Warbler	*Setophaga striata*	Yellow	-	-	3
Black-throated Green Warbler	*Setophaga virens*	Blue	-	-	11
Red-winged Blackbird	*Agelaius phoeniceus*	Yellow	-	-	124
Brewer's Blackbird	*Euphagus cyanocephalus*	Yellow	-	-	5
Baltimore Oriole	*Icterus galbula*	Blue	-	-	12
Brown-headed Cowbird	*Molothrus ater*	Yellow	-	-	10
LeConte's Sparrow	*Ammospiza leconteii*	Yellow	-	-	3
Nelson's Sparrow	*Ammospiza nelsoni*	Red	Not at Risk	-	1
Dark-eyed Junco	*Junco hyemalis*	Yellow	-	-	63
Swamp Sparrow	*Melospiza georgiana*	Yellow	-	-	30
Lincoln's Sparrow	*Melospiza lincolnii*	Yellow	-	-	71
Song Sparrow	*Melospiza melodia*	Yellow	-	-	75
Savannah Sparrow	*Passerculus sandwichensis*	Yellow	-	-	6
Vesper Sparrow	*Pooecetes gramineus*	Yellow	-	-	19
Clay-colored Sparrow	*Spizella pallida*	Yellow	-	-	98
Chipping Sparrow	*Spizella passerina*	Yellow	-	-	11
White-throated Sparrow	*Zonotrichia albicollis*	Yellow	-	-	372
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Yellow	-	-	29
Western Tanager	*Piranga ludoviciana*	Yellow	-	-	71

* Includes woodpeckers. Although not songbirds, woodpeckers are part of the Breeding Bird Follow-up Monitoring Program (surveyed separately from songbirds) and are regularly detected during points counts.

4.0 DISCUSSION

Surveys in 2023 were conducted at the same 102 stations surveyed in 2022 (SEES JV 2022). The total number of birds detected was similar between the two years with 87 birds detected in 2022 and 86 birds detected in 2023. Of the detected birds, in 2022, 76 were songbirds, and in 2023, 73 were songbirds. The number of species listed under COSEWIC, SARA and/or BC's Red and Blue lists were comparable, with seven listed species detected in 2022, and six listed species detected in 2023. The median number of songbirds detected per point count survey was 9 in 2022 and 9.5 in 2023. In both years, the most detected bird was White-throated Sparrow (*Zonotrichia leucophrys*) and the second-most detected bird was Red-eyed Vireo (*Vireo olivaceus*).

Two new species were detected in 2023 that had not been detected in previous surveys, Rock Wren (*Salpinctes obsoletus*) and Nelson's Sparrow (*Ammospiza nelsoni*). Nelson's Sparrow is red-listed and is known to occur in the Peace River valley (Phinney 2015) but was not detected during point-count surveys until this year. Rock Wren is typically found in the southern interior of BC, but there are occasional records of Rock Wren in the region, though very few (eBird 2021). The individual was detected in suitable habitat and was singing so breeding may be possible within the Peace River valley.

Surveys conducted in 2023 represent a continuation in monitoring of semi-permanent monitoring stations that will be monitored through to 10 years post-construction. In future years, some stations may be lost to land use changes or access, and others will be added as needed to address the objective to characterize changes in the bird community of the Peace River Valley over time.

5.0 REFERENCES

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APPENDIX A
SONGBIRD POINT COUNT STATIONS SURVEYED IN 2023

Table A1: Songbird point count stations surveyed in 2023

Station	UTM Zone	UTM Easting	UTM Northing	Survey Number	Survey Date	Survey Time	Cloud Ceiling[1]	Cloud Cover[2]	Wind Speed	Precipitation[3]	Temperature (°C)	Bird Habitat Class
PC23-007	10	616913	6234543	1	6/3/2023	8:24	ATT	4	0	N	16.6	Dry slopes-grassland
PC23-007	10	616913	6234543	2	6/21/2023	8:18	ATT	1	1	N	19.9	Dry slopes-grassland
PC23-008	10	616553	6234827	1	6/3/2023	7:38	ATT	4	0	N	18.5	Dry slopes-shrubland
PC23-008	10	616553	6234827	2	6/21/2023	7:20	ATT	2	0	N	18.2	Dry slopes-shrubland
PC23-009	10	616192	6234479	1	6/3/2023	8:54	ATT	3	0	N	18.2	Cultivated
PC23-009	10	616192	6234479	2	6/21/2023	8:51	ATT	1	2	N	20.5	Cultivated
PC23-010	10	615902	6234745	1	6/3/2023	7:04	ATT	4	0	N	18.1	Dry slopes-shrubland
PC23-010	10	615902	6234745	2	6/21/2023	6:55	ATT	2	1	N	12.6	Dry slopes-shrubland
PC23-011	10	615862	6234301	1	6/3/2023	6:38	ATT	4	0	N	17.5	Cultivated
PC23-011	10	615862	6234301	2	6/21/2023	6:31	ATT	2	2	N	12.8	Cultivated
PC23-019	10	603014	6234339	1	6/7/2023	5:04	ATT	2	1	N	8.5	Dry slopes-grassland
PC23-019	10	603014	6234339	2	6/25/2023	4:09	BTT	4	2	N	13.8	Dry slopes-grassland
PC23-021	10	601274	6234292	1	6/7/2023	4:25	ATT	1	1	N	14.3	Deciduous-shrub
PC23-021	10	601274	6234292	2	6/25/2023	4:47	BTT	4	0	N	15.3	Deciduous-shrub
PC23-024	10	600679	6234123	1	6/7/2023	5:33	ATT	2	2	N	12.3	Deciduous-shrub
PC23-024	10	600679	6234123	2	6/25/2023	5:24	ATT	4	0	N	16.1	Deciduous-shrub
PC23-027	10	605811	6234955	1	6/8/2023	4:48	VH	2	1	N	11.0	Fen/bog-shrub
PC23-027	10	605811	6234955	2	6/26/2023	4:55	VH	2	1	N	13.0	Fen/bog-shrub
PC23-032	10	594779	6230591	1	6/7/2023	6:03	ATT	2	0	N	13.3	Coniferous-shrub
PC23-032	10	594779	6230591	2	6/25/2023	5:57	BTT	2	0	N	16.1	Coniferous-shrub
PC23-035	10	593385	6229860	1	6/7/2023	6:24	ATT	3	0	N	14.1	Deciduous-shrub
PC23-035	10	593385	6229860	2	6/25/2023	6:26	ATT	1	0	N	16.2	Deciduous-shrub
PC23-038	10	592767	6229065	1	6/7/2023	7:27	ATT	1	0	N	13.5	Dry slopes-shrubland
PC23-038	10	592767	6229065	2	6/25/2023	7:30	ATT	2	0	N	16.7	Dry slopes-shrubland
PC23-039	10	592553	6228662	1	6/7/2023	8:08	ATT	1	0	N	15.5	Cultivated
PC23-039	10	592553	6228662	2	6/25/2023	7:56	ATT	2	0	N	17.7	Cultivated
PC23-040	10	593058	6229341	1	6/7/2023	7:08	ATT	2	0	N	13.0	Dry slopes-shrubland
PC23-040	10	593058	6229341	2	6/25/2023	7:09	BTT	4	1	N	18.1	Dry slopes-shrubland
PC23-050	10	593202	6229554	1	6/7/2023	6:47	ATT	2	0	N	11.0	Dry slopes-shrubland
PC23-050	10	593202	6229554	2	6/25/2023	6:49	BTT	4	0	N	16.0	Dry slopes-shrubland

Table A1: Songbird point count stations surveyed in 2023

Station	UTM Zone	UTM Easting	UTM Northing	Survey Number	Survey Date	Survey Time	Cloud Ceiling[1]	Cloud Cover[2]	Wind Speed	Precipitation[3]	Temperature (ºC)	Bird Habitat Class
PC23-069	10	577259	6220860	1	6/6/2023	8:41	ATT	1	3	N	16.3	Dry slopes-shrubland
PC23-069	10	577259	6220860	2	6/24/2023	8:48	ATT	2	3	N	24.3	Dry slopes-shrubland
PC23-070	10	576921	6220683	1	6/6/2023	8:16	ATT	1	3	N	15.3	Dry slopes-shrubland
PC23-070	10	576921	6220683	2	6/24/2023	8:11	ATT	3	3	N	26.6	Dry slopes-shrubland
PC23-071	10	576686	6220531	1	6/6/2023	7:55	ATT	1	3	N	15.3	Deciduous-shrub
PC23-071	10	576686	6220531	2	6/24/2023	7:49	ATT	1	2	N	25.4	Deciduous-shrub
PC23-072	10	576256	6220108	1	6/6/2023	7:17	ATT	1	3	N	12.3	Riparian-mixed young forest
PC23-072	10	576256	6220108	2	6/24/2023	7:18	ATT	1	2	N	17.5	Riparian-mixed young forest
PC23-073	10	576001	6219985	1	6/6/2023	6:55	ATT	1	3	N	12.6	Cultivated
PC23-073	10	576001	6219985	2	6/24/2023	6:54	ATT	2	2	N	18.5	Cultivated
PC23-076	10	570355	6212864	1	6/6/2023	5:44	ATT	1	1	N	9.0	Coniferous-young forest
PC23-076	10	570355	6212864	2	6/24/2023	5:45	ATT	2	2	N	15.8	Coniferous-young forest
PC23-077	10	570134	6213209	1	6/6/2023	6:08	ATT	1	0	N	10.1	Coniferous-young forest
PC23-077	10	570134	6213209	2	6/24/2023	6:07	ATT	2	0	N	15.4	Coniferous-young forest
PC23-078	10	565870	6206360	1	6/6/2023	6:39	VH	1	1	N	10.0	Deciduous-mature forest
PC23-078	10	565870	6206360	2	6/24/2023	6:33	VH	2	1	N	13.0	Deciduous-mature forest
PC23-080	10	566416	6207084	1	6/6/2023	4:27	VH	2	0	N	6.0	Deciduous-shrub
PC23-080	10	566416	6207084	2	6/24/2023	4:21	VH	2	1	N	12.0	Deciduous-shrub
PC23-081	10	566341	6206470	1	6/6/2023	4:53	VH	2	0	N	10.0	Wetland-shrub
PC23-081	10	566341	6206470	2	6/24/2023	5:13	VH	2	0	N	13.0	Wetland-shrub
PC23-082	10	564101	6205711	1	6/6/2023	7:40	VH	1	2	N	11.0	Deciduous-mature forest
PC23-082	10	564101	6205711	2	6/24/2023	7:33	VH	2	0	N	14.0	Deciduous-mature forest
PC23-084	10	566021	6206826	1	6/6/2023	6:05	VH	1	1	N	12.0	Deciduous-shrub
PC23-084	10	566021	6206826	2	6/24/2023	4:50	VH	2	1	N	12.0	Deciduous-shrub
PC23-085	10	563734	6205440	1	6/6/2023	8:50	VH	1	2	N	12.0	Fen/bog-shrub
PC23-085	10	563734	6205440	2	6/24/2023	8:52	VH	2	0	N	16.0	Fen/bog-shrub
PC23-086	10	564312	6205213	1	6/6/2023	8:16	VH	1	2	N	12.0	Deciduous-shrub
PC23-086	10	564312	6205213	2	6/24/2023	8:18	VH	2	1	N	15.0	Deciduous-shrub
PC23-087	10	565416	6206263	1	6/6/2023	7:06	VH	1	1	N	10.0	Deciduous-shrub
PC23-087	10	565416	6206263	2	6/24/2023	7:00	VH	2	1	N	14.0	Deciduous-shrub

Table A1: Songbird point count stations surveyed in 2023

Station	UTM Zone	UTM Easting	UTM Northing	Survey Number	Survey Date	Survey Time	Cloud Ceiling[1]	Cloud Cover[2]	Wind Speed	Precipitation[3]	Temperature (ºC)	Bird Habitat Class
PC23-088	10	562713	6205763	1	6/6/2023	4:29	ATT	1	0	N	18.1	Deciduous-mature forest
PC23-088	10	562713	6205763	2	6/24/2023	4:17	ATT	1	1	N	18.3	Deciduous-mature forest
PC23-089	10	562800	6206063	1	6/6/2023	5:06	ATT	1	0	N	13.1	Deciduous-mature forest
PC23-089	10	562800	6206063	2	6/24/2023	5:00	ATT	1	1	N	17.9	Deciduous-mature forest
PC23-101	10	566447	6205946	1	6/6/2023	5:26	VH	2	1	N	10.0	Coniferous-young forest
PC23-101	10	566447	6205946	2	6/24/2023	5:49	VH	2	0	N	12.0	Coniferous-young forest
PC23-104	10	577541	6220783	1	6/6/2023	9:07	ATT	1	3	N	16.3	Deciduous-young forest
PC23-104	10	577541	6220783	2	6/24/2023	9:08	ATT	1	2	N	22.5	Deciduous-young forest
PC23-144	10	606558	6235589	1	6/8/2023	5:20	VH	2	0	N	12.0	Wetland-graminoid
PC23-144	10	606558	6235589	2	6/26/2023	5:45	VH	2	1	N	14.0	Wetland-graminoid
PC23-201	10	611065	6238042	1	6/7/2023	4:10	VH	3	0	N	10.0	Dry slopes-shrubland
PC23-201	10	611065	6238042	2	6/25/2023	4:16	H	4	0	N	14.0	Dry slopes-shrubland
PC23-202	10	611295	6238013	1	6/7/2023	4:28	VH	3	1	N	10.0	Deciduous-young forest
PC23-202	10	611295	6238013	2	6/25/2023	4:38	H	4	0	N	14.0	Deciduous-young forest
PC23-203	10	611606	6237736	1	6/7/2023	5:14	VH	2	0	N	11.0	Deciduous-mature forest
PC23-203	10	611606	6237736	2	6/25/2023	5:32	H	4	0	N	15.0	Deciduous-mature forest
PC23-204	10	611968	6237681	1	6/7/2023	5:47	VH	2	1	N	12.0	Deciduous-young forest
PC23-204	10	611968	6237681	2	6/25/2023	6:08	H	4	0	N	15.0	Deciduous-young forest
PC23-205	10	612332	6237495	1	6/7/2023	6:27	VH	2	1	N	11.0	Deciduous-mature forest
PC23-205	10	612332	6237495	2	6/25/2023	6:42	VH	3	0	N	16.0	Deciduous-mature forest
PC23-206	10	612573	6237329	1	6/7/2023	7:04	VH	1	0	N	12.0	Wetland-shrub
PC23-206	10	612573	6237329	2	6/25/2023	7:24	VH	2	1	N	14.0	Wetland-shrub
PC23-207	10	613084	6236953	1	6/7/2023	8:16	VH	1	0	N	13.0	Wetland-shrub
PC23-207	10	613084	6236953	2	6/25/2023	8:51	VH	2	1	N	15.0	Wetland-shrub
PC23-208	10	612820	6236955	1	6/7/2023	7:38	VH	1	1	N	12.0	Deciduous-shrub
PC23-208	10	612820	6236955	2	6/25/2023	8:02	VH	2	1	N	15.0	Deciduous-shrub
PC23-209	10	613174	6236752	1	6/7/2023	8:38	VH	1	0	N	12.0	Deciduous-young forest
PC23-209	10	613174	6236752	2	6/25/2023	8:24	VH	2	0	N	15.0	Deciduous-young forest
PC23-210	10	611575	6237602	1	6/7/2023	4:50	VH	2	1	N	10.0	Wetland-shrub
PC23-210	10	611575	6237602	2	6/25/2023	5:04	H	4	0	N	15.0	Wetland-shrub

Table A1: Songbird point count stations surveyed in 2023

Station	UTM Zone	UTM Easting	UTM Northing	Survey Number	Survey Date	Survey Time	Cloud Ceiling[1]	Cloud Cover[2]	Wind Speed	Precipitation[3]	Temperature (ºC)	Bird Habitat Class
PC23-500	10	613140	6235203	1	6/3/2023	7:55	H	4	0	N	13.0	Deciduous-young forest
PC23-500	10	613140	6235203	2	6/21/2023	8:02	VH	1	1	N	10.0	Deciduous-young forest
PC23-501	10	612849	6235419	1	6/3/2023	8:30	H	4	0	N	14.0	Deciduous-mature forest
PC23-501	10	612849	6235419	2	6/21/2023	8:32	VH	1	1	N	12.0	Deciduous-mature forest
PC23-502	10	612581	6235611	1	6/3/2023	8:59	VH	2	0	N	15.0	Deciduous-mature forest
PC23-502	10	612581	6235611	2	6/21/2023	9:05	VH	1	2	N	12.0	Deciduous-mature forest
PC23-601	10	623773	6232892	1	6/3/2023	4:22	H	2	0	N	10.0	Riparian-mixed young forest
PC23-601	10	623773	6232892	2	6/21/2023	4:20	VH	2	0	N	9.0	Riparian-mixed young forest
PC23-602	10	624125	6233158	1	6/3/2023	4:25	ATT	4	0	N	16.8	Riparian-mixed shrub
PC23-602	10	624125	6233158	2	6/21/2023	4:22	ATT	2	0	N	12.0	Riparian-mixed shrub
PC23-603	10	621827	6232349	1	6/3/2023	5:00	ATT	4	0	N	13.5	Riparian-mixed shrub
PC23-603	10	621827	6232349	2	6/21/2023	4:56	ATT	2	0	N	14.1	Riparian-mixed shrub
PC23-604	10	621685	6232571	1	6/3/2023	5:23	ATT	4	0	N	15.1	Riparian-mixed shrub
PC23-604	10	621685	6232571	2	6/21/2023	5:19	ATT	2	1	N	13.7	Riparian-mixed shrub
PC23-605	10	621248	6232354	1	6/3/2023	5:50	ATT	4	0	N	18.7	Riparian-mixed shrub
PC23-605	10	621248	6232354	2	6/21/2023	5:45	ATT	2	1	N	13.5	Riparian-mixed shrub
PC23-606	10	614571	6234696	1	6/3/2023	6:32	H	4	0	N	14.0	Coniferous-shrub
PC23-606	10	614571	6234696	2	6/21/2023	6:31	VH	1	1	N	9.0	Coniferous-shrub
PC23-607	10	614201	6234874	1	6/3/2023	6:55	AR	4	0	N	12.0	Riparian-mixed shrub
PC23-607	10	614201	6234874	2	6/21/2023	7:04	VH	1	1	N	10.0	Riparian-mixed shrub
PC23-608	10	613880	6235428	1	6/3/2023	7:18	H	4	0	N	12.0	Riparian-mixed shrub
PC23-608	10	613880	6235428	2	6/21/2023	7:28	VH	1	1	N	10.0	Riparian-mixed shrub
PC23-610	10	622131	6231923	1	6/3/2023	5:24	H	3	0	N	13.0	Deciduous-young forest
PC23-610	10	622131	6231923	2	6/21/2023	5:23	VH	1	0	N	9.0	Deciduous-young forest
PC23-611	10	623167	6232457	1	6/3/2023	4:55	H	2	0	N	12.0	Deciduous-shrub
PC23-611	10	623167	6232457	2	6/21/2023	4:53	VH	1	0	N	9.0	Deciduous-shrub
PC23-A1	10	602990	6233046	1	6/4/2023	4:42	VH	2	1	N	13.0	Deciduous-mature forest
PC23-A1	10	602990	6233046	2	6/22/2023	4:35	VH	3	0	N	13.0	Deciduous-mature forest
PC23-A10	10	599738	6232286	1	6/4/2023	8:43	VH	2	0	N	16.0	Coniferous-mature forest
PC23-A10	10	599738	6232286	2	6/22/2023	8:44	H	4	1	N	16.0	Coniferous-mature forest

Table A1: Songbird point count stations surveyed in 2023

Station	UTM Zone	UTM Easting	UTM Northing	Survey Number	Survey Date	Survey Time	Cloud Ceiling[1]	Cloud Cover[2]	Wind Speed	Precipitation[3]	Temperature (ºC)	Bird Habitat Class
PC23-A2	10	602661	6232990	1	6/4/2023	4:20	VH	2	1	N	12.0	Deciduous-shrub
PC23-A2	10	602661	6232990	2	6/22/2023	4:16	VH	3	0	N	13.0	Deciduous-shrub
PC23-A3	10	602233	6232962	1	6/4/2023	5:12	VH	2	1	N	14.0	Deciduous-shrub
PC23-A3	10	602233	6232962	2	6/22/2023	5:06	VH	3	0	N	14.0	Deciduous-shrub
PC23-A4	10	601952	6232770	1	6/4/2023	5:44	VH	2	1	N	14.0	Coniferous-mature forest
PC23-A4	10	601952	6232770	2	6/22/2023	5:32	VH	3	0	N	14.0	Coniferous-mature forest
PC23-A5	10	601607	6232742	1	6/4/2023	6:13	VH	1	0	N	15.0	Coniferous-mature forest
PC23-A5	10	601607	6232742	2	6/22/2023	6:00	VH	3	0	N	14.0	Coniferous-mature forest
PC23-A6	10	601260	6232688	1	6/4/2023	6:44	VH	2	0	N	15.0	Coniferous-mature forest
PC23-A6	10	601260	6232688	2	6/22/2023	6:30	VH	3	0	N	14.0	Coniferous-mature forest
PC23-A7	10	600890	6232601	1	6/4/2023	7:18	VH	2	0	N	15.0	Coniferous-mature forest
PC23-A7	10	600890	6232601	2	6/22/2023	6:59	VH	3	1	N	15.0	Coniferous-mature forest
PC23-A8	10	600496	6232512	1	6/4/2023	7:45	VH	2	1	N	15.0	Coniferous-mature forest
PC23-A8	10	600496	6232512	2	6/22/2023	7:47	VH	4	0	N	15.0	Coniferous-mature forest
PC23-A9	10	600121	6232427	1	6/4/2023	8:13	VH	2	1	N	16.0	Coniferous-mature forest
PC23-A9	10	600121	6232427	2	6/22/2023	8:20	VH	4	2	N	16.0	Coniferous-mature forest
PC23-B1	10	595349	6229423	1	6/4/2023	4:21	ATT	1	0	N	13.5	Coniferous-young forest
PC23-B1	10	595349	6229423	2	6/22/2023	4:08	ATT	1	0	N	16.2	Coniferous-young forest
PC23-B10	10	593197	6227928	1	6/4/2023	8:53	ATT	3	0	N	20.6	Coniferous-shrub
PC23-B10	10	593197	6227928	2	6/22/2023	8:27	ATT	4	1	N	15.8	Coniferous-shrub
PC23-B2	10	595098	6229182	1	6/4/2023	4:47	ATT	2	0	N	15.3	Coniferous-mature forest
PC23-B2	10	595098	6229182	2	6/22/2023	4:34	ATT	2	0	N	18.0	Coniferous-mature forest
PC23-B3	10	594882	6228865	1	6/4/2023	5:14	ATT	2	0	N	15.8	Coniferous-young forest
PC23-B3	10	594882	6228865	2	6/22/2023	5:01	ATT	2	0	N	15.7	Coniferous-young forest
PC23-B4	10	594639	6228571	1	6/4/2023	5:43	ATT	2	1	N	15.2	Coniferous-young forest
PC23-B4	10	594639	6228571	2	6/22/2023	5:32	ATT	2	0	N	17.5	Coniferous-young forest
PC23-B5	10	594340	6228348	1	6/4/2023	6:12	ATT	1	0	N	17.5	Deciduous-young forest
PC23-B5	10	594340	6228348	2	6/22/2023	6:01	ATT	2	0	N	16.3	Deciduous-young forest
PC23-B6	10	594087	6228135	1	6/4/2023	6:42	ATT	2	0	N	16.5	Deciduous-young forest
PC23-B6	10	594087	6228135	2	6/22/2023	6:30	ATT	3	0	N	16.4	Deciduous-young forest

Table A1: Songbird point count stations surveyed in 2023

Station	UTM Zone	UTM Easting	UTM Northing	Survey Number	Survey Date	Survey Time	Cloud Ceiling[1]	Cloud Cover[2]	Wind Speed	Precipitation[3]	Temperature (ºC)	Bird Habitat Class
PC23-B7	10	593863	6227915	1	6/4/2023	7:09	ATT	2	1	N	15.9	Deciduous-young forest
PC23-B7	10	593863	6227915	2	6/22/2023	6:52	ATT	4	0	N	16.1	Deciduous-young forest
PC23-B8	10	593646	6227692	1	6/4/2023	7:36	ATT	3	1	N	18.8	Coniferous-young forest
PC23-B8	10	593646	6227692	2	6/22/2023	7:16	ATT	4	0	N	19.4	Coniferous-young forest
PC23-B9	10	593609	6228086	1	6/4/2023	8:08	ATT	3	0	N	18.2	Coniferous-shrub
PC23-B9	10	593609	6228086	2	6/22/2023	7:45	ATT	4	0	N	16.6	Coniferous-shrub
PC23-C1-1	10	589114	6225713	1	6/5/2023	8:00	VH	3	1	N	10.0	Deciduous-shrub
PC23-C1-1	10	589114	6225713	2	6/23/2023	7:50	VH	2	1	N	14.0	Deciduous-shrub
PC23-C1-2	10	589021	6225353	1	6/5/2023	8:26	VH	3	1	N	9.0	Coniferous-mature forest
PC23-C1-2	10	589021	6225353	2	6/23/2023	8:15	VH	1	0	N	14.0	Coniferous-mature forest
PC23-C1-3	10	588775	6225032	1	6/5/2023	8:50	VH	3	1	N	10.0	Coniferous-mature forest
PC23-C1-3	10	588775	6225032	2	6/23/2023	8:42	VH	1	0	N	15.0	Coniferous-mature forest
PC23-C1-4	10	588528	6224817	1	6/5/2023	9:14	VH	3	1	N	10.0	Coniferous-mature forest
PC23-C1-4	10	588528	6224817	2	6/23/2023	9:15	VH	1	0	N	15.0	Coniferous-mature forest
PC23-C1-5	10	588244	6225026	1	6/5/2023	9:40	VH	3	1	N	12.0	Riparian-mixed mature forest
PC23-C1-5	10	588244	6225026	2	6/23/2023	9:44	VH	1	1	N	16.0	Riparian-mixed mature forest
PC23-C2-1	10	587264	6223631	1	6/5/2023	7:56	ATT	3	1	N	15.8	Deciduous-young forest
PC23-C2-1	10	587264	6223631	2	6/23/2023	7:43	ATT	1	0	N	15.6	Deciduous-young forest
PC23-C2-2	10	587483	6223815	1	6/5/2023	8:23	ATT	2	1	N	16.3	Deciduous-young forest
PC23-C2-2	10	587483	6223815	2	6/23/2023	8:15	ATT	1	0	N	15.7	Deciduous-young forest
PC23-C2-3	10	587687	6224007	1	6/5/2023	9:04	ATT	3	0	N	13.1	Deciduous-young forest
PC23-C2-3	10	587687	6224007	2	6/23/2023	8:40	ATT	1	0	N	15.9	Deciduous-young forest
PC23-C2-4	10	587990	6224257	1	6/5/2023	9:30	ATT	3	1	N	18.1	Coniferous-young forest
PC23-C2-4	10	587990	6224257	2	6/23/2023	9:07	ATT	1	0	N	15.9	Coniferous-young forest
PC23-C2-5	10	588205	6224535	1	6/5/2023	9:57	ATT	2	1	N	15.5	Coniferous-mature forest
PC23-C2-5	10	588205	6224535	2	6/23/2023	9:34	ATT	1	0	N	20.7	Coniferous-mature forest
PC23-D1-1	10	574352	6217752	1	6/5/2023	4:30	H	2	0	N	4.0	Riparian-mixed young forest
PC23-D1-1	10	574352	6217752	2	6/23/2023	4:21	VH	2	0	N	11.0	Riparian-mixed young forest
PC23-D1-2	10	574335	6217385	1	6/5/2023	5:03	VH	2	2	N	8.0	Coniferous-mature forest
PC23-D1-2	10	574335	6217385	2	6/23/2023	5:04	VH	2	0	N	11.0	Coniferous-mature forest

Table A1: Songbird point count stations surveyed in 2023

Station	UTM Zone	UTM Easting	UTM Northing	Survey Number	Survey Date	Survey Time	Cloud Ceiling[1]	Cloud Cover[2]	Wind Speed	Precipitation[3]	Temperature (ºC)	Bird Habitat Class
PC23-D1-3	10	574574	6217605	1	6/5/2023	5:24	VH	2	2	N	9.0	Coniferous-mature forest
PC23-D1-3	10	574574	6217605	2	6/23/2023	5:23	VH	2	0	N	12.0	Coniferous-mature forest
PC23-D1-4	10	574823	6217844	1	6/5/2023	5:55	VH	2	2	N	8.0	Deciduous-mature forest
PC23-D1-4	10	574823	6217844	2	6/23/2023	5:49	VH	2	0	N	13.0	Deciduous-mature forest
PC23-D1-5	10	575018	6218149	1	6/5/2023	6:22	VH	2	2	N	7.0	Coniferous-mature forest
PC23-D1-5	10	575018	6218149	2	6/23/2023	6:13	VH	2	0	N	13.0	Coniferous-mature forest
PC23-D2-1B	10	578738	6219672	1	6/5/2023	7:19	ATT	2	1	N	10.4	Deciduous-young forest
PC23-D2-1B	10	578738	6219672	2	6/23/2023	4:15	ATT	1	0	N	12.3	Deciduous-young forest
PC23-D2-2B	10	577450	6219145	1	6/5/2023	6:32	ATT	2	1	N	6.5	Coniferous-shrub
PC23-D2-2B	10	577450	6219145	2	6/23/2023	4:54	ATT	2	0	N	11.9	Coniferous-shrub
PC23-D2-3	10	576950	6218948	1	6/5/2023	6:11	ATT	2	2	N	11.8	Riparian-mixed shrub
PC23-D2-3	10	576950	6218948	2	6/23/2023	5:22	ATT	1	0	N	11.2	Riparian-mixed shrub
PC23-D2-4	10	574657	6218563	1	6/5/2023	5:10	ATT	1	1	N	6.1	Deciduous-mature forest
PC23-D2-4	10	574657	6218563	2	6/23/2023	6:48	ATT	2	0	N	14.8	Deciduous-mature forest
PC23-D2-5	10	574463	6218308	1	6/5/2023	4:42	ATT	1	1	N	6.3	Deciduous-mature forest
PC23-D2-5	10	574463	6218308	2	6/23/2023	6:20	ATT	2	0	N	13.2	Deciduous-mature forest
PC23-PR-38	10	607605	6236561	1	6/8/2023	6:32	VH	2	0	N	11.0	Wetland-graminoid
PC23-PR-38	10	607605	6236561	2	6/26/2023	6:26	VH	1	1	N	15.0	Wetland-graminoid
PC23-PR-39	10	607396	6236515	1	6/8/2023	6:50	VH	1	0	N	12.0	Wetland-shrub
PC23-PR-39	10	607396	6236515	2	6/26/2023	6:46	VH	1	1	N	15.0	Wetland-shrub
PC23-PR-46	10	606770	6235559	1	6/8/2023	5:55	H	2	0	N	13.0	Wetland-graminoid
PC23-PR-46	10	606770	6235559	2	6/26/2023	5:18	VH	2	1	N	14.0	Wetland-graminoid
PC23-PR-56	10	605447	6234696	1	6/8/2023	4:28	ATT	2	1	N	11.0	Coniferous-mature forest
PC23-PR-56	10	605447	6234696	2	6/26/2023	4:34	VH	2	0	N	13.0	Coniferous-mature forest

Table Notes:

[1] Codes for Cloud Ceiling: Above Tree Tops (ATT), Below Tree Tops (BTT), Above Ridges (AR), Below Ridges (BR), High (H), and Very High (VH)

[2] Codes for Cloud Cover: Clear (1), Scattered Clouds <50% (2), Scattered Clouds >50% (3), and Unbroken Clouds (4)

[3] Codes for Precipitation: No Precipitation (N)

APPENDIX B
PROJECT QUALIFIED ENVIRONMENTAL PROFESSIONALS

Name and Affiliation	Project Role
Jeff Matheson, M.Sc., R.P.Bio., P.Biol. Tetra Tech Canada Inc.	Project Manager, Report Author
Elyse Hofs, B.Sc., B.I.T. Tetra Tech Canada Inc.	Field Data Collection, Data Entry, Report Author
Natasha Gidluck, B.Sc., B.I.T. Tetra Tech Canada Inc.	Field Data Collection

APPENDIX C

INCIDENTAL OBSERVATIONS OF BIRDS RECORDED DURING POINT COUNTS THAT ARE NOT SONGBIRDS

Table C.1: Incidental observations of non-songbirds recorded during the point count surveys, listed in taxonomic order

English Name	Scientific Name	BC List	COSEWIC	SARA Status	Detections
Canada Goose	*Branta canadensis*	Yellow	-	-	7
Bufflehead	*Bucephala albeola*	Yellow	-	-	1
Trumpeter Swan	*Cygnus buccinator*	Yellow	Not at Risk	-	5
Ruffed Grouse	*Bonasa umbellus*	Yellow	-	-	2
Yellow Rail	*Coturnicops noveboracensis*	Red	Special Concern	Special Concern	5
Sora	*Porzana carolina*	Yellow	-	-	6
Sandhill Crane	*Antigone canadensis*	Yellow	Not at Risk	-	1
Killdeer	*Charadrius vociferus*	Blue	-	-	2
Spotted Sandpiper	*Actitis macularius*	Yellow	-	-	5
Wilson's Snipe	*Gallinago delicata*	Yellow	-	-	16
Solitary Sandpiper	*Tringa solitaria*	Yellow	-	-	1
Bald Eagle	*Haliaeetus leucocephalus*	Yellow	Not at Risk	-	2
American Kestrel	*Falco sparverius*	Yellow	-	-	1

APPENDIX D
TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

NATURAL SCIENCES

1.1 USE OF DOCUMENT AND OWNERSHIP

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Where SEES JV submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed SEES JV's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by SEES JV shall be deemed to be the original. SEES JV will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of SEES JV's Instruments of Professional Service shall not, under any circumstances, be altered by any party except SEES JV. SEES JV's Instruments of Professional Service will be used only and exactly as submitted by SEES JV.

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Services performed by SEES JV for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of SEES JV.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with SEES JV with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for SEES JV to properly provide the services contracted for in the Contract, SEES JV has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO SEES JV BY OTHERS

During the performance of the work and the preparation of this Professional Document, SEES JV may have relied on information provided by third parties other than the Client.

While SEES JV endeavours to verify the accuracy of such information, SEES JV accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to SEES JV at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

SEES JV is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL ISSUES

The ability to rely upon and generalize from environmental baseline data is dependent on data collection activities occurring within biologically relevant survey windows.

It is incumbent upon the Client and any Authorized Party, to be knowledgeable of the level of risk that has been incorporated into the project design or scope, in consideration of the level of the environmental baseline information that was reasonably acquired to facilitate completion of the scope.

1.8 NOTIFICATION OF AUTHORITIES

SEES JV professionals are bound by their ethical commitments to act within the bounds of all pertinent regulations. In certain instances, observations by SEES JV of regulatory contravention may require that regulatory agencies and other persons be informed. The client agrees that notification to such bodies or persons as required may be done by SEES JV in its reasonably exercised discretion.

Appendix 3. Bank Swallow 2023 Monitoring Memo

TETRA TECH

TECHNICAL MEMO

ISSUED FOR USE

To:	Brent Matsuda, BC Hydro	**Date:**	March 6, 2024
		Memo No.:	001
From:	Elyse Hofs, Jeff Matheson	**File:**	704-ENW.PENW03042-02
Subject:	Site C 2023 Bank Swallow Survey Memo – Revised		

1.0 INTRODUCTION

Saulteau EBA Environmental Joint Venture (SEES JV) completed surveys for Bank Swallow (*Riparia riparia*) at BC Hydro and Power Authority's (BC Hydro) Site C Clean Energy Project ("Site C") in the summer of 2023. The purpose of the surveys were to determine the presence and breeding status of Bank Swallow (BKSW) at two locations within an area of the construction site referred to as Area A.

BKSW are federally designated as 'threatened' under the *Species at Risk Act* (SARA) and by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Within British Columbia, BKSW are Yellow-listed (i.e., secure and not at risk of extinction).

2.0 SURVEY SITES

In 2023 BKSW surveys were conducted at two sites within Area A known as the Batch Plant and Subsection 24 (Table 2-1; Figures 1 and 2).

Table 2-1. 2023 Area A Bank Swallow Survey Sites

Survey Site	UTM Coordinates	Elevation (metres above sea level)
Batch Plant	10 V 630522 6227799	478 m
Subsection 24	10 V 632048 6228128	465 m

2.1 Batch Plant

The Batch Plant monitoring site was a temporary habitat compensation site established in 2021 that has now undergone three years of monitoring for BKSW. The Batch Plant is located on the south bank of the Site C construction site, south of Septimus Road. The BKSW cavities are located on a previously excavated pit face / slope that is directly adjacent to a concrete waste area. There are two slopes within the Batch Plant site that were surveyed for BKSW (Figure 1):

1. A small, north-facing slope located close to the survey station (Photo 1). BKSW cavities were observed on this slope in 2021, but the slope was subsequently disturbed by excavation during the winter of 2021/2022. The soils along this slope appeared unstable, and slope faces are <75º.

Tetra Tech Canada Inc.
Suite 1000 – 10th Floor, 885 Dunsmuir Street
Vancouver, BC V6C 1N5 CANADA
Tel 604.685.0275 Fax 604.684.6241

2. A large, continuous east/northeast-facing slope that follows the alignment of the road (Photos 2 – 4). Since 2022, the slope appeared to have experienced at least two slope failures along its length, resulting in the loss of numerous BKSW cavities. The soils along the remainder of the east/northeast-facing slope appeared to be stable and the slope faces were near vertical (>75º).

2.2 Subsection 24

The Subsection 24 monitoring site is located within a stockpile area, north of Septimus Road (Figure 2). This year (2023) was the first year of monitoring at this site. BC Hydro environmental staff had located a single cavity on a near-vertical, north-facing slope of a stockpile, and requested that it be included in the BKSW monitoring program (Photos 5 – 6). Tetra Tech did not find any other cavities within this area.

3.0 SURVEY METHODS

Standwatch surveys were conducted at the Batch Plant and Subsection 24 survey sites three times throughout June of 2023. During each standwatch survey, the surveyor observed the potential nesting site for 30 minutes to record BKSW entering and exiting the nest cavity sites. Surveys were conducted after 10 a.m., and always under clear weather conditions (i.e., no surveys were conducted in rain or inclement weather).

4.0 SURVEY RESULTS

4.1 Batch Plant

The east/northeast slopes were observed to be utilized by BKSW, with upwards of 50 nest cavities present along the slope face (Table 4-1; Photo 2). Although BKSW nest cavities were present along the length of the east/northeast-facing slopes, individual BKSW were often observed entering and exiting cavities located at two specific locations ("active colonies") along the slopes (Figure 1). The first active colony, Colony 1, was located on the east-facing slope (Photo 3), and of the 12 nest cavities in this colony, it was estimated that, at most, 6 cavities were active. The second active colony, Colony 2, was located along the northeast-facing slope (Photo 4), and it was estimated that, at most, three of the nest cavities within this colony were active. During the first survey event, BKSW activity was observed at two additional nest cavities along the slope that were not part of a colony, but activity was not observed at these cavities during subsequent surveys.

No BKSW cavities were observed on the north-facing slope during the 2023 surveys.

Table 4-1. Survey Results for the 2023 Bank Swallow Surveys at the Batch Plant

Observation Date / Time	Observers	Observations
June 3, 2023 13:10 – 13:40	Elyse Hofs & Natasha Gidluck	Approximately 50 BKSW nest cavities were counted on the east/northeast-facing slopes. This is approximately 40 fewer cavities than documented in 2022, due to two slope failures that had occurred along the east/northeast-facing slope. No nest cavities were observed on the disturbed north-facing slope. **13:10** – BKSW were observed flying around the bank and entering/exiting cavities throughout the 30-minute survey. **13:16** – Observed eight BKSW foraging above the site. Two active colonies were observed: – Colony 1 with approximately 12 nest cavities was observed along the east-facing slope, and – Colony 2 with approximately 21 nest cavities was observed along the northeast-facing slope. – There were also single cavities located along the slope, that were not part of a colony. **13:35** – Determined that Colony 1 had at least six active nest cavities, and Colony 2 had at least one active nest cavity. There were at least two additional active nest cavities along the slope that were not part of a colony.
June 7, 2023 12:45 – 13:15	Elyse Hofs & Simon Campbell	**12:45** – Observed six BKSW flying over the area. **12:54** – Observed four BKSW flying overhead. **13:05** – Observed seven BKSW flying overhead and one BKSW sitting in a cavity, for a total of eight individuals. **13:05** – Confirmed five active cavities in Colony 1, and two active cavities in Colony 2. Did not observe BKSW entering or exiting any of the single cavities along the slope.
June 21, 2023 13:20 – 13:50	Elyse Hofs & Natasha Gidluck	**13:25 –** Observed activity at one cavity in Colony 1 and two cavities in Colony 2. **13:27** – Confirmed that there was a third active cavity in Colony 2 **13:32** – Observed four BKSW flying above slopes. Overall, there is less BKSW activity today than during previous surveys. **13:35** – Observed six BKSW flying in the area. **13:45** – Confirmed that there was a second active cavity in Colony 1. Did not observe BKSW entering or exiting any of the single cavities along the slope.

4.2 Subsection 24

Tetra Tech did not observe any activity at the single cavity and was not able to confirm if the cavity was active (Table 4-2; Photos 5 – 6). In an email sent on June 6, 2023, Alexis Parkinson (Ecofor Environmental Monitor) informed Tetra Tech that the single cavity in Subsection 24 was confirmed to be active by the environmental consultant, Blackbird, who visited the site sometime between June 3 and 7, 2023.

Table 4-2. Survey Results for the 2023 Bank Swallow Surveys at Subsection 24

Observation Date / Time	Observers	Observations
June 3, 2023 14:00 – 14:30	Elyse Hofs & Natasha Gidluck	There was a single BKSW cavity located on a near-vertical, north-facing slope of a stockpile. Tetra Tech staff examined the surrounding area for additional cavities but did not locate any others. **14:00 – 14:20** – No BKSW seen or heard. **14:24** – Heard and observed two BKSW flying approximately 200 m away to the south. **14:26** – One BKSW flew close to the stockpile slope with the cavity. **14:30** – Survey complete. Could not confirm if the cavity was active or inactive.
June 7, 2023 13:24 – 13:54	Elyse Hofs & Simon Campbell	A large area surrounding the single cavity had been flagged off to prevent disturbance. **13:47** – Rock truck and dozer/loader started working nearby, producing loud noise and disturbance. **13:54** – Survey complete. No BKSW observed throughout 30-minute survey.
June 21, 2023 12:40 – 13:10	Elyse Hofs & Natasha Gidluck	**12:42** – Single BKSW observed flying overhead but far from the cavity. **12:54** – Single BKSW observed flying in the distance. **12:42** – Single BKSW observed flying overhead, far from cavity, and then flew away. **13:10** – Survey complete. Could not confirm if the cavity was active or inactive.

5.0 DISCUSSION

There was evidence of BKSW breeding activity along the east/northeast-facing slopes within the Batch Plant. Of the 50 cavities present along the slope, surveys indicated that up to 11 cavities (22%) may have been active in 2023. This represents a decrease from 2022, when at least 25 BKSW nest cavities were estimated to have been active at the Batch Plant. Similar to the 2022 surveys, no BKSW cavities were observed on the previously disturbed north-facing slope.

Tetra Tech did not observe evidence of BKSW breeding activity within Subsection 24; however, Blackbird Consulting was able to confirm that the single BKSW cavity present at this location was active.

6.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of BC Hydro and Power Authority and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than BC Hydro and Power Authority, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in Appendix A or Contractual Terms and Conditions executed by both parties.

7.0 CLOSURE

We trust this technical memo meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

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Enclosure: Photos (6)
Figures (2)
Appendix A: Tetra Tech's Limitations on the Use of this Document

PHOTOS

Photo 1: View of the disturbed north-facing slope at the Batch Plant.

Photo 2: View of the east/northeast-facing slope at the Batch Plant and the location of the active BKSW Colonies 1 and 2.

Photo 3: Close-up view of the active BKSW Colony 1 at the Batch Plant.

Photo 4: Close-up view of the active BKSW Colony 2 at the Batch Plant.

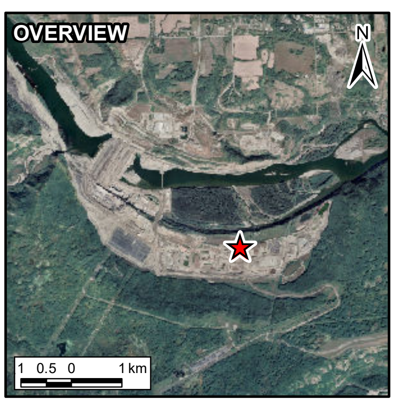
Photo 5: View of the stockpile slope in Subsection 24 with the single BKSW cavity.

Photo 6: Close-up view of the single BKSW cavity in Subsection 24.

FIGURES

LEGEND

- Bank Swallow Standwatch Station
- Slope Face



NOTES
Base data source:
Imagery from Google Earth (Main Map: May 2023 / Overview: Sept 2022).

STATUS
ISSUED FOR USE

SITE C
2023 BANK SWALLOW SURVEY MEMO

Area A - Subsection 24

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC Hydro Power smart

Scale: 1:2,000
30 15 0 30
Metres

TETRA TECH

FILE NO.				
PENW03042-02_Fig02_Subsection24.mxd				
OFFICE	**DWN**	**CKD**	**APVD**	**REV**
Tt-VANC	SL	BB	EH	0
DATE	**PROJECT NO.**			
MARCH 2024	ENW.PENW03042-02			

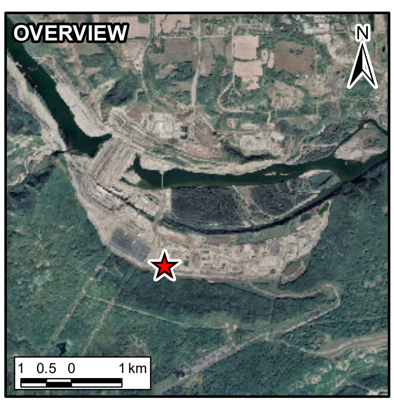
Figure 2

G:\ENVIRONMENTAL\PENW\PENW03042-02\Maps\BankSwallow_2023\PENW03042-02_Fig02_Subsection24.mxd modified 12/21/2023 by Stephanie.Leusink

G:\ENVIRONMENTAL\PENW\PENW03042-02\Maps\BankSwallow_2023\PENW03042-02_Fig01_BatchPlant.mxd modified 12/21/2023 by Stephanie.Leusink

LEGEND

- Bank Swallow Standwatch Station
- Approximate Location of Active Colony
- Slope Face



NOTES
Base data source:
Imagery from Google Earth (Main Map: May 2023 / Overview: Sept 2022).

STATUS
ISSUED FOR USE

SITE C
2023 BANK SWALLOW SURVEY MEMO

Area A - Batch Plant

PROJECTION UTM Zone 10			**DATUM** NAD83	**CLIENT** BC Hydro Power smart
Scale: 1:2,000 (30 15 0 30 Metres)				TETRA TECH
FILE NO. PENW03042-02_Fig01_BatchPlant.mxd				
OFFICE Tt-VANC	**DWN** SL	**CKD** BB	**APVD** EH	**REV** 0
DATE MARCH 2024	**PROJECT NO.** ENW.PENW03042-02			**Figure 1**

APPENDIX A.

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

NATURAL SCIENCES

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The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

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TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL ISSUES

The ability to rely upon and generalize from environmental baseline data is dependent on data collection activities occurring within biologically relevant survey windows.

It is incumbent upon the Client and any Authorized Party, to be knowledgeable of the level of risk that has been incorporated into the project design or scope, in consideration of the level of the environmental baseline information that was reasonably acquired to facilitate completion of the scope.

1.8 NOTIFICATION OF AUTHORITIES

TETRA TECH professionals are bound by their ethical commitments to act within the bounds of all pertinent regulations. In certain instances, observations by TETRA TECH of regulatory contravention may require that regulatory agencies and other persons be informed. The client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

Appendix 4. Waterbird Migration Follow-up Monitoring Program 2023 Annual Report

Site C Vegetation and Wildlife Waterbird Migration Follow-up Monitoring Program – 2023 Annual Report

Photo Credit: C. Toby St. Clair

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Project No. 107578-04

March 26, 2024

Executive Summary

The Site C Waterbird Migration Follow-up Monitoring Program is being conducted to fulfill, in part, the requirements and conditions set forth in the Site C Clean Energy Project's (Project) Provincial Environmental Assessment Certificate (EAC) and the Federal Decision Statement (FDS). The objectives of the Site C waterbird monitoring program are as follows:

- Assess changes in waterbird wetland and non-wetland habitat on the Peace River and the transmission line right-of-way from Project construction through to the first 10 years of Project operations to assess Project-related impacts relative to the impacts predicted in the EIS.
- Document changes in waterbird abundance and diversity across habitats (Peace River and wetlands) during the first 10 years of Project operations relative to pre-reservoir and transmission line conditions to assess Project-related impacts relative to those predicted in the EIS.
- Monitor waterbird use of natural and created compensatory wetland features from Project construction through to the first 10 years of Project operations to evaluate the effectiveness of mitigation and compensation measures.

The monitoring program has been implemented annually from 2017 through 2023 within the Peace River from Hudson's Hope to the British Columbia-Alberta border (Peace River study area) and within wetlands along and adjacent to the Project transmission line right-of-way (ROW) on the Moberly Plateau (wetlands study area). Over these 7 years, surveys have been carried out in accordance with FDS conditions to obtain baseline data on waterbird abundance, density, species presence, and habitat use (e.g., habitat associations) within habitats used by waterbirds. Within years, the temporal scope of the waterbird migration monitoring program covers spring migration (April 1 to May 30) and fall migration (August 1 to October 30). The target taxa for the program are all waterbird species which, for effects assessment and planning (e.g., power analyses) purposes, have been categorized into 7 foraging guilds comprised of species with similar morphology and foraging strategies and anticipated to be affected similarly by the Project:

- Benthic-feeding divers (e.g., goldeneyes [*Bucephala* species (spp.)]), scoters [*Melanita* spp.])
- Dabbling ducks (e.g., wigeon [*Mareca* spp.], teal [*Spatula* spp.])
- Gulls and terns
- Large dabblers (geese and swans)
- Marsh birds (e.g., snipe and rails)
- Piscivorous divers (e.g., mergansers [*Mergus* spp.], loons [*Gavia* spp.)])
- Shorebirds (e.g., sandpipers [*Calidris* spp.], plovers [*Charadrius* spp.]).

The primary method applied to obtain abundance and diversity data within the Peace River study area has been river boat surveys encompassing all safely navigable portions of the river. Within the wetlands study area, the primary survey methods have been 20-minute standwatch surveys of open water areas, 100- metre walking transect surveys of vegetated wetlands, and multi-night autonomous recording unit (ARU) deployments for bioacoustics monitoring of vegetated wetlands.

The report describes abundance and diversity statistics (e.g., density, species richness, species evenness) across habitat types, seasons, and survey periods within seasons throughout the Peace River and wetlands study areas. These statistics are also provided for control and impact areas defined within the Peace River study area.

A summary of 2023 monitoring efforts and pooled results from 2017 through 2023 are provided below for monitoring conducted along the Peace River study area, followed by results from the wetlands study area. More detailed results summarized across all survey years and specific to the current monitoring year are provided within the main body of the report and within supporting appendices.

During northward waterbird migrations in spring 2023, 2 surveys were conducted along the Peace River (April 2 to April 13). During southward migrations in fall 2023, 3 surveys were conducted (August 9 to September 30). Wetlands along and adjacent to the Project transmission line ROW were also surveyed in 2023 during 2 and 3 survey rounds over the spring (May 3 to May 26) and fall migration periods (August 2 to September 28), respectively. Bioacoustics surveys in 2023, were conducted at 9 locations on the Moberly Plateau from May through early August.

Surveys of the Peace River in 2017 through 2023 provide 7 years of data under primarily baseline conditions. These data will be used together with data collected during the Project operations phase to assess potential impacts of the Project on waterbirds within a before-after control-impact (BACI) study design framework. A total of 109,359 waterbirds of 66 species were recorded during boat-based surveys conducted during the spring and fall of 2017 through 2023. From these results, summary statistics were calculated using pooled data from 51 complete surveys of the Peace River study area across all seasons and years. As reported in previous years, all 7 foraging guilds occurring within areas of anticipated Project-related effects were also recorded in the control portion of the study area. These results support the BACI study design assumption that areas of the Peace River downstream of the Pine River provide an appropriate control for assessing background variation for waterbirds, with which Project-related changes to waterbirds in the Peace River will be assessed.

To help describe variation in waterbird abundance and diversity along the Peace River, areas of the river with similar water flow volumes and depth, substrate type, connectivity to the mainstem of the river, and aquatic vegetation were categorized into 3 habitat types:

- Mainstem - areas of the river where water flow rates, depths and substrate size are greatest
- Moderate Flow - areas of the river consistently connected to the mainstem, with moderate flows, and generally no impediment to boat travel regardless of water levels
- Limited Connectivity - backchannels with limited connectivity to the river, typically only on the downstream end with relatively low flow rate, and for which access by boat is restricted in some areas, particularly when water levels are low.

Abundance, density, and diversity statistics are presented for each of these river habitat types. Across all survey years, more waterbirds (46% and 62% in spring and fall, respectively, across all survey years) were found in Mainstem river habitat, the largest habitat type by area, compared to Moderate Flow (22% and 12% in spring and fall, respectively, across years) and Limited Connectivity habitats (32% and 26% in spring and fall, respectively, across years). However, the greatest densities of waterbirds were observed in Limited Connectivity habitat. Waterbird densities within Limited Connectivity habitat were 3.3 and 4.9 times the densities observed in Moderate Flow habitat in spring and fall, respectively. Relative to Mainstem areas of the river, densities within Limited Connectivity habitat were 9.3 and 5.5 times greater in spring and fall, respectively.

Wetlands surveys conducted from 2017 through 2023 resulted in detections of a total of 11,611 waterbirds of 47 species within 25 survey areas containing habitat used by waterbirds (i.e., wetland survey stations). Wetland survey stations contained varying combinations of the following habitat types:

- Open water - Open water with no (or limited) emergent vegetation, including shallow open water as well as ponds and lakes transitioning or connected to wetlands
- Sedge - Uniform sedge (*Carex* sp.) with less than 10% willow and/or scrub birch (*Betula nana*)
- Willow-sedge - Sedge (*Carex* sp.) meadow with scattered (>10%) willows and/or scrub birch.

Survey methods appropriate for each habitat type were applied and abundance and diversity statistics were calculated for each. Survey data provides season and survey-period- specific estimates of abundance and diversity in habitats regularly used by waterbirds within 3 km of the transmission line ROW.

Standwatch surveys of open water habitat detected 11,153 individuals of 45 waterbird species in 2017 through 2023. Relative to standwatch surveys of open water habitat, fewer individuals and species (458 individuals of 19 species) were observed within sedge and willow-sedge habitat surveyed by walking transects in 2018 through 2023. While fewer survey years and greater detection constraints in sedge and willow-sedge habitats contribute to the lower numbers and diversity reported from those habitats, open water habitats on the Moberly Plateau clearly support greater waterbird abundances and diversity.

Bioacoustics monitoring using ARUs provides additional data on marsh bird species, which can be detected more effectively using audio rather than visual survey methods. Bioacoustics monitoring in 2017 through 2023, including 49 ARU deployments, was conducted around the breeding season, between mid-May and early August, when marsh bird species vocalize most often. ARUs were deployed to record bird vocalizations within sedge and willow-sedge habitat in addition to the edge of open water and upland forested areas.

Sora (*Porzana carolina*) was detected at 45 of 49 locations where ARUs were deployed across years and only went undetected during late season (late July and August) deployments. Yellow rail (*Coturnicops noveboracensis*) was detected at 15 (31%) of 49 locations. Virginia rail (*Rallus limicola*), a species only recently known to occur in the region and not reported from baseline studies, was detected at 6 (18%) of 33 locations where ARUs were deployed in 2020 through 2023. In contrast, American bittern (*Botaurus lentiginosus*) was not detected at any location in any year of monitoring. These surveys provide data on sora complementary to those from transect surveys, demonstrating the species' ubiquity within vegetated wetlands. ARU survey results also continue to provide evidence of American bittern's absence or rarity in the wetlands study area, and the regular presence of yellow rail along and adjacent to the transmission line ROW, particularly within sedge-dominated habitat with low water levels and *Carex* sp. rather than *Typha* sp. (i.e., cattails).

This work was performed in accordance with Purchase Order 4130005793 under Master Service Agreement No. 579005 between Ausenco Sustainability ULC, a wholly owned subsidiary of Ausenco Engineering Canada Inc. (Ausenco), and BC Hydro (Client), dated June 21, 2016 (Contract). This report has been prepared by Ausenco, based on fieldwork conducted by Ausenco, for sole benefit and use by BC Hydro. In performing this work, Ausenco has relied in good faith on information provided by others, and has assumed that the information provided by those individuals is both complete and accurate.

This work was performed to current industry standard practice for similar environmental work, within the relevant jurisdiction and same locale. The findings presented herein should be considered within the context of the scope of work and project terms of reference; further, the findings are time sensitive and are considered valid only at the time the report was produced. The conclusions and recommendations contained in this report are based upon the applicable guidelines, regulations, and legislation existing at the time the report was produced; any changes in the regulatory regime may alter the conclusions and/or recommendations.

This Executive Summary is not intended to be a stand-alone document, but a summary of findings as described in the following Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

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List of Appendices

List of Acronyms and Abbreviations

Acronym / Abbreviation	Definition
ARU	Autonomous Recording Unit
BACI	before-after, control-impact
BC	British Columbia
cm	centimetre
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
dB	decibel
EAC	Environmental Assessment Certificate
EIS	Environmental Impact Statement
FDS	Federal Decision Statement
GPS	global positioning system
h	hour(s)
kHz	kilohertz
km	kilometres
km^2	square kilometres
km/h	kilometres per hour
m	metre
ROW	right-of-way
SC	special concern
SARA	*Species at Risk Act*
sec	second
TEM	terrestrial ecosystem mapping
UTM	Universal Transverse Mercator
VWTC	Vegetation and Wildlife Technical Committee
%	percent
<	lesser than
>	greater than

Glossary

Symbol / Unit of Measure	Definition
Absolute abundance	A measure of the true number of individuals, accounting for incomplete detection.
Control area	The geographical area of the Peace River from the Pine River confluence to the Alberta border and presumed not affected by the Project
Flow Impact area	The geographical area of the Peace River from the Site C dam to the Pine River confluence with the Peace River
Foraging guild	Species groups comprised of waterbird species with similar morphology and foraging strategies
Inundation Impact area	The geographical area of the Site C reservoir from Hudson's Hope to the Site C dam
Relative abundance	A measure, or index, of abundance that can be used to assess changes over time and space (e.g., between pre-existing and Project operations conditions and between **control areas** and **impact areas**)
Peace River study area	The geographical area of the Peace River between Hudson's Hope and the Alberta border
Species evenness	The degree of similarity in abundance of each species
Species richness	The number of species
Study area	The geographical area where all aspects of the study take place. The study area encompasses all sub-areas (e.g., **treatment areas**) including **control areas**, the **impact areas** and other defined areas as applicable
Survey day	Survey effort in a given day, which covers only a portion of the transmission line right-of-way **wetlands** or **Peace River study areas**
Survey period	A period of time which encompasses a defined period of spring or fall migration, including the peak migration of one or more **foraging guilds** (i.e., foraging guilds)
Survey round	A group of **survey days**, which together encompass the entire **Peace River study area** or the entire **wetlands study area**
Treatment area	Geographical areas that are sub-areas of a **study area** in which either the impact or control condition is present and measured. There are 2 types of treatment areas within the Peace River study area: a **control area**, and **impact areas**
Waterbird	The collective name for shorebirds, marsh birds, waterfowl, and other birds associated with aquatic and wetland habitats
Wetlands study area	The geographical area of wetland habitat on the Moberly Plateau within 3 kilometres of the Project transmission line

1.0 Introduction

This report describes the combined annual results of the 2017 to 2023 Waterbird Migration Follow-up Monitoring Program surveys for shorebirds, marsh birds, waterfowl, and other birds associated with aquatic and wetland habitats (collectively known as waterbirds). This program is being conducted to fulfill, in part, the requirements and conditions set forth in the Site C Clean Energy Project's Provincial Environmental Assessment Certificate (EAC) (Condition 21) and the Federal Decision Statement (FDS) (Conditions 10.2 10.3, 11.3 and 11.4) (BC Hydro 2013).

1.1 Background

In the Site C Environmental Impact Statement (EIS), BC Hydro assessed the potential effects of the Site C Clean Energy Project (Project) on Wildlife Resources using key species groups, including shorebirds, marsh birds, and waterfowl (BC Hydro 2013). Effects of the Project on these waterbirds were assessed in terms of habitat alteration and fragmentation, disturbance and displacement, and mortality (BC Hydro 2013).

The EIS assessed the residual effects of the Project on waterfowl and shorebirds as high magnitude because of the anticipated extent of river and back-channel habitat loss (i.e., habitat alteration and fragmentation). The duration and geographic extent of the effect is dependent on future waterbird use of the reservoir and wetlands created through habitat compensation. There was low confidence in the characterization of this expected use, because use will depend on the success of vegetation establishment along the boundaries of the reservoir, the extent of ice formation in the reservoir, the use of nest boxes, and the use of nesting habitat in constructed wetlands (BC Hydro 2013).

BC Hydro coordinated baseline studies of waterbirds in the Peace River and adjacent wetlands in 2006, 2008 and 2012 through 2014. Baseline surveys conducted for waterfowl between 2006 and 2014 were designed to assess species within the orders Anseriformes (i.e., ducks, geese, and swans), Procellariiformes (i.e., loons), and Podicipediformes (i.e., grebes). Surveys in 2015 and 2016 (Mushanski et al. 2015), using the same methods, expanded the focus to include Charadriiformes (e.g., snipe, sandpipers, phalaropes, plovers, gulls, terns, avocets), Gruiformes (e.g., rails), and Pelecaniformes (e.g., bitterns).

Baseline waterbird studies employed fixed-wing aircraft and twin-engine helicopter surveys and, to a lesser extent, ground and boat surveys (Simpson and Andrusiak 2009; BC Hydro 2013; Churchland et al. 2015). Waterbird surveys conducted using aerial approaches are limited in their accuracy, such that no shorebirds were documented during helicopter and fixed-wing aircraft surveys conducted between 2012 and 2014, and species identification from helicopters is challenging. Therefore, the waterbird follow-up monitoring program was modified with guidance from, and in consultation with, the Project's Vegetation and Wildlife Technical Committee (VWTC) to use exclusively boat and land-based approaches. This report presents Waterbird Migration Follow-up Monitoring Program data collected annually from 2017 through 2023 using methods designed to survey the full range of waterbird species present in the study area. Data from surveys before 2017 were not compared to nor compiled with those collected for this follow-up monitoring program due to inconsistencies in the timing of previous surveys and discrepancies between those methods and those used in the updated survey protocols.

1.2 Monitoring Objectives

The overall objective of the Waterbird Migration Follow-up Monitoring Program is to address uncertainties regarding the effects of the Project (i.e., change from river valley to reservoir and changes in flow regime) on waterbirds that use habitat along and surrounding the Peace River (including wetland and non-wetland areas). The specific objectives of the monitoring program are as follows:

- Assess changes in waterbird wetland and non-wetland habitat on the Peace River and the transmission line right-of-way (ROW) from Project construction through to the first 10 years of Project operations to assess Project-related impacts relative to those predicted in the EIS (EIS Volume 2; Appendix R- Section 4.1) (BC Hydro 2013).
- Document changes in waterbird abundance and diversity across habitats (Peace River and wetlands) during the first 10 years of Project operations relative to pre-reservoir and transmission line conditions to assess Project-related impacts relative to those predicted in the EIS (EIS Volume 2; Appendix R- Section 4.1) (BC Hydro 2013).
- Monitor waterbird use of natural and created compensatory wetland features from Project construction through to the first 10 years of Project operations to evaluate the effectiveness of mitigation and compensation measures.

The survey methods applied in this monitoring program provide data on waterbird relative abundance and diversity within habitat types present and used by waterbirds in the study area. Distance and repeated survey data were collected (as described in **Section 2.1.2** and **2.2.2.1**) to provide measures of detectability and allow for estimates of absolute abundance in future analyses. Baseline measures of abundance, density, species presence, and habitat use (i.e., associations) for waterbirds are required by FDS conditions.

The study is designed to assess changes in abundance and diversity of waterbirds for each of 7 foraging guilds comprised of species with similar morphology and/or foraging strategies:

- Benthic-feeding divers: small waterfowl and sea ducks that feed primarily on benthic invertebrates
- Dabbling ducks: small waterfowl that feed primarily on aquatic vegetation
- Gulls and surface-feeding terns: small to large species that forage on fish and insects near the water's surface, and occasionally on garbage, hereafter referred to as 'gulls'
- Marsh birds: cryptic species that forage primarily under vegetated cover within wetlands
- Large dabblers: large waterfowl such as geese and swans that feed primarily on vegetation
- Piscivorous divers: diving birds that forage on fish at various depths within the water column
- Shorebirds: plovers and sandpipers that feed primarily on or near the shoreline; phalaropes.

Foraging guilds are used to categorize waterbird species because forage is expected to be an important driver of waterbird abundance during migration. The use of foraging guilds also generally follows the waterbird species categorization approach used in the EIS, which facilitates the comparison of measured (i.e., observed effects) to predicted effects of the Project.

1.3 Study Area and Temporal Scope

The overall study area for the Waterbird Migration Follow-up Monitoring Program comprises the Peace River between Hudson's Hope and the Alberta border, and wetland habitat on the Moberly Plateau within 3 kilometres (km) of the Project transmission line (**Figure 1**). Hereafter, these two areas are referred to separately as the Peace River study area and the wetlands study area. Areas of the Peace River 2 km upstream and downstream of the Site C dam site were not surveyed during or following fall 2021 due to safety hazards associated with accessing these areas by boat (e.g., non-visible, underwater hazards).

Waterbird survey data will be collected each year through Project construction and for the first 10 years of Project operations (BC Hydro 2022) as per EAC Condition 21. The monitoring program has been focused on spring migration (i.e., April and May) and fall migration (i.e., August, September, October) because the greatest numbers and diversity of waterbirds are present in the study area during those months (Simpson and Andrusiak 2009; Hilton et al. 2013; eBird 2022).

Within subsequent sections of this report, the following terminology is used to define the temporal scope of survey efforts:

- Survey day – Survey effort in a given day, which covers only a portion of the transmission line wetlands or Peace River study areas
- Survey round – A group of survey days, which together encompass the entire Peace River study area or transmission line wetlands study area
- Survey period – A period of time (e.g., early spring, late fall) which encompasses a defined period of spring or fall migration, including the peak migration of one or more waterbird foraging guilds.

To inform the timing and number of surveys conducted in 2020 and subsequent years, a power analysis was conducted using the Peace River waterbird survey data collected by boat from 2017 through 2019 (**Appendix A**). The results of the analysis indicated that 2 survey rounds during the early spring migration (April 1 to 15) and one survey round during each of the first 3 fall migration survey periods (encompassing August 1 to October 14) would be sufficient to meet the study objectives. Specifically, that survey timing and frequency was calculated to allocate effort to detect, with 80 percent (%) statistical power, a 50% change in abundance of each foraging guild in the impact treatment areas contrasted with no change in the Control area over time. Surveys in 2020 through 2023 were conducted in accordance with survey timing and frequency recommendations based on this power analysis (**Appendix A**).

Surveys within the Peace River and wetlands study areas were conducted concurrently during the fall. However, during spring, Peace River surveys were started 3 to 4 weeks earlier than wetlands surveys to document waterbirds using the river before upland wetlands thaw. Prior to thawing, wetlands along the transmission line ROW are unavailable for waterbird foraging use and waterbirds primarily use habitat along the Peace River.

Migratory Waterbird Follow-up Monitoring Program
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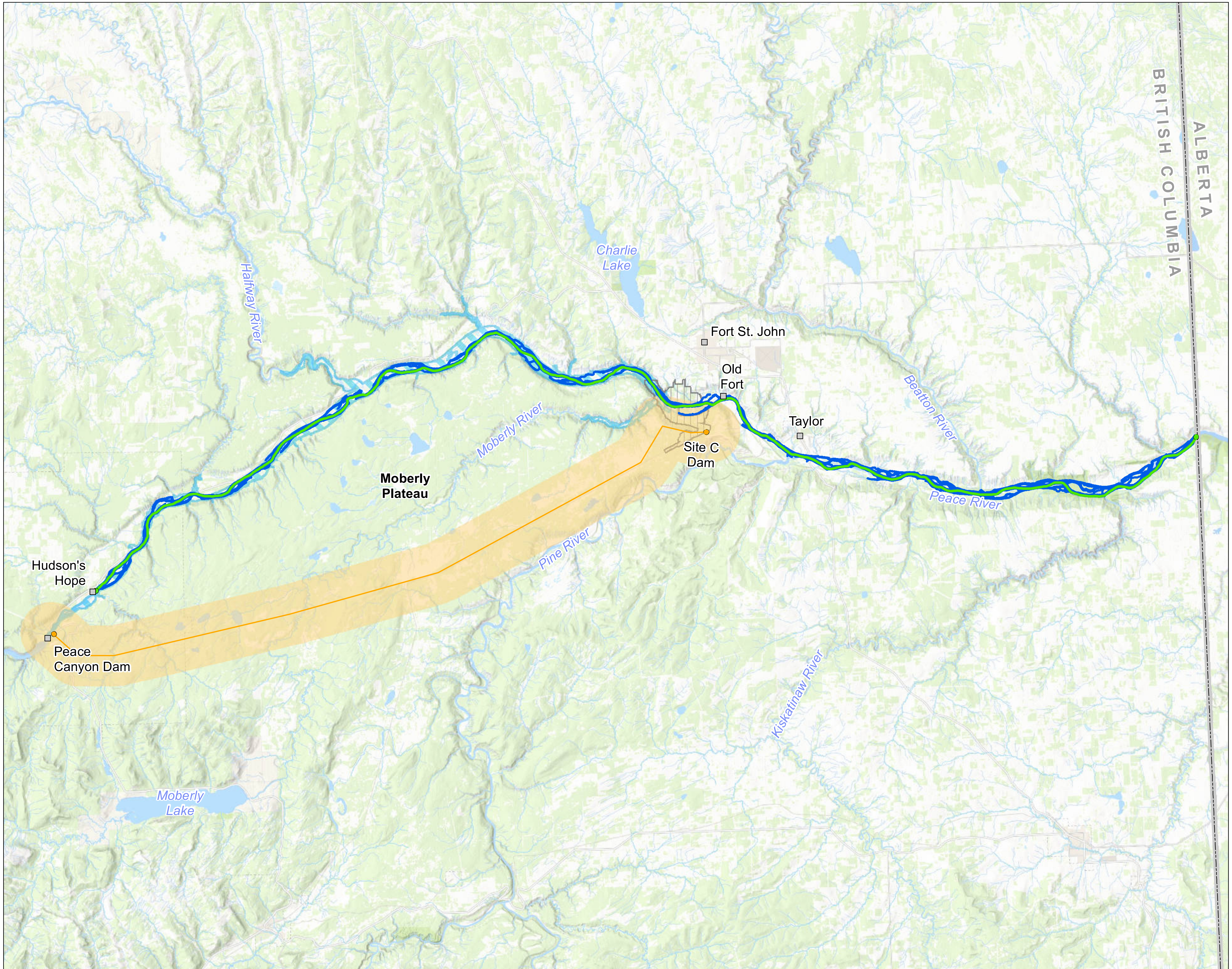
Figure 1 - Study Areas of the Waterbird Monitoring Program on the Peace River and Moberly Plateau



Legend

- Transmission Line
- Extent of Peace River Waterbird Surveys
- Proposed Dam Site
- Proposed Reservoir
- Peace River Study Area
- Wetlands Study Area
- Town
- Road
- Provincial Border
- Forested Area
- Waterbody / Watercourse

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Basemap: ESRI World Topographic Base

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Ausenco BC hydro

2.0 Monitoring Methods

Survey methods developed to meet the monitoring program objectives were developed using guidance from provincial Resource Inventory Standards Committee protocols, with review from the VWTC and subsequent input from Environment and Climate Change Canada and Native Plant Solutions of Ducks Unlimited Canada. The survey methods employed during the 2023 field program and prior years to assess habitat, and designed to maximize detection of waterbirds across habitats, are described in the following sections. Additional detail and rationale for the methods are presented in the Site C Vegetation and Wildlife Waterbird Migration Follow-up Monitoring Program (BC Hydro 2022).

2.1 Peace River Surveys

Surveys of the Peace River were conducted to assess the abundance and diversity of waterbirds using wetland (e.g., wetlands occasionally flooded by the Peace River) and non-wetland habitats (e.g., consistently flooded portions of the river) within the Peace River study area as per study objectives to document baseline conditions and to assess potential Project-related change. The approach by which Project-related change will be assessed, as per Condition 11.4.3 of the FDS, is presented in **Section 2.2.1**. The methods used to conduct surveys in the Peace River study area are described in **Section 2.1.2**.

2.1.1 Approach to Evaluating Change

A before-after, control-impact (BACI) study design is being applied to allow Project-related changes in waterbird abundance and diversity to be detected and distinguished from background (e.g., natural) variation within waterbird communities in the Peace River valley. Within the BACI study design framework, 3 areas are being surveyed to assess Project-related effects to waterbirds:

- Inundation Impact area – the Site C reservoir from Hudson's Hope to the Site C dam, to assess impact from inundation (**Figure 2**)
- Flow Impact area - the Peace River from the Site C dam to the Pine River confluence with the Peace River, to assess impact from change in flow regime (**Figure 3**)
- Control area - the Peace River from the Pine River confluence to the Alberta border, to assess background conditions (**Figure 4**).

Below the confluence of the Peace and Pine rivers, Project-related changes in flow regime are expected to be moderated by inputs from the Pine River, thereby providing a control that will maintain conditions similar to those existing prior to the Project. Control and impact areas within the Peace River study area are, hereafter, referred to as *treatment areas*. The 'before' period for the BACI design will be prior to reservoir filling, which is currently planned to occur in fall 2024. Widespread impacts are expected once reservoir filling begins. The river diversion period (occurring from 2020 through reservoir filling) will be part of the 'before' period because water volumes and flow rates are expected to be mostly unchanged outside the immediate construction area and small headpond during this time. However, survey data from areas affected by construction activity prior to reservoir filling will ultimately be excluded from the 'before' period dataset in future analyses of Project-related change. The 'after' period will be during Project operations.

Following collection and analysis of relative abundance data from the 'before' and 'after' study periods, use of the BACI design will permit evaluation of Project-related impacts through tests of statistical significance of the interaction effect between treatment areas (control vs. impact) and study periods (before vs. after).

Migratory Waterbird Follow-up Monitoring Program
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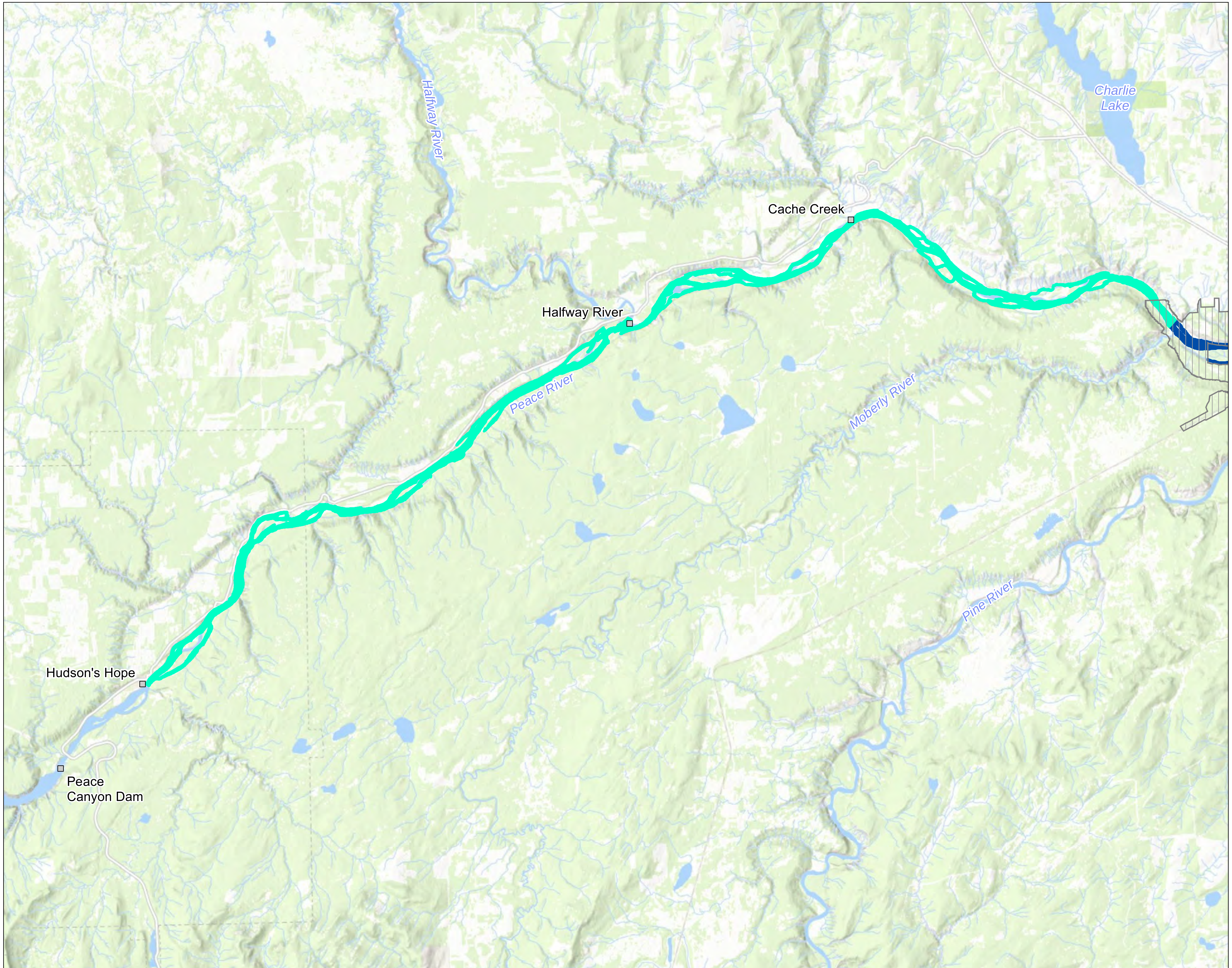
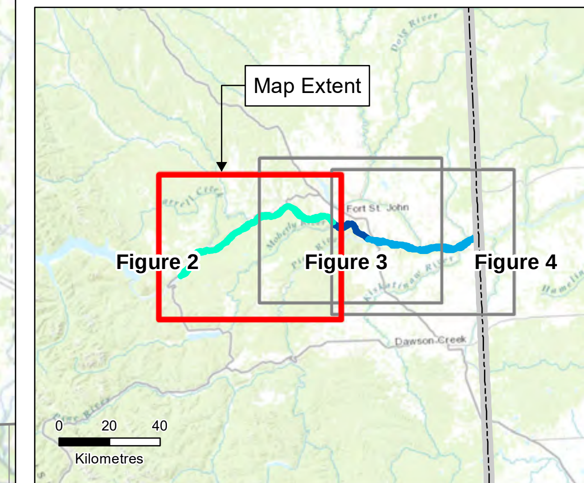
Site C, Peace River, BC

Figure 2 - Inundation Impact Area on the Peace River





Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Proposed Dam Site
- Town
- Road
- Forested Area
- Waterbody / Watercourse

Notes

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Sources

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Migratory Waterbird Follow-up Monitoring Program
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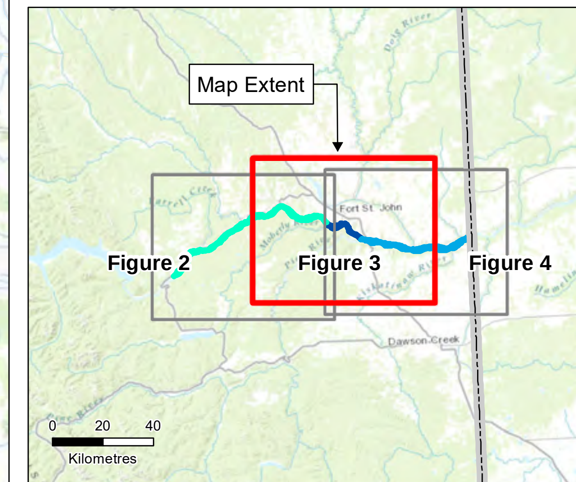
Figure 3 - Flow Impact Area on the Peace River



Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Proposed Dam Site
- Town
- Road
- Forested Area
- Waterbody / Watercourse

Notes

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107578-04	Production Date: Dec 8, 2023	Figure 3

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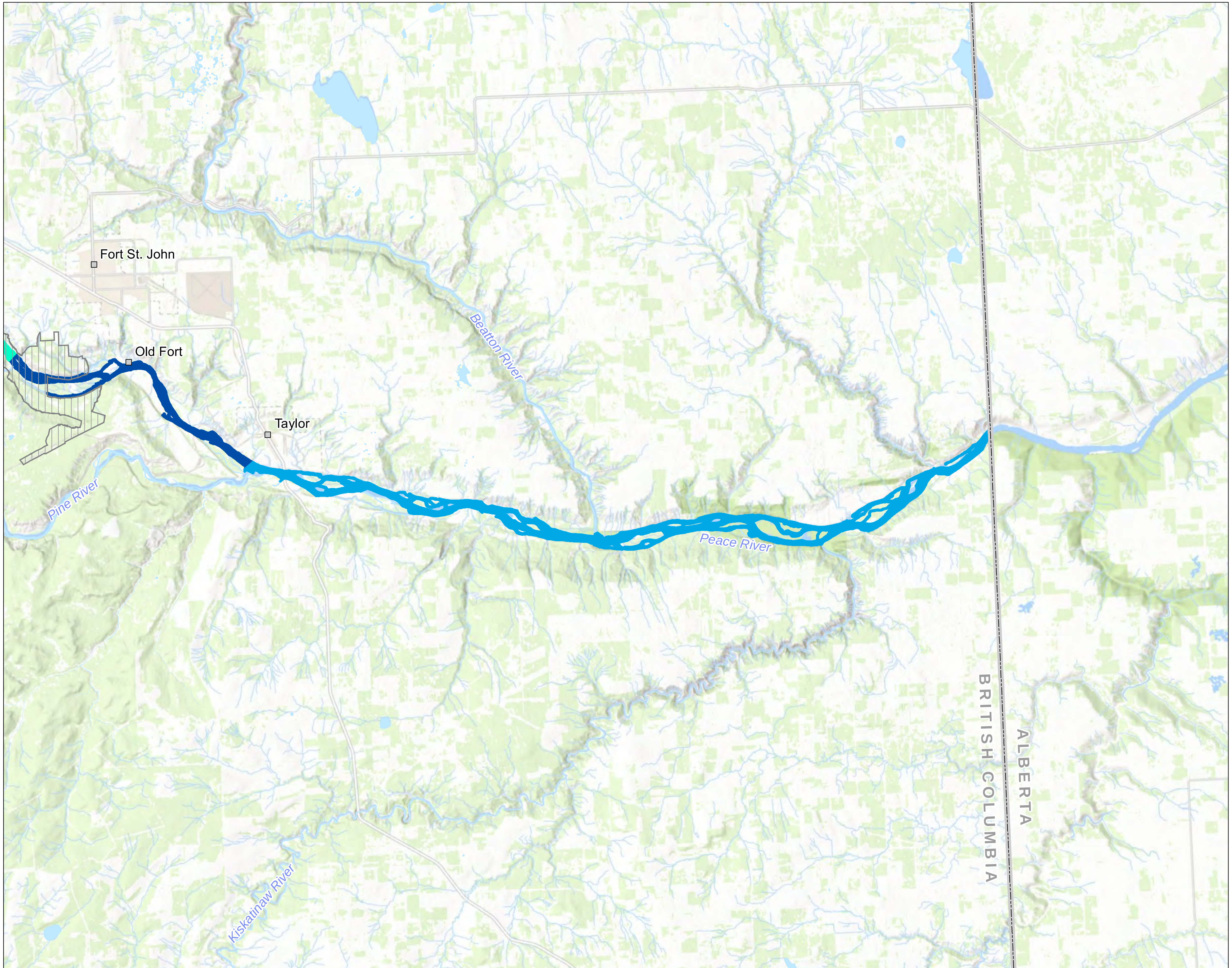
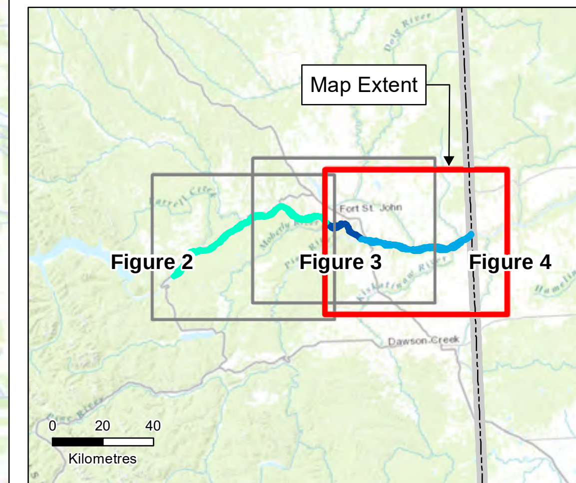
Migratory Waterbird Follow-up Monitoring Program
2023 Report
Site C, Peace River, BC

Figure 4 - Control Area on the Peace River





Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Proposed Dam Site
- Town
- Road
- Provincial Border
- Forested Area
- Waterbody / Watercourse

Notes

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2.1.2 Survey Methods

Boat surveys followed a modified version of the "Floating Rivers in Rafts or Kayaks" methods described in *Inventory Methods for Riverine Birds* (RIC 1998) and *Inventory Methods for Waterfowl and Allied Species* (RIC 1999) and provided visual coverage throughout most of the Peace River study area from Hudson's Hope to the Alberta border (**Figure 1**). Boat surveys provided clear lines of sight of open water habitat as well as shoreline, nearshore areas, exposed sandbanks, gravel bars, and mudbanks/flats along the mainstem of the river. Boat surveys also provided access to most side channels and many backchannels, depending on water levels.

Survey routes circled around islands and side channels and extended up backchannels wherever water levels allowed. Areas where water levels were too low for boat access, or where the entrance to backchannels or side channels was obstructed by debris, were not surveyed. Boat surveys were conducted at speeds of 30 to 40 km/h, except where shallow waters required faster speeds to prevent grounding the boat on the riverbed. Also, speeds were slowed for 1 to 2 minutes to improve the accuracy of species identification and abundance estimates when large or multiple flocks of waterbirds were observed. Surveys usually required 2 days to provide coverage of the complete length of river from Hudson's Hope to the Alberta border (i.e., 2 days per survey round). Surveys took place in daylight hours (h) between 07:00 and 18:00. During a typical survey round, upstream portions of the Peace River study area down to the Project dam site were surveyed during the first day and areas downstream of the dam site were surveyed the following day.

Surveys were conducted by biologists trained and experienced in waterbird identification and survey protocols. During boat surveys, 2 observers focused their respective survey efforts on opposite shores to the centre of the river and communicated bird movements to minimize the risk of double-counting birds. The observers scanned the river from the front of the boat using the naked eye to detect birds and used binoculars for species identification. Data were recorded on electronic data forms immediately following each observation using map-based software to provide georeferenced waterbird records. Only one observer entered data at any given time so at least one person was always surveying for waterbirds.

Surveys were not conducted during sustained inclement weather that could limit waterbird detection or identification. Weather was considered inclement under wave conditions associated with a Beaufort sea state greater than 3, as per provincial standards (RIC 1999). Sea states greater than 3 on the Beaufort scale are associated with whitecaps and waves higher than 1 m. Weather was also deemed inclement when rain or fog reduced visibility within 1 km.

Field crews recorded the following information during each survey day:

- Survey date
- Start and end time
- Proportion of backchannels surveyed by boat and visible with binoculars if not surveyed by boat
- Global positioning system (GPS) track of the survey transect line
- Weather conditions at the start of surveys and any notable changes in weather
- Survey crew (including a third observer if present).

Field crews recorded the following information for each waterbird observation:

- UTM coordinates
- Date and time (hour and minute)
- Species
- Number of individuals
- Habitat feature (gravel bar, open river, riverbank, terrestrial)
- Distance to disturbance (Distance of the survey vessel to waterbirds when disturbed: Not disturbed, less than [<] 50 m, 50 m to <100 m, 100 m to <200 m, 200 m to 400 m, greater than [>] 400 m).

Waterbirds were identified to the most specific taxonomic classification possible. When species identification was not possible, birds were identified by genus or foraging guild. Only those birds that could not be identified at any of these levels were classified as "unknown duck" or "unknown waterbird".

To account for incomplete detection of waterbirds (i.e., birds present during surveys but not detected and recorded), distance sampling data were collected during all surveys, and a 3rd observer was included during some surveys. Distance sampling using line transect methods (Buckland et al. 2015) was applied starting in the fall of 2018 (and continuing through 2023) by recording a track of each survey using a handheld GPS, from which distances are calculated between the transect and each georeferenced waterbird record. Using distance models (Buckland et al. 2015), these data can be used to adjust abundance and density estimates to account for incomplete detection based on the relationship between distance to birds from the path of the survey vessel (i.e., transect line) and the number of birds detected within various distance categories. Additionally, a subset of Peace River surveys has included a third observer to provide data that can be used to test assumptions of distance sampling (e.g., 100% detection along the transect line) and to specify the direction (i.e., positive versus negative) and magnitude of any resulting sampling biases.

2.2 Wetlands Surveys

Surveys of wetlands were designed and conducted to assess the abundance and diversity of waterbirds using wetland habitats along the transmission line ROW as per study objectives to document baseline conditions and to assess potential Project-related change from those conditions. The approach by which Project-related change will be assessed, as per Condition 11.4.3 of the FDS, is presented in **Section 2.2.1**. The specific methods applied during wetlands surveys are detailed in **Section 2.2.2**.

2.2.1 Approach to Evaluating Change

Survey methods were selected to provide habitat-specific estimates of waterbird density and species composition to document changes in waterbird abundance and diversity associated with the Site C transmission line and reservoir inundation, as per study objectives (**Section 1.2**). Absolute density estimates, derived from relative abundance and detection rates or distance sampling data to account for incomplete detection, can be multiplied by the area of affected habitat to estimate the abundance of birds within each foraging guild affected by habitat changes within the transmission line ROW. Relative abundance and species richness can also be compared over time (e.g., before versus after reservoir inundation) within wetland stations surveyed consistently across years to assess potential changes to wetland habitat use. Changes could result from the displacement of waterbirds from inundated river valley habitat into adjacent wetlands. The study provides data to compare densities and abundances of waterbirds for habitat types surveyed before relative to after reservoir inundation, using a before-after analysis framework to assess change. A BACI study design framework will not be applied to assess change in the wetlands study area as there is no clear distinction between wetlands on the Moberly Plateau that would be affected by reservoir filling versus not, as required to define impact and control areas.

2.2.2 Survey Methods

Wetland survey stations assessed during surveys in 2023 and prior years contained one or more focal habitat types. Each wetland habitat type within a station was surveyed separately such that multiple surveys were often conducted at a single station in a single survey day or survey round. To minimize detection constraints specific to each habitat type and maximize the amount of information obtained on waterbirds, 3 unique survey methods were applied across wetland habitat types:

- Fixed-length transects of vegetated habitat with water depths less than 50 cm, traversed on foot
- Stationary standwatch surveys of open water and flooded wetland habitat
- Bioacoustics monitoring using autonomous recording units (ARUs) of vegetated wetlands as well as transition zones between vegetated wetlands other habitat types (e.g., open water, forests).

2.2.2.1 Transect and Standwatch Surveys

Wetlands survey effort was standardized either by length (100 m transects) or time (20-minute standwatch surveys). Transect surveys were conducted in 2023 within sedge and willow-sedge habitats along the transmission line ROW. This method was considered appropriate given that vegetation obstructed lines of sight within these habitat types, thereby preventing bird detection through stationary survey methods. Vegetated habitat with water levels below 50 cm could be safely traversed on foot, which allowed close visual inspection of the surveyed area and increased detection by flushing birds hidden amongst vegetation. Stationary standwatch surveys were conducted in areas with open water habitat and flooded wetlands, including areas with open water interspersed with vegetation where visible open water comprised an area of at least 0.25 hectares. Standwatch surveys are the most appropriate method for these habitats because lines of sight from ground level, or from a slightly elevated perspective, provide efficient visual detection of waterbirds on the water's surface across large areas.

Where areas of contiguous open water were obscured from a single vantage point, the 20-minute standwatch survey was divided into two 10-minute segments at 2 vantage points, while observers were cautious to avoid double-counting birds. The same vantage points were used to survey open water wetland stations during each survey round. Transects could not always be completed in a consistent time due to differences in conditions between stations and seasons such as variable terrain, vegetation, and water depth. Transect surveys were targeted for completion within 5 to 10 minutes. Survey start and end times were recorded to enable future analyses to account for potential effects of survey time on waterbird detection rates. Wetland habitats at each station were surveyed once per survey round over a 2 to 4 days.

Crews of 2 field staff, each consisting of a biologist and a field assistant, completed wetlands surveys during daylight hours between 07:00 and 18:00. The biologists were experienced in visual and vocalization identification of waterbird species and were trained in survey protocols as well as wetland habitat characterization (i.e., identification of habitat types). Sedge and willow-sedge wetlands with water levels less than 50 cm were surveyed with one to 3 transects at each wetland station. Where multiple wetland types were present within wetland stations, transects were conducted within distinct habitat types to provide data specific to each type. Transects were generally straight but deviated to slightly curved or angled transects where necessary to stay within target habitat types and safe terrain. Transect surveys targeted vegetated wetlands with a minimum total width of 5 m of the target habitat type (e.g., sedge and/or willow-sedge habitat) and a minimum of 3 m of such habitat on either side of the transect line.

In accordance with provincial standards, surveys were not conducted under conditions that could compromise detection of waterbirds, impede foraging, or otherwise result in unique behaviours or habitat associations (e.g., sheltering from inclement weather). Surveys were not conducted during sustained inclement weather such as high winds (>5 on the Beaufort scale), moderate to heavy precipitation, or fog/smoke limiting vision within 1 km.

The following information was recorded at each wetland survey station:

- Wetland station ID
- Date and time
- Survey lead and field assistant names
- Weather data (temperature, cloud cover, wind, precipitation) recorded within the hour
- Extent (percent) of each habitat type within the wetland or survey station
- Estimated average water depth within sedge and willow-sedge habitat types in survey area.

The following information was recorded for each survey:

- Start and end time of survey
- Start and end UTM coordinates
- Survey method (transect, standwatch) and ID (transect 1, transect 2)
- Area of habitat surveyed (area of open water, width of contiguous habitat along transect)
- Extent (percent) of each habitat type present within the surveyed area
- Estimated water depth for each habitat type within the area surveyed
- Estimate of average vegetation height (measure of detection constraint)
- Extent (percent) of vegetation present within open water areas (for standwatch surveys)
- Extent (percent) of Area Surveyed with visible open water (for standwatch surveys).

The following information was recorded for each waterbird observation within habitats targeted during surveys:

- UTM coordinates
- Date and time (hour and minute)
- Species
- Number of individuals
- Habitat type in which the bird or flock was observed
- Estimated water depth (dry, >0 cm to 10 cm, 10 cm to 50 cm, >50 cm) where flock was observed
- Primary behaviour
- Detection type (e.g., detected while flushing, flying, not disturbed)
- Distance from the observer and transect (for transect surveys).

The methods of taxonomic classification and species identification applied for wetlands surveys were the same as described for surveys of the Peace River in **Section 2.1.2**. As detailed above, habitat data were collected at 3 scales (i.e., waterbird observation location, surveyed area, wetland station area) for each waterbird observation. This approach was taken to provide habitat association data for each waterbird record and to ensure that the size of wetland habitat patches and the habitat present within surrounding areas could be accounted for if either are found to affect the abundance or diversity of waterbirds.

Wetlands surveys were repeated during a subset of open water and flooded area surveys using standwatch methods to obtain a measure of waterbird detection rates, thereby, providing the means to account for incomplete detection. Transect surveys disturb waterbirds, causing them to flush and leave the area, thereby altering abundances. Consequently, repeated transect surveys are not informative of detection rates and were not carried out for this study. Instead, similar to Peace River boat surveys, distance sampling data was collected including distance of waterbirds observations from the observer and to the transect.

2.2.2.2 Bioacoustics Monitoring

Marsh bird species that can easily go undetected during standwatch and transect surveys (e.g., yellow rail [*Coturnicops noveboracensis*], American bittern [*Botaurus lentiginosus*]) were assessed with passive acoustic monitoring using ARUs (Song Meter 3 and Song Meter 4, Wildlife Acoustics Inc. Maynard, Massachusetts, USA). ARUs are particularly useful for detecting rail and bittern species as they have known call signatures but are rarely observed during time-constrained, daytime surveys due to scarcity on the landscape, cryptic appearance and behaviour, and limited diurnal activity. Furthermore, acoustic data from ARUs have been shown to provide greater detection rates for yellow rail compared to call playback methods (Bayne et al. 2014) and reduce safety hazards associated with accessing and working in remote areas at night.

ARUs are designed to record acoustic data (calls and songs of birds) at specified time intervals over a period of days, weeks, or months. ARUs were programmed to record acoustic data on an intensive, continuous schedule, from 30 minutes before dusk to 30 minutes after dawn, during May through July, when rails and American bittern vocalize most frequently (Conway 2011). ARU microphones were installed approximately 2 m above ground. Dusk and dawn recording times are recognized automatically by the internal GPS and clock of the ARU, which accurately detects the time zone where the ARU is recording. ARUs were deployed and recorded data for a minimum of 7 nights at each site. All ARUs were fitted with omnidirectional microphones (either built-in microphones on SM4 Wildlife Acoustics ARUs, or external SMM-A2 microphones on SM3 ARUs) recording at a sample rate of 16 kHz and gain of 0 decibels.

Bioacoustics monitoring for marsh birds in 2023 targeted habitat types in which rails have been recorded most often (sedge and mixed sedge/willow-sedge) at wetland stations not surveyed in previous years to provide more complete baseline data from the transmission line wetlands study area. Additionally, some stations where Virginia rail and yellow rail were detected in previous years during May and June were re-surveyed in 2023 during the latest survey round to further inform the extent to which these species can be detected in late July and August. The number of ARUs successfully deployed in 2023 are presented in **Section 4.2.1.2** along with deployment locations, habitat types, timing, and duration.

2.3 Habitat Assessment

Habitat types within the Peace River and wetlands study areas were summarized in 2017 from existing terrestrial ecosystem mapping (TEM) data using ArcGIS Desktop (v.10.5.1) software (Hemmera 2018). The TEM data were complimented with satellite imagery and observations from the field to refine wetlands and river habitat type classifications within study areas.

2.3.1 Peace River

Within the Peace River study area, waterbird habitat was classified into 4 types based on connectivity to the river and associated water flow rates and depths: Mainstem, Moderate Flow, Limited Connectivity, and Minimal Connectivity. Polygons of these habitat types were delineated across the study area using satellite imagery and water depth data collected during 2017 through 2021. Characteristics for each habitat type are detailed in **Table 1**. Habitat characteristics associated with flow rate and connectivity to the Peace River were considered relevant to waterbirds because they correspond with substrate type, the amount and type of aquatic vegetation available as a foraging resource for waterbirds (e.g., dabbling ducks, large dabblers), and the abundance and availability of other waterbird prey (e.g., fish and invertebrates). Additionally, water depth is known to influence waterbirds' habitat selection, with dabbling ducks selecting habitat along a depth gradient relevant to their morphology, and piscivorous and benthic-feeding divers typically preferring deeper water (Baschuk et al. 2012; Colwell and Taft 2000).

Table 1 Characteristics of River Habitat Types Used to Delineate Polygons along the Peace River

River Habitat Type	Characteristics
Minimal Connectivity	Minimal or no connectivity to the river (e.g., lentic water features) except during extreme high water or flooding events with minimal or no flow and silty or otherwise fine-grained substrates and mostly shallow, including ephemeral ponds. Both emergent and submergent aquatic vegetation proliferate in these habitats.
Limited Connectivity	Limited connectivity to the river (e.g., backchannels primarily connected to the river at the downstream end) with relatively low flow rate and volumes, fine substrates (e.g., silts and sands) and many shallow areas only inundated when river levels are high. Submergent aquatic vegetation occurs along the shoreline in these habitats.
Moderate Flow	Consistently connected to the river (e.g., side channels connected on up- and downstream ends) with relatively moderate flows, moderately sized substrates (e.g., sand, gravel) and shallow waters typically inundating most of the riverbed. Aquatic vegetation is sparse.
Mainstem	Main channel of the river where water flow rates, depths, and substrate size (e.g., gravel, cobble) are greatest. Permanently inundated with aquatic vegetation sparse or absent.

Portions of the river classified as Minimal Connectivity habitat were not accessible by boat and therefore were not surveyed in 2020 through 2023. Limited Connectivity habitat was also inaccessible by boat in a small proportion of areas (**Table 2**) and more broadly when river levels and associated flow rates were low. Despite these constraints on river boat survey methods, the power analysis conducted using data collected from 2017 through 2019 determined that surveys of areas accessible by boat would provide sufficient power to detect changes in waterbird abundance for all foraging guilds (**Appendix A**).

Table 2 Area of River Habitat Types Within the Peace River Study Area by Treatment Areas

Treatment Area	River Habitat Type Areas (km^2)				Total (km^2)	Boat Access (km^2)
	Minimal Connectivity (Boat Access)	Limited Connectivity (Boat Access)	Moderate Flow	Mainstem		
Control	0.93 (0.00)	1.14 (1.08)	4.23	16.47	**22.77**	**21.78**
Flow Impact	0.05 (0.00)	0.35 (0.35)	0.32	5.31	**6.03**	**5.98**
Inundation Impact	1.42 (0.00)	1.89 (1.83)	2.93	21.73	**27.98**	**26.48**
Total	**2.40 (0.00)**	**3.39 (3.25)**	**7.47**	**43.51**	**56.78**	**54.24**

Note: Minimal Connectivity habitat and some Limited Connectivity habitat were not accessible for boat surveys. The areas accessible by boat for these habitat types are provided in parentheses next to their total areas.

An example of the Mainstem river habitat type within the Peace River study area is presented in **Photo 1** and Moderate Flow and Limited Connectivity river habitat types in **Photo 2**.

Photo 1 Mainstem River Habitat Type

Photo 2 Moderate Flow (centre/right) and Limited Connectivity (left) River Habitat Types

The total length of river within the study area is 142.5 km; 78.1 km in the Inundation Impact area (**Figure 2**), 18.0 km in the Flow Impact area (**Figure 3**), and 46.5 km in the Control area (**Figure 4**). The total river area assessed in this study, including side channels and wetted backchannels, varies depending on water levels associated with discharge rates from the Peace Canyon dam and tributaries to the Peace River. The total mapped area of the Peace River study area defined with TEM data is 56.78 square kilometres (km^2), with 27.98 km^2 in the Inundation Impact area, 6.03 km^2 in the Flow Impact area, and 22.77 km^2 in the Control area (**Table 2**). These statistics represent wetted areas under typical water levels and include a small proportion (<5%) of the study area not typically accessible by boat (**Table 2**). The actual wetted area in each treatment area varies from day to day and across survey rounds in association with precipitation rates, snow melt, and the rate of water release from the Peace Canyon dam.

All 4 river habitat types described in **Table 1** are present within the Inundation Impact and Control treatment areas (**Table 2**), and all habitat types but Minimal Connectivity are present and accessible by boat within the Flow Impact area. Mainstem habitat comprises the vast majority (77%) of the area of the Peace River, followed by Moderate Flow habitat (13%). Minimal and Limited Connectivity habitat comprise 4% and 6% of the total study area, respectively.

Water flow and depth are known to influence the abundance, distribution, and species composition of waterbirds within wetland systems (Colwell and Taft 2000; Baschuk et al. 2012). These factors are particularly important to consider on the Peace River given the pronounced fluctuations in flow associated with hydroelectric dams and the presence of the Peace Canyon dam immediately upstream of the study area. Hourly flow data were obtained from monitoring stations within each treatment area (Inundation Impact, Flow Impact, Control) since flows in each of these areas are uniquely influenced by inputs from tributaries along the course of the Peace River.

2.3.2 Wetlands Surveys

The TEM data developed for the Peace River Terrestrial Ecosystem Mapping Project (Keystone 2012) were also used to identify 6 habitat types with potential to be used by waterbirds across the wetlands study area (**Table 3**). Wetlands surveys within Labrador-tea-sedge, tamarack-sedge and cultivated field ecosystem units were discontinued as of 2019 due to the limited number of waterbird detections (no more than one) in these habitats during 2017 and 2018 (**Table 3**). Consequently, wetlands waterbird surveys in subsequent years, including 2023, were focused on survey stations encompassing open water, sedge, and willow-sedge habitats.

Table 3 Wetland Habitat Types Adjacent to the Project Transmission Line ROW and Observed Waterbird Presence

Wetland Habitat Type	Characteristics	Multiple Waterbird Observations in 2017 and 2018?
Open water (OW)	Open water with no (or limited) emergent vegetation, including shallow open water (less than 2 m depth), as well as ponds, and lakes transitioning or connected to wetlands	Yes
Tamarack-sedge (TS)[1]	Fen with overstorey dominated by tamarack (*Larix laricina*)	No
Sedge (SE)	Uniform sedge (*Carex* sp.) flat low area with less than 10% willow – scrub birch (*Betula nana*). Typically wetted and often with standing water	Yes
Labrador-tea-sedge (BT) [1]	Peat bogs dominated by Labrador-tea (*Rhododendron groenlandicum*), often with black spruce (*Picea mariana)* overstory	No
Willow-sedge (WS)	Sedge (*Carex* sp.) meadow with scattered (>10%) willows – scrub birch. Often bordering sedge habitat in slightly elevated areas with less standing water than sedge habitat	Yes
Cultivated field (CF) [1]	Only considered if wetted and/or water source or wetland occurs within 100 m	No

Note: [1]Monitoring in TS, BT, and CF habitat types discontinued as of 2019

Wetland habitat areas has not changed appreciably since 2017, such that the proportional extent of habitat types is expected to have remained unchanged through 2023. According to the TEM data, the most widespread wetland habitat types in the study area are Labrador-tea-sedge and tamarack-sedge (**Table 4**, **Figure 5**). Sedge and open water are less widespread, and willow-sedge is the least common wetland habitat type. Habitat data were collected with waterbird observations as described above in **Sections 2.1** and **2.2** for each survey method.

Table 4 Area of Wetland Habitat Types in the Peace River Valley and Moberly Plateau Study Area

Wetland Habitat Type	Area (ha)
Labrador-tea-sedge	7,243
Tamarack-sedge	4,749
Cultivated field	3,845
Sedge	1,782
Open water	1,535
Willow-sedge	720
Non-forested floodplain wetlands	440

Note: Habitat areas presented here are derived from TEM data developed for the Peace River Terrestrial Ecosystem Mapping Project (Keystone 2012).

Photo 3, **Photo 4** and **Photo 5** show examples of standwatch and transect surveys and habitats surveyed by the respective methods. An example of a waterbird observation within open water habitat is provided in **Photo 6**. Examples of ARU deployments for bioacoustics monitoring of marsh birds are illustrated in **Photo 7** and **Photo 8**.

Photo 3 Wetland Standwatch Survey of Open Water Habitat Within Station OW-06

Photo 4 Transect Survey of Sedge-Dominated Wetland Within Station SE-04

Photo 5 Transect Survey of Willow-Sedge and Scrub Birch-Dominated Wetland Within Station WS-03.

Photo 6 Trumpeter Swan (*Cygnus buccinator*) Adults and Juveniles Using Open Water Wetland Habitat at Station OW-06

Photo 7 Example Deployment of an SM3 Autonomous Recording Unit with External Microphones within Wetland Habitats

Photo 8 Example Deployment of an SM4 Autonomous Recording Unit with Internal Microphones within Wetland Habitats

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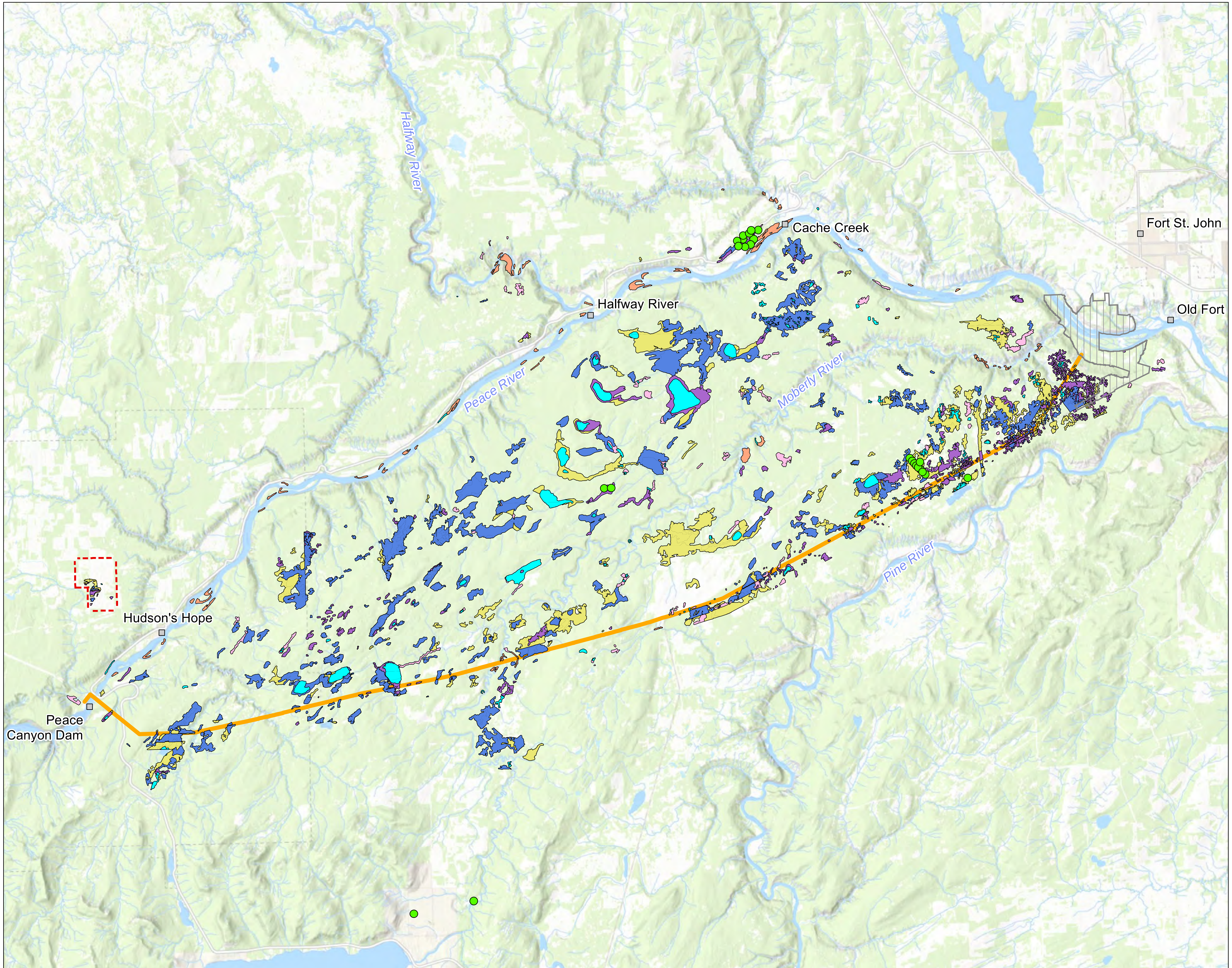
Figure 5 - Wetland Habitat Types and Historic Yellow Rail Detections in and Adjacent to the Peace River Valley and Transmission Line Route



Legend

- Historic YERA records (prior to 2017) from eBird and Baseline Studies
- Transmission Line Right-of-Way
- Marl Fen Property - BC Hydro Wetland Compensation Site
- Proposed Dam Site
- Town
- Road
- Waterbody / Watercourse
- Forested Area

Wetland Types

- Labrador-tea – sedge (BT)
- Non-forested floodplain wetland (WH)
- Sedge (SE)
- Open water (OW)
- Tamarack-sedge (TS)
- Willow sedge (WS)

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. OW has been used as the idientfier for Shallow Open Water wetland field locations; however, please note that the wetland classification also includes LA and PD habitat codes.

Sources

- Basemap: ESRI World Topographic Base

N

1:250,000

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Ausenco BC hydro

3.0 Data Management and Analysis

This section details the methods applied for data management (quality assurance, quality control and compilation) and for calculation of summary statistics for waterbird abundance and diversity. Data are summarized by survey period and habitat type for Peace River and wetlands study areas as well as by treatment area for the Peace River study area.

3.1 Data Management

Waterbird records from 2023 surveys were screened and vetted for accuracy. Any outlying records (e.g., high counts, rare species) were verified by confirming with field staff and, where possible, by reviewing hardcopy data forms, survey notes, and ARU recordings. Once these quality assurance measures were applied to identify anomalous species or counts, data from the current year were appended to a relational database management system (Microsoft Access) holding data from previous survey years.

Hourly flow data from 2023 obtained from gauges at monitoring stations within each treatment area (Inundation Impact, Flow Impact, Control) were compiled into a relational database (Microsoft Access) and appended to data from prior years. Hours for which data were not available were interpolated from surrounding hours or provided from secondary monitoring stations within the same treatment area, where observed flows were similar to the primary monitoring stations.

3.2 Data Analysis

As in previous years, the scope of this annual report is limited to descriptive statistics (e.g., ranges, means, and variability around means). These statistics are presented to demonstrate that survey methods are capturing the targeted foraging guilds across all study areas and treatment areas within relevant time periods and habitat types, as required to meet the study objectives. Metrics of waterbird diversity and relative abundance are reported for each foraging guild within study areas, treatment areas, seasons, survey periods, and habitat types. A full list of species observed and the guilds to which they are assigned is presented in **Appendix B-1**.

Measures of abundances in this report are presented in terms of relative abundance because they represent the number of waterbirds detected, rather than absolute abundances. Distance and repeated survey data were collected (as described in **Sections 2.1.2** and **2.2.2.1**) to provide measures of detectability and allow for estimates of absolute abundance in future analyses to assess Project-related change following data collection from the operations phase.

Throughout the remainder of this report, the terms abundance and density refer to relative abundance and relative density, as summary statistics are not yet corrected for detection rate via distance sampling or other means. Relative abundance is an index of abundance that can reveal changes over time (e.g., between baseline conditions and Project operations conditions). While relative abundance does not necessarily reflect the true and exact number of individuals, generally referred to as absolute abundance, it is a standard measure recognized as appropriate in British Columbia (BC) for monitoring studies assessing change (RIC 1998). Measures of relative abundance are reported in terms of density per unit of survey area or transect length except in cases where abundances are reported for an entire study area (e.g., the Peace River study area), in which case the relevant area is specified within the results (see **Section 4.1.2**).

Waterbird diversity is presented for each survey period, with averages calculated as means across years, in terms of species richness (i.e., the number of species) and species evenness (i.e., the degree of similarity in abundance of each species) using Pielou's evenness index. A full list of the species observed was developed including the cumulative total of each species recorded across all study years and during 2023 monitoring. The equation for calculating Pielou's evenness index is reported by MacDonald et al. (2017):

$$Species\ evenness = \frac{(-\sum_{i=1}^{s}(p_i \times \ln p_i))}{(\ln S)}$$

Where *S* is the number of species detected (species richness), p_i is the proportion of all detected waterbirds represented by species *i,* and *ln* is the natural logarithm. MacDonald et al. (2017) generally recommend against using indices that combine measures of species richness and evenness (e.g., Shannon-Wiener index) for measuring changes in biodiversity because of the subjective nature of weighting diversity by evenness and outputs (indices) that are difficult to meaningfully interpret.

3.2.1 Peace River Surveys

Waterbird data from Peace River surveys were summarized to provide mean measures of abundance and diversity across survey periods and seasons, and mean measures of density and abundance by habitat type and treatment area for each foraging guild. To calculate mean abundance and diversity measures for each survey period, density estimates were averaged first across survey rounds within survey periods of each year, then averaged across years. To compare the number of waterbirds observed across habitat types and treatment areas, density measures were calculated in addition to abundances to provide a measure that accounts for the variable size of habitat types and treatment areas. To account for variable survey timing across years (some survey periods were not surveyed in all years), mean measures of density and abundance for each habitat type and treatment area were calculated for each survey period in each year, then averaged across periods to provide mean statistics for each season in each year, then across years to, ultimately, provide average measures for each survey period within seasons.

Survey data were initially summarized in terms of the number of birds/ha within polygons of distinct habitat types in each study area to calculate habitat-specific measures of abundance and density. Each waterbird detection was assigned to the habitat polygon in which the bird was recorded in or closest to (i.e., birds within the polygon, on the shoreline, or within 100 m of the polygon). Cumulative counts from all combinations of habitat type and treatment area (**Table 1**) were divided by the area that was surveyed during each survey round. Abundance data were summarized for each treatment area and habitat type by multiplying density estimates (birds/km^2) by the total area within each treatment area and by the total area of each river habitat type within the study area as a whole for each survey round.

Determining densities based on assigning waterbird records to habitat polygons is a method that has been applied to other monitoring studies of wetlands and riverine systems in BC (Gill and Craig 2020). This method provides improved resolution for density determinations compared to estimates based on river length (e.g., birds/km), as it allows for separate estimates of density in unique habitats that occur within each of the treatment areas. The use of density by area estimates is aligned with the statistical power analyses conducted in 2020 which informed the level and timing of survey effort for 2021 and subsequent years of monitoring. For these 2020 power analyses, measures of survey effort used to generate estimates of statistical power were adjusted based on the area covered during each survey round (**Appendix A**).

To provide comparable measures of diversity based on equivalent survey effort across surveys rounds, diversity statistics were derived from data collected in areas that were surveyed consistently in all completed survey rounds. Consequently, diversity estimates were derived from survey data collected from

Mainstem and Moderate Flow habitat types, as these areas were accessible by boat during both low and high river flow conditions. Those habitat types comprise the vast majority (approximately 90%) of the Peace River study area (**Table 2**). While some species that forage predominantly in shallow and low-flow habitats may be missed by these summaries of diversity, subsequent analyses of Project-related effects can apply more sophisticated analytical methods (e.g., species rarefaction / accumulation curves) to account for variable survey effort.

Data from surveys that did not cover the entire study area due to logistical constraints or inappropriate survey conditions were excluded from calculations of abundance and diversity. However, these data will be maintained within the monitoring program database and can be incorporated into more sophisticated analyses of Project-related effects in future years. Such analyses were considered beyond the scope of annual baseline monitoring reporting.

3.2.2 Wetlands Surveys

Data from surveys conducted annually from 2017 through 2023 were summarized to provide estimates of average (mean) density and diversity for both standwatch and vegetated transect surveys. For transect surveys, the number of birds of each foraging guild observed in sedge and willow-sedge habitat was determined for each 100 m transect survey conducted. The mean number of birds observed per transect was calculated and extrapolated to an estimate of density per kilometre of transect by multiplying survey results by a factor of 10 (i.e., 10 x 100 m = 1 km). Data collected from standwatch surveys were used to provide estimates of density at stations with open water, and an average estimate of density was calculated across all these stations for each foraging guild based on the area of open water (i.e., total number of birds observed divided by total area surveyed). Diversity statistics from wetlands surveys were summarized to provide estimates of mean diversity for each survey period, averaged across survey periods within years and then across years. Cumulative species richness for each foraging guild was also calculated for habitats surveyed by both standwatch and transect methods and the proportion of species within each foraging guild was determined.

Waterbirds recorded outside of target habitats (e.g., in open water during vegetated transect surveys, waterbirds flying over the transect or survey area) were recorded as incidental observations and are not included in summary statistics. Likewise, data obtained from repeat surveys has been recorded for assessment of detection rates to be used in future analyses but is not included in summary statistics of abundance or diversity in this report.

Acoustic data were downloaded and analyzed using a cluster analysis method in Kaleidoscope Pro V.5.1.9 (Wildlife Acoustics, Inc.), followed by manual verification. Cluster analysis groups bird songs with similar parameters such as minimum and maximum frequency range of the song, duration of the song and inter-syllable gap. Reference songs of sora, yellow rail, and American bittern were obtained from the Cornell Laboratory of Ornithology (Macauley Library), and Xeno-canto (www.xeno-canto.org) and characteristics for several songs from each of these species were matched to the groups of songs from the cluster analysis. Recorded songs suspected to be of sora, yellow rail or American bittern were aurally verified and checked against the reference calls from the Macaulay Library. Although the Peace Region is outside of the recognized range of Virginia rail (*Rallus limicola*) (Conway 2021), an incidental observation of this species at Watson Slough in 2019 prompted a review of recent species records in the region, which revealed multiple records in 2019 and 2020 (eBird 2022). Consequently, bioacoustics data recorded from ARU deployments in 2020 and subsequent years, including 2023, were also analyzed to identify vocalizations of Virginia rail, also using the methods described above.

The number of nights that ARUs were deployed was recorded at each site and the results of acoustic data analyses were assessed as ‘present’ or ‘not detected’ for American bittern, sora, Virginia rail, and yellow rail for each deployment. Bioacoustics data cannot easily distinguish between individual birds to provide estimates of density at ARU monitoring sites. However, estimates of density for sora are provided from standwatch and transect surveys and all audio data has been archived for more detailed analyses if they are later deemed necessary.

3.2.3 Habitat Assessment

Peace River hourly flow data were summarized using SigmaPlot (v.12.5) to illustrate the frequency of flow rates within each treatment area. To determine if surveys were conducted under representative flow conditions, frequency distributions of hourly river flow rates throughout the spring and fall of 2017 through 2023 were compared to frequency distributions from hours during which surveys were conducted in those years. Following subsequent years of data collection, flow rate data can also be used as a habitat variable in models describing waterbird distribution within the Inundation Impact area prior to inundation and within the Flow Impact and Control areas before and after inundation. After inundation, reservoir water level changes within the Inundation Impact area are expected to be minimal, with the exception of short duration changes due to relatively rare, extreme events.

4.0 Results

Results for the monitoring program from 2017 through 2023 provide an overview of habitat data as well as estimates of waterbird relative abundance and diversity metrics within habitat types, seasons, and, where possible, survey periods. Results are summarized together for all years of monitoring and are also presented separately for 2023 surveys.

4.1 Peace River Surveys

This section describes the results of the Peace River component of the monitoring program including the temporal and spatial scope of completed surveys relative to survey objectives (**Sections 4.1.1** and **4.1.2**).

4.1.1 Survey Effort and Timing

In 2017, 2018, and 2019 the Peace River study area was surveyed during 5 survey rounds in the spring and 6 survey rounds in the fall (**Table 5**). Survey effort and timing in subsequent years was adjusted in accordance with a power analysis of the first 3 years of data (**Appendix A**), resulting in 2 surveys in early spring and 3 surveys in fall (**Table 5**). In 2023, boat-based surveys were conducted on the Peace River during spring (April 2 to April 13, 2023) and fall (August 9 to September 30, 2023) waterbird migrations. During the first 7 years of the monitoring program, 55 surveys of the full length of the Peace River study area were attempted and 51 surveys were completed (**Table 5**).

Table 5 Peace River Survey Timing During 2017 Through 2023 Annual Waterbird Migration Monitoring

Survey Period (Dates)	2017 Survey Dates	2018 Survey Dates	2019 Survey Dates	2020 Survey Dates	2021 Survey Dates	2022 Survey Dates	2023 Survey Dates
Spring							
Early (Apr 1 to Apr 14)	Apr 5, 6 Apr 12[2]	Apr 13, 14	Apr 3, 4, 8[1] Apr 11, 12	Apr 7, 8 Apr 13, 14	Apr 6, 7 Apr 12, 13	Apr 5, 6 Apr 11, 12	Apr 2, 3, Apr 12, 13
Middle (Apr 15 to May 6)	Apr 26, 27 May 3, 4	Apr 25, 26, May 1[1] May 5, 6	Apr 19, 24[2] May 1, 2	Apr 23, 24[2]	No surveys	No surveys	No surveys
Late (May 7 to May 30)	May 10, 11 May 14, 15	May 10, 11 May 18, 19	May 9, 10	No surveys	No surveys	No surveys	No surveys
Fall							
Early (Aug 1 to Aug 14)	Aug 8, 9 Aug 14, 15	Aug 4, 5	Aug 7, 9	Aug 5, 6	Aug 9, 10	Aug 8, 9	Aug 9, 10
Early-Middle (Aug 15 to Sep 14)	Aug 22, 23 Aug 28, 29	Aug 20, 21 Sep 4, 5	Aug 19, 20 Sept 4, 5[2]	Aug 31, Sep 1	Aug 27, 28	Aug 29, 30	Sep 6, 7
Late-Middle (Sep 15 to Oct 14)	Sep 21, 22 Sep 27, 28	Sep 20, 21 Oct 4, 5	Sep 16, 17 Sep 30, Oct 1	Sep 29, 30	Sep 27, 28	Oct 5, 6	Sep 29, 30
Late (Oct 15 to Oct 30)	No surveys	Oct 15, 16	Oct 16, 17	No surveys	No surveys	No surveys	No surveys

Note: When multiple survey rounds were completed within a survey period, survey dates from each round are presented on separate lines. [1]Typically, 2 days were required to complete surveys; however, due to inclement weather (e.g., heavy rain, snow, high winds), unsafe river conditions (e.g., release of ice-break up from tributaries into the Peace River), or logistical constraints (e.g., mechanical issues with boat) a third day for surveys was occasionally required. [2]In other cases, survey conditions and logistical constraints did not allow for complete coverage of the study area within a week and resulted in an incomplete survey.

Incomplete surveys and surveys requiring a third day were typically the result of poor survey conditions or mechanical issues with the boat. Due to rain and wind speeds that exceeded survey standards (**Section 2.1.2**), the Control area was not surveyed during the second survey round of the early spring period in 2017. The first survey of middle spring 2018 and early spring 2019 were not completed within the usual 2 days because ice from the Pine River entered the Peace River and a third survey day was required to complete these survey rounds. In 2019, the first round of middle spring surveys was not completed due to mechanical issues with the river boat and a lack of alternative options within the survey window (**Table 5**). Finally, a survey round in the middle period of spring 2020 (conducted prior to finalization of the power analysis) was cut short at the confluence with the Beatton River due to release of an ice break-up preventing access to areas of the Peace River downstream of that tributary. All survey rounds in 2023 were completed successfully within 2 days each.

4.1.2 Habitat Assessment

Locations with active hydrological monitoring gauges from which water flow data were obtained were as follows:

- Inundation Impact area - Hudson's Hope (2017, 2018)[1] and Peace Canyon Dam (2019 to 2023)
- Flow Impact area - Old Fort (all years)
- Control area – Taylor (all years).

The hydrological gauges are located within or adjacent to the towns they are named after in **Figure 1**. Water flow data from these monitoring stations during the spring and fall migrations of 2017 through 2023 are summarized across years, seasons, and treatment areas in **Table 6**. Frequency distributions of the flow regime throughout the spring and fall migration within each treatment area relative to flows during surveys are presented in **Figure 6**.

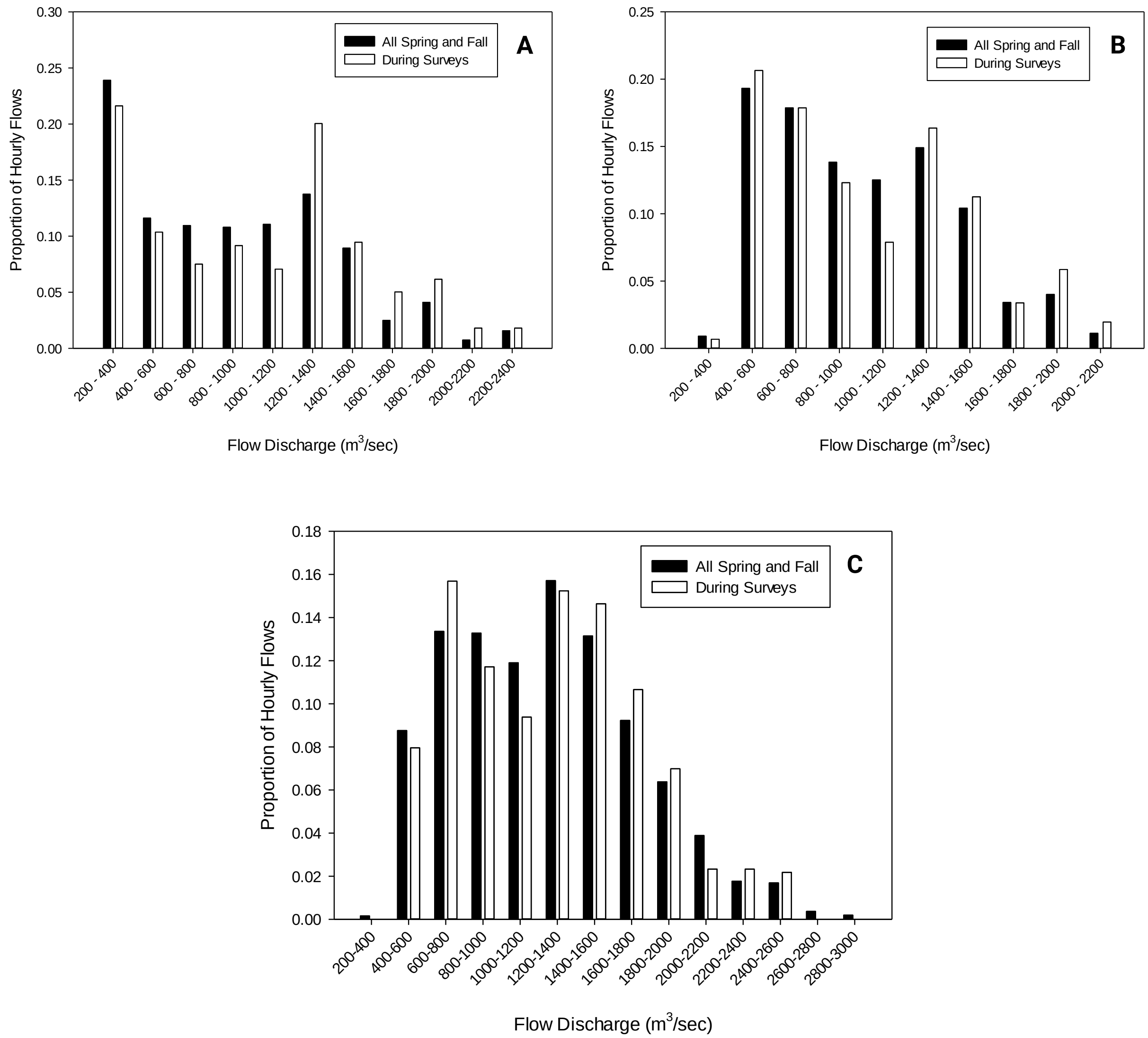
Mean flow rates during waterbird surveys varied substantially across years and seasons, ranging from a low of 602 m^3/sec during the spring of 2019 to a high of 1,956 m^3/sec during spring 2021 (**Table 6**). Frequency distribution plots of flow rate data illustrated in **Figure 6** provide evidence that, across the 7 survey years, flow rates were similarly distributed and, thus, representative of flow rates throughout the spring and fall migration periods in all treatment areas. Similar figures are presented in **Appendix F** for 2023 flow rates during surveys relative to throughout spring and fall migration.

1 The Hudson's Hope gauge was discontinued in 2019 to facilitate the placement of rip-rap for Site C reservoir shoreline erosion protection. Thus, in 2019 and subsequent years, flow data for the Inundation Impact area were collected from a gauge immediately downstream of the Peace Canyon Dam.

Table 6 Mean Hourly Water Flow Rates on the Peace River During Waterbird Surveys Across Years, Seasons, and Treatment Areas in 2017 Through 2023

Season	Year	Water Flow (m^3/sec) within Treatment Areas			
		Inundation Impact	Flow Impact	Control	Mean
Spring	2017	650	909	1,412	**991**
	2018	594	862	1,626	**1,027**
	2019	520	559	725	**602**
	2020	1,383	1,364	1,492	**1,413**
	2021	1,943	1,953	1,972	**1,956**
	2022	1,375	1,418	1,452	**1,415**
	2023	1,558	1,474	1,523	**1,518**
Fall	2017	1,409	1,363	1,445	**1,406**
	2018	1,086	1,129	1,232	**1,149**
	2019	847	787	982	**872**
	2020	1,565	1,687	1,869	**1,707**
	2021	711	693	806	**737**
	2022	1,348	1,187	1,262	**1,266**
	2023	658	652	718	**676**

Note: Flow discharge rate data for the Inundation Area were collected from Hudson's Hope in 2017 and 2018 and from Peace Canyon Dam in subsequent years. Data for the Flow Impact and Control areas were collected from Old Fort and Taylor (downstream of the Pine River confluence), respectively (see **Figure 1**). Data include hourly flow rates during the day (0700 to 1800 hours) on dates when Peace River waterbird surveys were conducted (see **Table 5**).



Note: Hourly flows shown as the distribution of the proportion of total hours 'During Surveys' (white bars) and for 'All Spring and Fall' (black bars). 'All Spring and Fall' data include all 24 hours throughout April, May, August, September, and October. Hours 'During surveys' include 0700 through 1800 of survey days.

Figure 6 Hourly Flow Rates in the Inundation Impact (A), Flow Impact (B), and Control (C) Areas During Surveys Relative to During All Spring and Fall Migrations of 2017 through 2023

4.1.3 Abundance and Density

As in previous years, waterbirds were observed along the entirety of the Peace River study area in spring and fall of 2023 (see waterbird location figures in **Appendix C: Figures C-1 to C-4**). A complete list of the species and numbers of waterbirds observed during Peace River surveys in 2023 and across all monitoring years is presented within **Appendix B**. In total, 109,359 waterbirds were observed and recorded during Peace River boat surveys in 2017 through 2023, of which 94% were identified to species (**Appendix B-1**). In 2023, a total of 15,408 waterbirds were observed during Peace River boat surveys, of which 94% were identified to species (**Appendix B-2**).

The highest mean waterbird abundances during spring were observed in the early survey period and during fall were found in the early-middle survey period (**Table 7**). Large dabblers, primarily Canada goose (*Branta canadensis*) (**Appendix B-1**), were the most abundant waterbirds observed overall, with the highest abundances observed during the early spring (more than 3 times as many birds than observed during other survey periods). Dabbling ducks and gulls were the next most abundant guilds observed during surveys (**Table 7**). Note that means presented in **Table 7** from early spring and early through late-middle fall survey periods incorporate data collected across all survey years (2017-2023). Estimates of interannual variability are presented in **Appendix E** (**Table E-7**). Means from middle and late spring as well as late fall are calculated from data collected in 2017 through 2019 and are presented in **Appendix E** (**Table E-7**). Surveys were not continued during the later survey periods of each season after 2019 as per guidance from Native Plant Solutions, informed by power analyses (**Appendix A**). Estimates of foraging guild abundances specific to survey periods in 2023 are presented in **Table 8.**

Table 7 Mean Relative Abundance Estimates (Birds/Survey Round) of Waterbird Foraging Guilds within the Peace River, Spring and Fall of 2017 Through 2023

Foraging Guild	Spring Survey Period	Fall Survey Periods		
	Early	Early	Early- Middle	Late- Middle
Benthic-feeding Divers	156	3	17	26
Dabbling Ducks	1,049	105	275	309
Gulls	2	648	594	237
Large Dabblers	3,025	271	657	873
Piscivorous Divers	296	36	35	20
Shorebirds	2	212[1]	102	3
Unknown Waterbirds	65	14	13	21
Total (All Waterbirds)	**4,594**	**1,274**	**1,693**	**1,489**

Note: Mean abundances reflect relative rather than absolute abundances as they do not account for incomplete detection. Abundances within each survey round were calculated by extrapolating density estimates observed within each habitat across the entire study area to account for the areas not accessible by boat, which varied across survey rounds depending on water levels and boat access. Mean abundances were then calculated within each habitat type across survey rounds first within periods of each year, and then averaged across years. [1]Data collected for shorebirds in the early fall survey period in 2023 was incomplete and is excluded from mean abundance estimates across years.

Table 8 Mean Abundance Estimates (Birds/Survey Round) of Waterbird Foraging Guilds within the Peace River, Spring and Fall of 2023

Foraging Guild	Spring Survey Period	Fall Survey Periods		
	Early	Early	Early- Middle	Late- Middle
Benthic-feeding Divers	130	1	11	42
Dabbling Ducks	417	175	117	628
Gulls	0	354	187	69
Large Dabblers	4,251	352	1,176	1,904
Piscivorous Divers	338	22	30	26
Shorebirds	0	-[1]	22	2
Unknown Waterbirds	5	3	50	35
Total (All Waterbirds)	**5,141**	**1,016**	**1,593**	**2,707**

Note: Mean abundances reflect relative rather than absolute abundances as they do not account for incomplete detection. Abundances within each survey round were calculated by extrapolating density estimates observed within each habitat across the entire study area to account for the areas not accessible by boat, which varied across survey rounds depending on water levels and boat access. Mean abundances were then calculated within each habitat type across survey rounds first within periods of each year, and then averaged across years. [1]Data collected for shorebirds in early fall was not collected within the inundation area and is, thus, considered incomplete for this survey period.

Totals of mean densities of waterbird foraging guilds determined for 2017 through 2023 varied across river habitat types, primarily reflecting the distribution of the most abundant guilds (i.e., large dabblers and dabbling ducks in spring [**Table 9**], dabbling ducks, gulls, and large dabblers in fall [**Table 11**]). The highest mean densities of waterbirds observed across seasons and habitat types were in the spring within Limited Connectivity habitat. During spring, mean densities summed across foraging guilds were almost 10 times higher within Limited Connectivity habitat than in Mainstem habitat and just over 3 times higher within Limited Connectivity habitat than in Moderate Flow habitat (**Table 9**, **Figure 7**, **Figure 8**, **Figure 9**).

Mean densities observed during spring were greater in the Flow Impact treatment area compared to other treatment areas (**Table 9**). During fall, total waterbird densities observed across survey years were again greatest within Limited Connectivity habitat (**Table 11**). Mean densities observed during fall were higher in the Flow Impact area compared to other treatment areas (**Table 11**, **Figure 10**, **Figure 11**, **Figure 12**). Survey results specific to 2023 are presented in **Table 10** for spring surveys and **Table 12** for fall surveys. Variability statistics across years are provided for spring and fall in **Appendix E** in **Table E-9** and **E-11**, respectively.

Table 9 Mean 2017 Through 2023 Spring Densities (Birds/km^2/Survey Round) and Estimated Abundances of Migrant Waterbirds by River Habitat Type and Treatment Area

Foraging Guild	Density by River Habitat Type			Density by Treatment Area		
	Limited Connectivity	Moderate Flow	Mainstem	Inundation Impact	Flow Impact	Control
Benthic-feeding Divers	14.9	2.4	1.3	2.4	5.1	1.5
Dabbling Ducks	85.0	24.7	7.6	8.0	30.0	18.3
Gulls	0.0	<0.1	0.4	0.2	1.2	<0.1
Large Dabblers	200.8	62.2	22.5	40.1	32.8	38.4
Piscivorous Divers	15.8	7.0	2.6	6.4	2.3	1.5
Shorebirds	3.9	0.6	0.1	0.4	0.4	0.5
Unknown Waterbirds	4.5	1.5	0.7	1.3	0.7	0.9
Total (All Waterbirds)	**324.9**	**98.5**	**35.1**	**58.8**	**72.6**	**61.1**
Estimated Abundance	**1,057**	**736**	**1,528**	**1,556**	**434**	**1,331**

Note: Mean densities reflect relative rather than absolute densities as they do not account for incomplete detection. Means were calculated by averaging density estimates (birds/km^2/survey) within each habitat type across survey rounds first within periods of each year, then across periods for each season of each year, and then across years so that differences in sampling effort did not bias means towards results from years with more survey rounds or years with more survey periods. Total mean density is the sum of all foraging guild and unknown waterbird densities. Abundances calculated as density multiplied by area.

Table 10 Mean 2023 Spring Densities (Birds/km^2/Survey Round) and Estimated Abundances of Migrant Waterbirds by River Habitat Type and Treatment Area

Foraging Guild	Density by River Habitat Type			Density by Treatment Area		
	Limited Connectivity	Moderate Flow	Mainstem	Inundation Impact	Flow Impact	Control
Benthic-feeding Divers	12.5	1.5	1.8	2.3	4.1	2.0
Dabbling Ducks	48.6	14.7	3.4	6.8	8.5	8.6
Gulls	0.0	0.0	0.0	0.0	0.0	0.0
Large Dabblers	325.8	159.3	46.0	76.6	63.8	84.5
Piscivorous Divers	24.8	11.6	3.9	10.1	2.8	2.4
Shorebirds	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Waterbirds	0.2	0.0	<0.1	0.2	<0.1	0.0
Total (All Waterbirds)	**411.9**	**187.1**	**55.2**	**96.0**	**79.3**	**97.5**
Estimated Abundance	**1,340**	**1,398**	**2,402**	**2,542**	**474**	**2,124**

Note: Mean densities reflect relative rather than absolute densities as they do not account for incomplete detection. Means were calculated by averaging density estimates (birds/km^2/survey) within each habitat type across survey rounds first within periods of each year, then across periods for each season of each year, and then across years so that differences in sampling effort did not bias means towards results from years with more survey rounds or years with more survey periods. Total mean density is the sum of all foraging guild and unknown waterbird densities. Abundances calculated as density multiplied by area.

Table 11 Mean 2017 Through 2023 Fall Densities (birds/km²/survey round) of Migrant Waterbirds by River Habitat Type and Treatment Area

Foraging Guild	Density by River Habitat Type			Density by Treatment Area		
	Limited Connectivity	Moderate Flow	Mainstem	Inundation Impact	Flow Impact	Control
Benthic-feeding Divers	0.4	<0.1	0.2	0.3	0.2	0.1
Dabbling Ducks	31.5	5.7	1.1	5.2	7.1	0.7
Gulls	2.2	1.0	9.1	6.5	38.9	0.3
Large Dabblers	54.1	9.7	6.5	11.5	11.0	7.3
Piscivorous Divers	1.9	0.6	0.3	0.6	0.3	0.3
Shorebirds	6.7	3.0	0.8	1.5[1]	0.7	1.9
Unknown Waterbirds	2.7	0.4	0.1	0.4	0.4	0.1
Total (All Waterbirds)	**99.6**	**20.4**	**18.1**	**25.8**	**58.7**	**10.6**
Estimated Abundance	**324**	**152**	**788**	**684**	**351**	**230**

Note: Mean densities reflect relative rather than absolute densities as they do not account for incomplete detection. Means were calculated by averaging density estimates (birds/km²/survey) within each habitat type across survey rounds first within periods of each year, then across periods for each season of each year, and then across years so that differences in sampling effort did not bias means towards results from years with more survey rounds or years with more survey periods. Total mean density is the sum of all foraging guilds and unknown waterbird densities. Abundances calculated as density multiplied by area. [1]The shorebird density average for the inundation impact area excludes data from 2023 due to missing data from the early fall of that year, specifically in this treatment area.

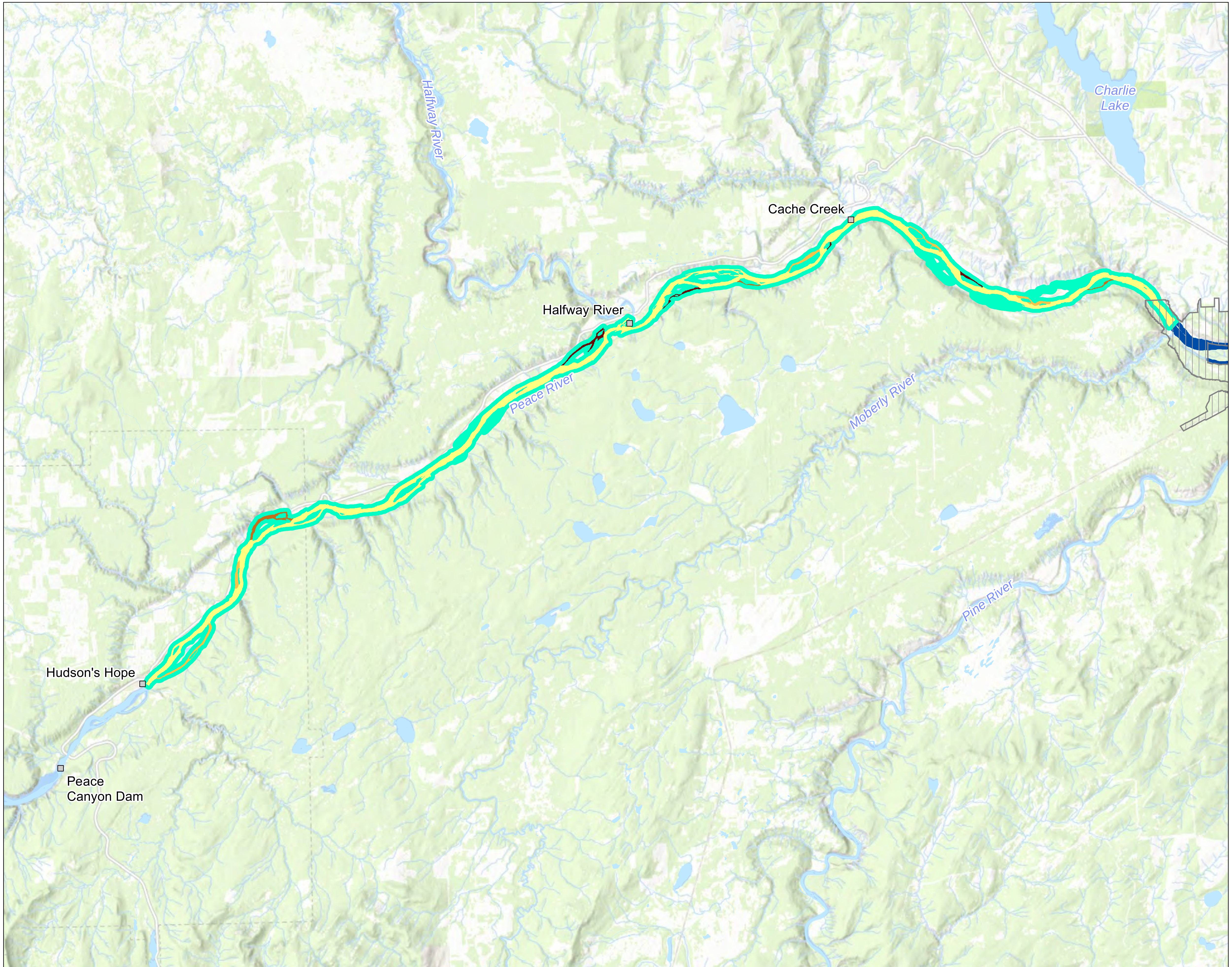
Table 12 Mean 2023 Fall Densities (birds/km²/survey round) of Migrant Waterbirds by River Habitat Type and Treatment Area

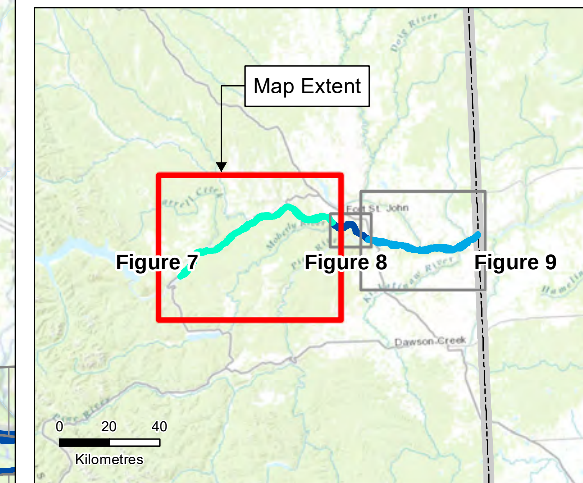
Foraging Guild	**Density by River Habitat Type**			**Density by Treatment Area**		
	Limited Connectivity	**Moderate Flow**	**Mainstem**	**Inundation Impact**	**Flow Impact**	**Control**
Benthic-feeding Divers	0.7	<0.1	0.4	0.3	0.0	0.5
Dabbling Ducks	48.5	4.6	2.6	9.3	5.8	1.1
Gulls	1.0	3.0	4.1	4.3	13.5	0.4
Large Dabblers	96.6	18.3	15.9	38.0	13.4	2.7
Piscivorous Divers	0.7	0.2	0.5	0.8	0.5	<0.1
Shorebirds	1.8	2.3	0.5	0.5[1]	0.7	1.4
Unknown Waterbirds	4.1	1.9	<0.1	1.0	0.0	0.1
Total (All Waterbirds)	**153.4**	**30.3**	**24.0**	**54.1**	**34.0**	**6.3**
Estimated Abundance	**499**	**227**	**1,046**	**1,432**	**203**	**137**

Note: Mean densities reflect relative rather than absolute densities as they do not account for incomplete detection. Means were calculated by averaging density estimates (birds/km²/survey) within each habitat type across survey rounds first within periods of each year, then across periods for each season of each year, and then across years so that differences in sampling effort did not bias means towards results from years with more survey rounds or years with more survey periods. Total mean density is the sum of all foraging guilds and unknown waterbird densities. Abundances calculated as density multiplied by area. Shorebird densities exclude data from the inundation impact area during early fall.

Migratory Waterbird Follow-up Monitoring Program
2023 Report
Site C, Peace River, BC

Figure 7 - Mean Density of Spring Migrant Waterbirds within Inundation Impact Area Habitat Polygons from 2017 through 2023





Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Proposed Dam Site
- Town
- Road
- Forested Area
- Waterbody / Watercourse

Waterbird densities (birds/km²/survey round) by quartile [3]

- 6 - 81
- 82 - 166
- 167 - 357
- 358 - 1325

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. Quantile breaks based on a dataset of densities within all polygons of distinct river habitat types during spring.

Sources

- Basemap: ESRI World Topographic Base

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107578-04	Production Date: Dec 8, 2023	Figure 7

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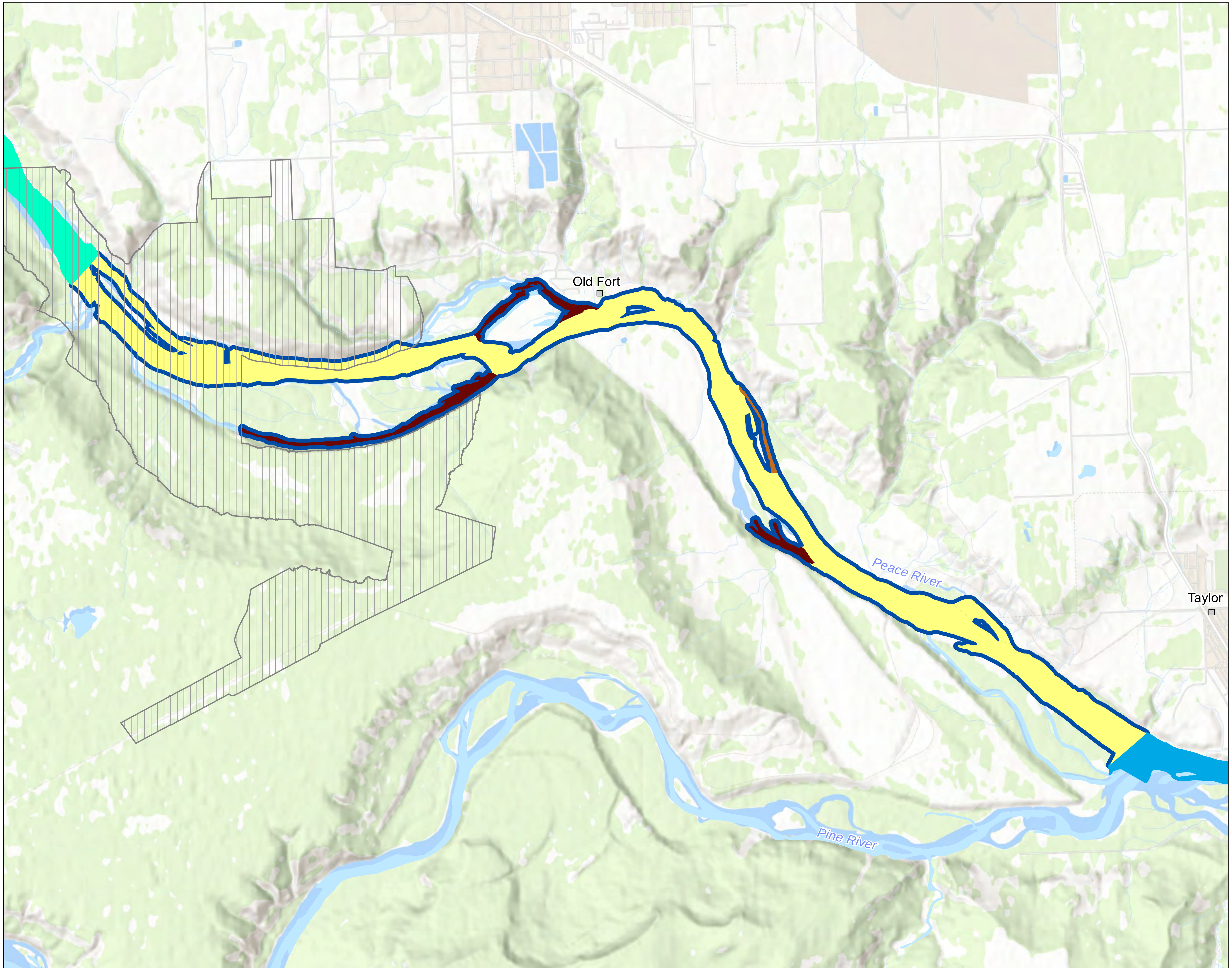
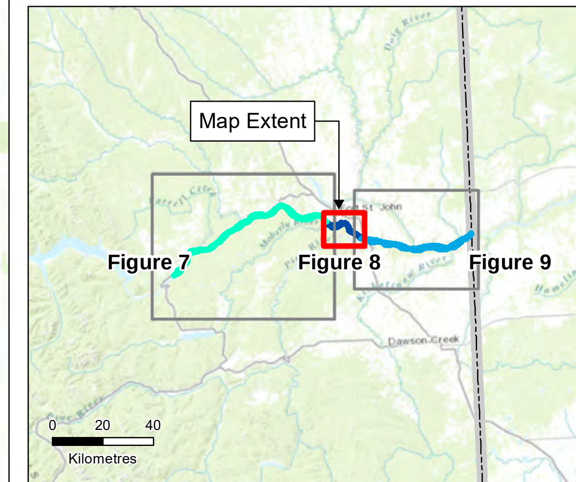
Migratory Waterbird Follow-up Monitoring Program
2023 Report
Site C, Peace River, BC

Figure 8 - Mean Density of Spring Migrant Waterbirds within Flow Regime Impact Area Habitat Polygons from 2017 through 2023





Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Proposed Dam Site
- Town
- Road
- Forested Area
- Waterbody / Watercourse

Waterbird densities ($birds/km^2$/survey round) by quartile [3]

- 6 - 81
- 82 - 166
- 167 - 357
- 358 - 1325

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3. Quantile breaks based on a dataset of densities within all polygons of distinct river habitat types during spring.

Sources

- Basemap: ESRI World Topographic Base

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107578-04	Production Date: Dec 8, 2023	Figure 8

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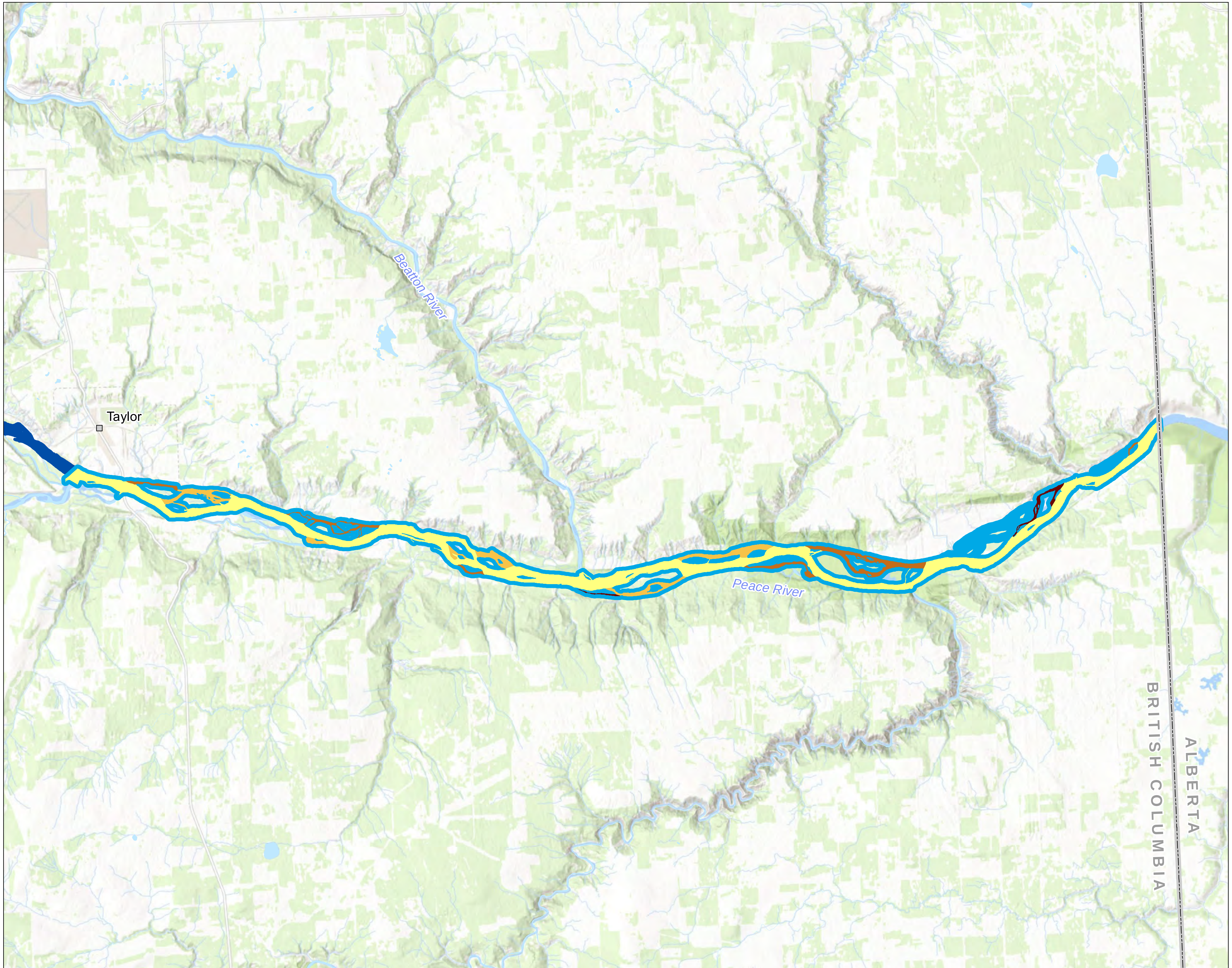
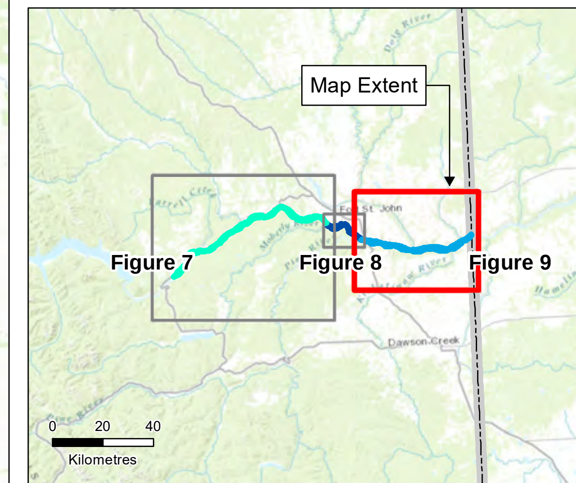
Migratory Waterbird Follow-up Monitoring Program
2023 Report
Site C, Peace River, BC

Figure 9 - Mean Density of Spring Migrant Waterbirds within Control Area Habitat Polygons from 2017 through 2023





Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Town
- Road
- Provincial Border
- Forested Area
- Waterbody / Watercourse

Waterbird densities (birds/km²/survey round) by quartile [3]

- 6 - 81
- 82 - 166
- 167 - 357
- 358 - 1325

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3. Quantile breaks based on a dataset of densities within all polygons of distinct river habitat types during spring.

Sources

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107578-04	Production Date: Dec 8, 2023	Figure 9

Ausenco BC hydro

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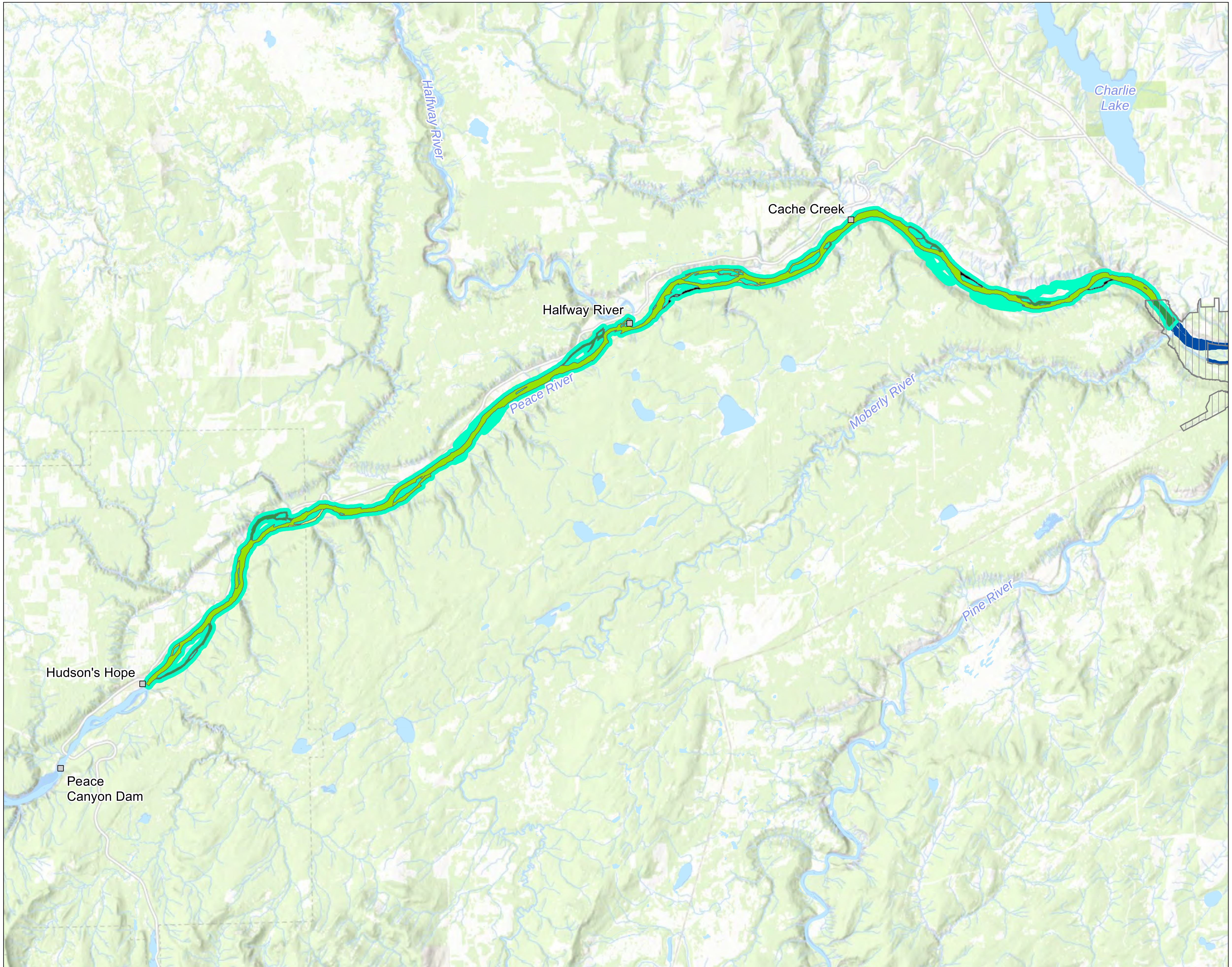
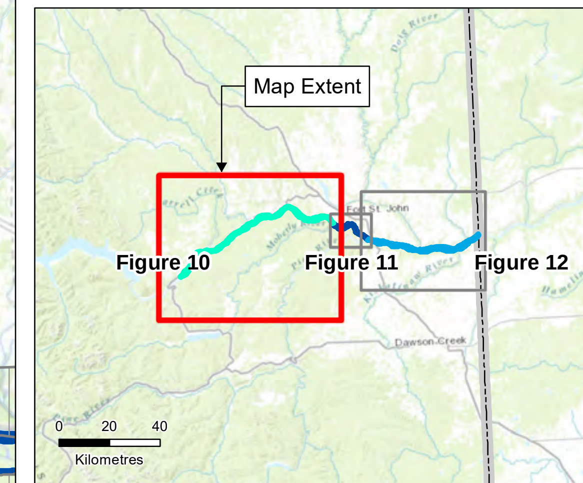
Migratory Waterbird Follow-up Monitoring Program
2023 Report
Site C, Peace River, BC

Figure 10 - Mean Density of Fall Migrant Waterbirds within Inundation Impact Area Habitat Polygons from 2017 through 2023





Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Proposed Dam Site
- Town
- Road
- Forested Area
- Waterbody / Watercourse

Waterbird densities (birds/km²/survey round) by quartile [3]

- 2 - 11
- 12 - 24
- 25 - 138
- 139 - 475

Notes

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2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. Quantile breaks based on a dataset of densities within all polygons of distinct river habitat types during fall.

Sources

- Basemap: ESRI World Topographic Base

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Kilometres

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107578-04	Production Date: Dec 8, 2023	Figure 10

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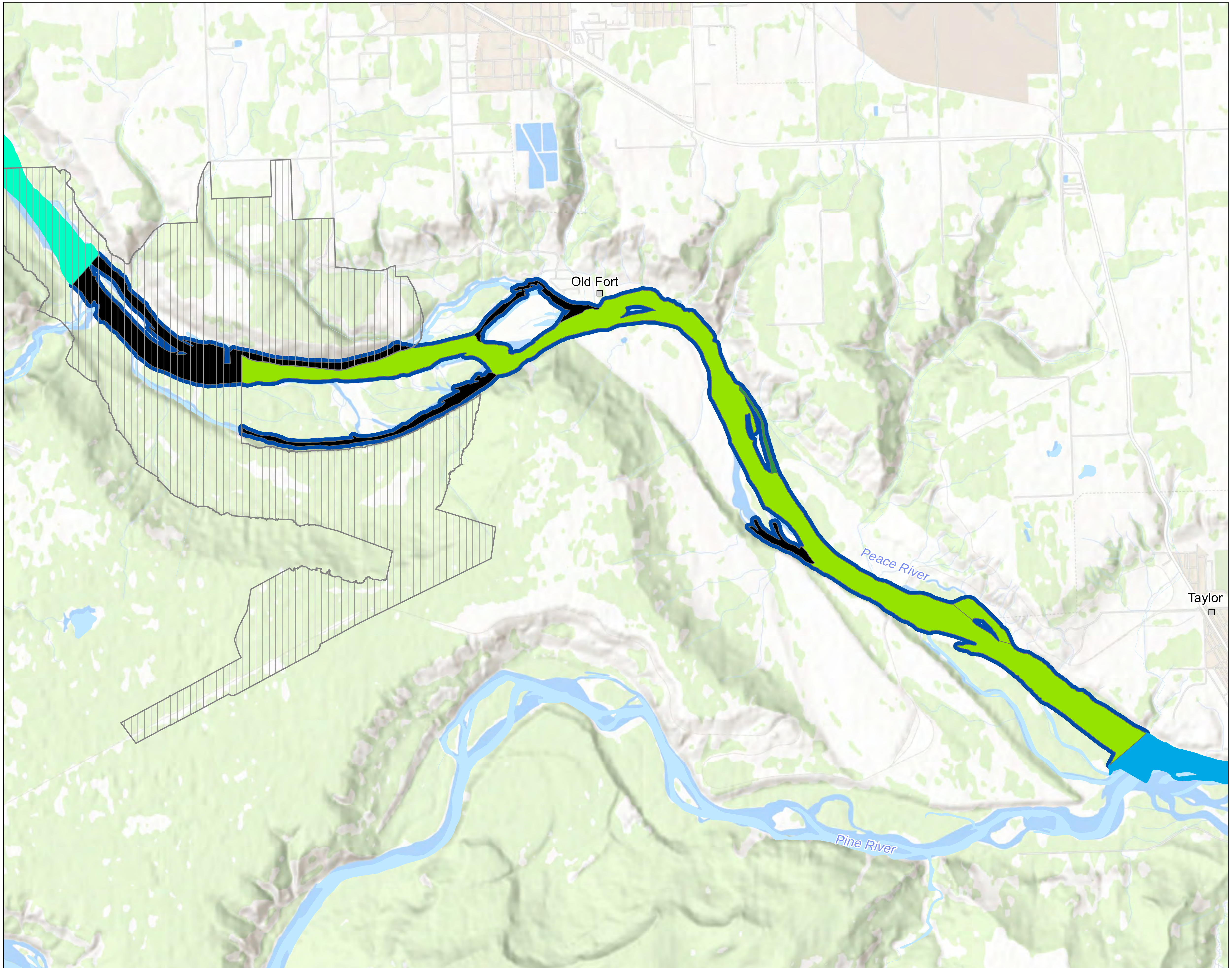
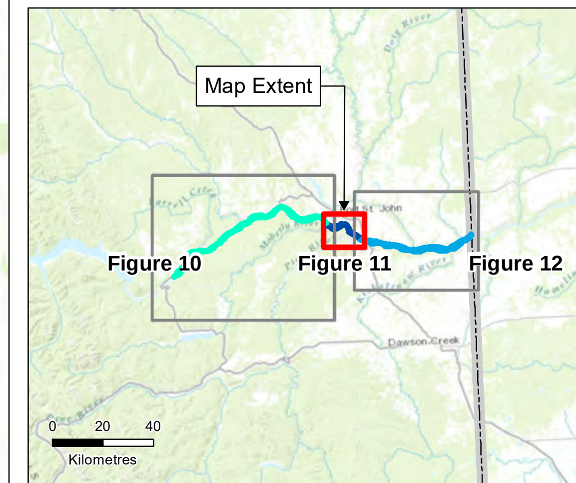
Migratory Waterbird Follow-up Monitoring Program
2023 Report
Site C, Peace River, BC

Figure 11 - Mean Density of Fall Migrant Waterbirds within Flow Regime Impact Area Habitat Polygons from 2017 through 2023





Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Proposed Dam Site
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Waterbird densities (birds/km²/survey round) by quartile [3]

- 2 - 11
- 12 - 24
- 25 - 138
- 139 - 475

Notes

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2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. Quantile breaks based on a dataset of densities within all polygons of distinct river habitat types during fall.

Sources

- Basemap: ESRI World Topographic Base

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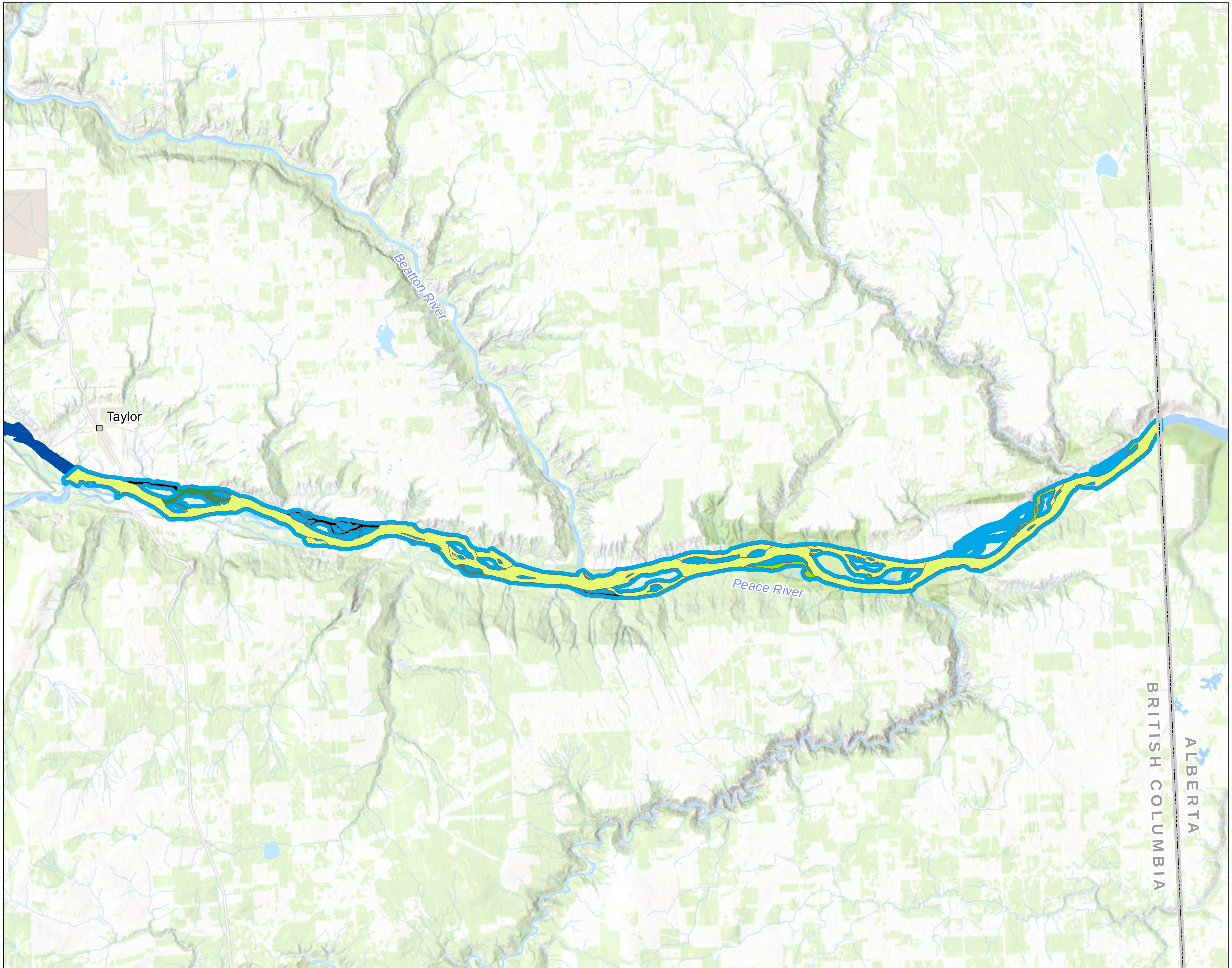
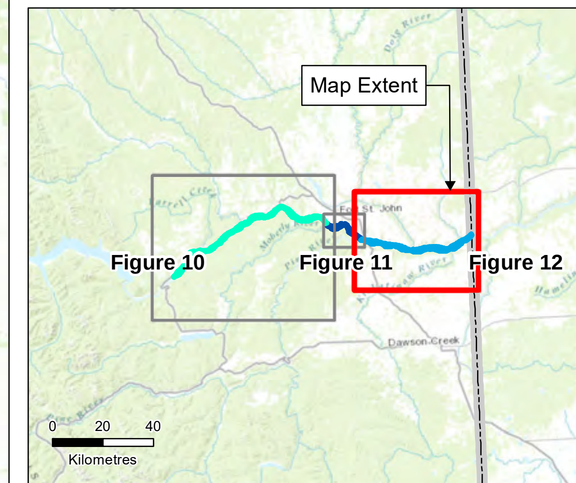
107578-04	Production Date: Dec 8, 2023	Figure 11

Ausenco BC hydro

Migratory Waterbird Follow-up Monitoring Program
2023 Report
Site C, Peace River, BC

Figure 12 - Mean Density of Fall Migrant Waterbirds within Control Area Habitat Polygons from 2017 through 2023





Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Town
- Road
- Provincial Border
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- Waterbody / Watercourse

Waterbird densities (birds/km^2/survey round) by quartile [3]

- 2 - 11
- 12 - 24
- 25 - 138
- 139 - 475

Notes

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2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. Quantile breaks based on a dataset of densities within all polygons of distinct river habitat types during fall.

Sources

- Basemap: ESRI World Topographic Base

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Page Size: 11" x 17"

107578-04	Production Date: Dec 8, 2023	Figure 12

Ausenco BC hydro

4.1.4 Diversity

A total of 66 waterbird species were detected across boat surveys of the Peace River conducted annually from 2017 through 2023 (**Appendix B-1**), including 32 species from 2023 surveys (**Appendix B-2**). Over the 7 years of monitoring conducted thus far, dabbling ducks (15 species) were the most species-rich foraging guild observed, followed by piscivorous divers (13 species) and shorebirds (11 species) (**Appendix B-1**). Average species richness within Mainstem and Moderate Flow river habitats was lower overall during early spring compared to early, early-middle, and late-middle fall survey periods (**Table 13**). Survey results specific to 2023 are presented in **Table 14**. Variability in diversity metrics across years are presented in **Appendix E** (**Table E-13**).

Table 13 Mean 2017 Through 2023 Diversity Metrics for Waterbird Foraging Guilds on the Peace River Across Seasons and Survey Periods

Foraging Guild	Spring Species Richness	Fall Species Richness		
	Early	Early	Early-Middle	Late-Middle
Benthic-feeding Divers	2.0	0.6	0.8	1.6
Dabbling Ducks	4.8	2.5	3.8	3.0
Gulls	0.3	4.1	3.6	2.8
Large Dabblers	2.1	1.1	1.7	2.1
Piscivorous Divers	1.4	1.9	2.8	3.1
Shorebirds	0.4	2.3	1.1	0.7
Total Species Richness	**11.0**	**12.6**	**13.8**	**13.2**
Species Evenness	**0.4**	**0.6**	**0.5**	**0.5**

Note: Mean species richness was calculated by averaging species richness across survey rounds first within periods each year, and then across years so that differences in sampling effort did not bias means towards diversity observed in years with more survey rounds. Data from Minimal and Limited Connectivity habitat are excluded due to inconsistent survey effort within these habitats due to variable access with fluctuations in water levels. Individual birds not identified to species are excluded from species richness totals and diversity calculations.

Table 14 Mean 2023 Diversity Metrics for Waterbird Foraging Guilds on the Peace River Across Seasons and Survey Periods

Foraging Guild	Spring Species Richness	Fall Species Richness		
	Early	Early	Early-Middle	Late-Middle
Benthic-feeding Divers	1.0	1.0	1.0	4.0
Dabbling Ducks	6.0	3.0	4.0	7.0
Gulls	0.0	1.0	2.0	3.0
Large Dabblers	1.5	1.0	2.0	5.0
Piscivorous Divers	1.0	2.0	3.0	4.0
Shorebirds	0.0	0.0	1.0	1.0
Total Species Richness	**9.5**	**9.0**	**13.0**	**24.0**
Species Evenness	**0.3**	**0.5**	**0.5**	**0.5**

Note: Mean species richness was calculated by averaging species richness across survey rounds first within periods each year, and then across years so that differences in sampling effort did not bias means towards diversity observed in years with more survey rounds. Data from Minimal and Limited Connectivity habitat are excluded due to inconsistent survey effort within these habitats due to variable access with fluctuations in water levels. Individual birds not identified to species are excluded from species richness totals and diversity calculations.

Due to unequal areas of the river habitat types and treatment areas (i.e., unequal survey effort and sample sizes; see **Table 2**), diversity statistics are not summarized or compared across habitat types or treatment areas.

4.1.5 Waterbird Species at Risk

Species observed during 2017 through 2023 Peace River boat surveys, and that are currently designated as at risk as per provincial, *Species at Risk Act* (SARA), or Committee on the Status of Endangered Wildlife in Canada (COSEWIC) rankings, are listed in (**Table 15**).

Table 15 Peace River Survey Observations and Conservation Status of Waterbird Species At Risk

English Name	Latin Name	Conservation Listing Status			Count of Birds Observed	
		BC Status	SARA	COSEWIC	2017-2023	2023
Double-crested cormorant	*Nannopterum auritum*	Blue	-	-	10	6
California gull	*Larus californicus*	Red[3]	-	-	35	0
Eared grebe	*Podiceps nigricollis*	Blue	-	-	6	0
Great blue heron[2]	*Ardea42 herodias*	Blue	-	-	1	0
Horned grebe	*Podiceps auratus*	-	SC	SC	2	0
Killdeer[1]	*Charadrius vociferus*	Blue	-	-	31	0
Lesser yellowlegs[1]	*Tringa flavipes*	Blue	-	T	17	0

English Name	Latin Name	Conservation Listing Status			Count of Birds Observed	
		BC Status	SARA	COSEWIC	2017-2023	2023
Long-tailed duck	*Clangula hyemalis*	Blue	-	-	1	0
Red-necked phalarope	*Phalaropus lobatus*	Blue	SC	SC	11	0
Surf scoter	*Melanitta perspicillata*	Blue	SC	SC	273	2
Tundra swan	*Cygnus columbianus*	Blue	-	-	3	0
Western grebe	*Aechmophorus occidentalis*	Red	SC	SC	1	0

Notes: BC Status – British Columbia conservation status rank, SC – Special Concern, T – Threatened, SARA – *Species At Risk Act*, COSEWIC – Committee on the Status of Endangered Wildlife in Canada. [1]Not identified as species at risk in prior annual monitoring reports. [2]Great blue heron was not a target species and is not included in estimates of relative abundance or diversity due to its rarity in the region and unique foraging strategy compared to the species guilds assessed in this study. [3]California gull BC status upgraded from Blue to Red, relative to prior annual monitoring reports.

The waterbird species at risk observed most (i.e., with 10 or more birds observed) across years during Peace River surveys were, in descending order from most numerous to least: surf scoter (*Melanitta perspicillata*), California gull (*Larus californicus*), killdeer (*Charadrius vociferus*), lesser yellowlegs (*Tringa flavipes*), red-necked phalarope (*Phalaropus lobatus*), and double-crested cormorant (*Nannopterum auritum*) (**Table 15**, **Appendix B-1**). In 2023, the only at-risk waterbirds observed during Peace River surveys were surf scoter and double-crested cormorant (**Table 15**, **Appendix B-2**).

4.2 Wetlands Surveys

This section describes the results of the transmission line ROW wetlands survey component of the monitoring program, including the temporal and spatial scope of surveys (**Sections 4.2.1**) relative to survey objectives. Estimates of mean abundance and diversity across years are summarized for each foraging guild by season, survey period, and habitat type. Diversity statistics are also summarized by foraging guild with means averaged across years provided for each survey period. Results are summarized together for all years of monitoring and are also presented independently for 2023 surveys.

4.2.1 Survey Effort and Timing

In 2023, transect and standwatch surveys were conducted on the Moberly Plateau adjacent to the Site C transmission line ROW during spring (May 3 through May 24) and fall (August 3 through September 28) waterbird migration periods (**Table 16**). Surveys in 2023 were conducted during 2 survey periods in spring and 3 survey periods in fall over a total of 22 days (7 days in spring and 15 days in fall). No wetlands surveys were conducted in the early spring survey because wetlands have always been frozen and unavailable for waterbird foraging during that time (**Table 16**). Bioacoustics monitoring for marsh birds in 2023 was conducted from May 8 through August 9 (**Table 23**).

Table 16 Wetlands Survey Timing During 2017 to 2023 Annual Waterbird Migration Monitoring

Survey Period (Dates)	2017 Survey Dates	2018 Survey Dates	2019 Survey Dates	2020 Survey Dates	2021 Survey Dates	2022 Survey Dates	2023 Survey Dates
Spring							
Early (Apr 1 to Apr 14)	Wetlands Frozen	Wetlands Frozen	Wetlands Frozen	Wetlands Frozen	Wetlands Frozen	Wetlands Frozen	Wetlands Frozen
Middle (Apr 15 to May 6)	Apr 29,30; May 1,2	Apr 27,28,29; May 2,3,4	Apr 21,22,23; May 3,4,5	May 4,5,6	May 3,4,5,6	May 2,3,4	May 3,4,5
Late (May 7 to May 30)	May 16,17; May 18,19, May 25,26; May 27,28	May 7,8,9; May 15,16,17	May 11,12,13; May 22,23,24	May 24,25,26,27	May 14,15,16	May 16,17,18,19	May 7,15,24,26
Fall							
Early (Aug 1 to Aug 14)	Aug 10,11; Aug 12,13	Aug 6,7,8	Aug 10,11,12	Aug 7,8,9	Aug 11,12,13	Aug 10,11,12,13	Aug 2,3,11,12,13
Early-Middle (Aug 15 to Sep 14)	Aug 24,25; Aug 26,27	Aug 22,23,24; Sep 6,7,10	Aug 21,22,23; Sep 10,11	Sep 2,3,4	Aug 26,29,30	Aug 31, Sep 1, 2,	Aug 30,31 Sep 1,3,4,5
Late-Middle (Sep 15 to Oct 14)	Sep 23,24; Sep 25,26	Sep 17,18,19; Oct 1, 2, 3	Sep 18,19,20; Oct 2,3	Sep 28, Oct 1,2	Sep 29,30, Oct 1,2,6	Oct 3,4,5,7	Sep 25,26, 27,28
Late (Oct 15 to Oct 30)	No surveys	Oct 17,18,19	Oct 18,19	No surveys	No surveys	No surveys	No surveys

4.2.1.1 Transect and Standwatch Surveys

In 2023, bioacoustics, transect, and/or standwatch surveys were conducted within 25 of the 26 wetland stations surveyed since 2017 for which data are summarized in this report (**Figure 13**, **Figure 14**, **Figure 15**, **Table 17**). Station OW-12, not surveyed in previous years, was added to the list of wetland survey stations in 2023 (**Table 17**) to offset discontinuation of surveys at SE-12 and OW-10, and due to access constraints at station OW-14 due to tree fall. As described in **Section 2.2.2**, each wetland station included one or more habitat types in which waterbird surveys were conducted. Within the 25 stations surveyed in 2023, 14 areas of open water habitat were surveyed by standwatch methods, 12 areas with predominantly (60% or greater) willow-sedge habitat were surveyed by transect methods, and 17 areas with predominantly sedge habitat were also surveyed by transect methods. Photos of stations showing aerial views or representative habitat are provided in **Appendix D**.

Table 17 Survey Methods and Wetland Habitat Types Surveyed Within Wetland Stations by Year

Wetland Station ID	Bioacoustics (ARU) Surveys	Transect Surveys[1]	Standwatch Surveys[2]
	Sedge, Open Water, Willow-Sedge	Sedge, Willow-Sedge	Open Water
OW-01	2021, 2023[4]	2020 - 2023	2017 - 2023
OW-02	-	-	2017 - 2023
OW-04	2023	-	2017 - 2023
OW-06	2020	2020 - 2023	2017 - 2023
OW-07	2022	-	2020 - 2023
OW-09	-	-	2017 - 2023
OW-10	-	-	2017 - 2022
OW-11	2023	2023	2017 - 2023
OW-12	2023	2023	2023
OW-13	2023	2022, 2023	2022, 2023
OW-14	-	-	2022, 2023
SE-01[3]	2023	2018, 2019	-
SE-02	2021	2018 - 2023	2020 - 2023
SE-03	2021, 2022	2018 - 2023	2020 - 2023
SE-04	2018 - 2023	2018 - 2023	2020
SE-05	2017, 2019 - 2021	2018 - 2023	-
SE-06	2017, 2019, 2020	2018, 2019	2020 - 2023
SE-07	2022	2018 - 2023	2020, 2021
SE-09	2020, 2022	2018 - 2023	2020 - 2023
SE-10	2017, 2019	2018 - 2023	-
SE-11	2020 - 2023	2018 - 2023	-
SE-12	2023	2018, 2019	2020, 2021
SE-14	2022	2018 - 2023	2020 - 2022
WS-01	2019	2018 - 2023	-
WS-02	2022	2018 - 2023	-
WS-03	2021	2018 - 2023	-

Notes: Dashes indicate no surveys conducted. [1]Surveys conducted with water depths of 0.5 m or less. [2]Surveys conducted in areas of 0.25 ha or more of open water. [3]Discontinued after 2019. Replaced with more easily accessed habitat adjacent to OW-01. [4]Adjacent to OW-01 (Bioacoustics survey ID ARU-44).

Within the wetland survey stations listed above, 339 standwatch surveys of open water and 697 transect surveys of sedge and willow-sedge habitat were conducted under appropriate survey conditions during the spring and fall of 2017 through 2023 (**Table 18**). Of the total 1,036 surveys conducted across all years, 567 and 469 surveys were conducted during spring and fall, respectively, and 139 were conducted during 2023. Survey efforts in 2023 were generally similar to those achieved in 2020 through 2022, with the exception of reduced effort during wildfire-associated evacuations from the Peace region during the late spring survey period resulting in a reduced number of transect surveys.

Table 18 Number of Unique Wetlands Surveys for Migrating Waterbirds Conducted by Standwatch and Transect Methods by Survey Period, 2017 to 2023

Survey Method		Spring		Fall				
	Year	Middle	Late	Early	Middle-Early	Middle-Late	Late[1]	Total
Standwatch *(Open water [OW] habitats)*	2017	2	8	6	5	6	0	27
	2018	9	14	6	11	12	6	58
	2019	11	13	6	13	12	3	58
	2020	11	12	11	11	9	0	54
	2021	7	14	8	10	8	0	47
	2022	9	11	12	10	9	0	51
	2023	9	9	9	8	9	0	44
Total		**58**	**81**	**58**	**68**	**65**	**9**	**339**
Transect *(Sedge [SE] and Willow-sedge (WS) dominated vegetated habitats)*	2018	11	31	19	26	34	18	139
	2019	26	36	20	36	37	6	161
	2020	20	22	21	23	20	0	106
	2021	19	10	22	21	18	0	90
	2022	18	25	21	20	22	0	106
	2023	21	7[2]	21	23	23	0	95
Total		**115**	**131**	**124**	**149**	**154**	**24**	**697**
Grand Total		**173**	**212**	**182**	**217**	**219**	**33**	**1,036**

Note: Multiple transects conducted within the same habitat type counted as a single unique survey. [1]No surveys were conducted during early spring and few surveys were conducted during late fall due to snow and ice cover of wetlands which restricted access and has also been found to be associated with limited use by waterbirds relative to warmer conditions. [2]Relatively few transect surveys were completed in late spring 2023 during wildfires and associated evacuations from the Peace region at that time.

4.2.1.2 Bioacoustics Monitoring

Bioacoustics monitoring during 2017 through 2023 was conducted with ARU deployments at 22 wetland survey stations (**Table 17**) and at 7 other locations where target habitats (e.g., sedge and willow-sedge wetlands) were present. In 2023, 9 ARU deployments successfully recorded bioacoustics data for 11 to 36 nights across deployment locations for a total 151 nights of recordings (**Table 23**). Across all years of bioacoustics monitoring (2017-2023), 939 nights of bioacoustics data have been recorded across 49 deployments. ARU surveys for marsh birds in 2023 were conducted at 2 stations where they were conducted in previous years and at 6 stations not previously surveyed with this method (**Figure 13**). Species presence/not detected results from ARU deployments across all years are summarized in **Table 23** along with the coordinates, habitats surveyed, and results specific to each 2023 deployment. Deployment specific data from earlier years are available in prior annual waterbird monitoring reports (Hemmera 2022; Ausenco 2023).

The location of successful ARU deployment locations (e.g., wetland stations) are provided below along with the habitat types, and time periods assessed by those deployments followed by figures illustrating wetland stations and 2023 ARU deployment locations (**Figure 13, Figure 14, Figure 15**).

<u>Mid-May to mid-June:</u>

- **SE-12**: Large patches of sedge, including those on floating vegetation mats, with small areas of open water surrounded by a thin band of willow-sedge and broader areas of upland habitat. This station and sedge habitat with floating vegetation had not previously been targeted for bioacoustics monitoring.
- **OW-04**: Large patches of willow-sedge and sedge with some surrounding upland and open water habitat. This station had not previously been surveyed by ARU.
- **OW-12**: Primarily sedge habitat surrounded by a ring of tamarack-sedge with some willow-sedge and with small (<0.5 ha) body of open water surrounded by bulrush (*Schoenoplectus* sp.). The sedge and tamarack-sedge wetland is surrounded by wet upland forest, dominated by black spruce and sphagnum moss. This station had not previously been surveyed by ARU.

<u>Mid-June to mid-July:</u>

- **OW-11**: Mixed patches of sedge, open water, upland and willow-sedge including areas of exposed mud and young vegetation in previously flooded areas around beaver dams. Sedge habitat not quite as extensive relative to SE-11 and other stations where yellow rail have been documented. This station had not previously been surveyed by ARU.
- **OW-13**: Mixed patches of sedge and open water sedge including areas of exposed mud and young vegetation in previously flooded areas surrounded by upland, forested habitat. Smaller areas of sedge relative to SE-11 and other stations where yellow rail are more traditionally documented. This station had not previously been surveyed by ARU.
- **OW-01 adjacent**: Primarily sedge and willow-sedge with a lesser amount of tamarack-sedge. Given the extensive area of wetland habitat adjacent to OW-01, an ARU was deployed at this additional and novel location near OW-01, on the west side of the lake.

<u>Mid-July to mid-August:</u>

- **SE-01:** Sedge-dominated wetland with some willow-sedge surrounded by spruce-dominated upland forests. This station had not been surveyed by ARU.
- **SE-04 and SE-11**: Sedge-dominated wetlands. Yellow rail were detected at these stations in May/June during previous years. Virginia rail was detected at SE-11 in July/August of 2022. Additional monitoring of these species during mid-July through early August provides evidence regarding how consistently these species vocalize later in the season, informing the value of monitoring data from that time.

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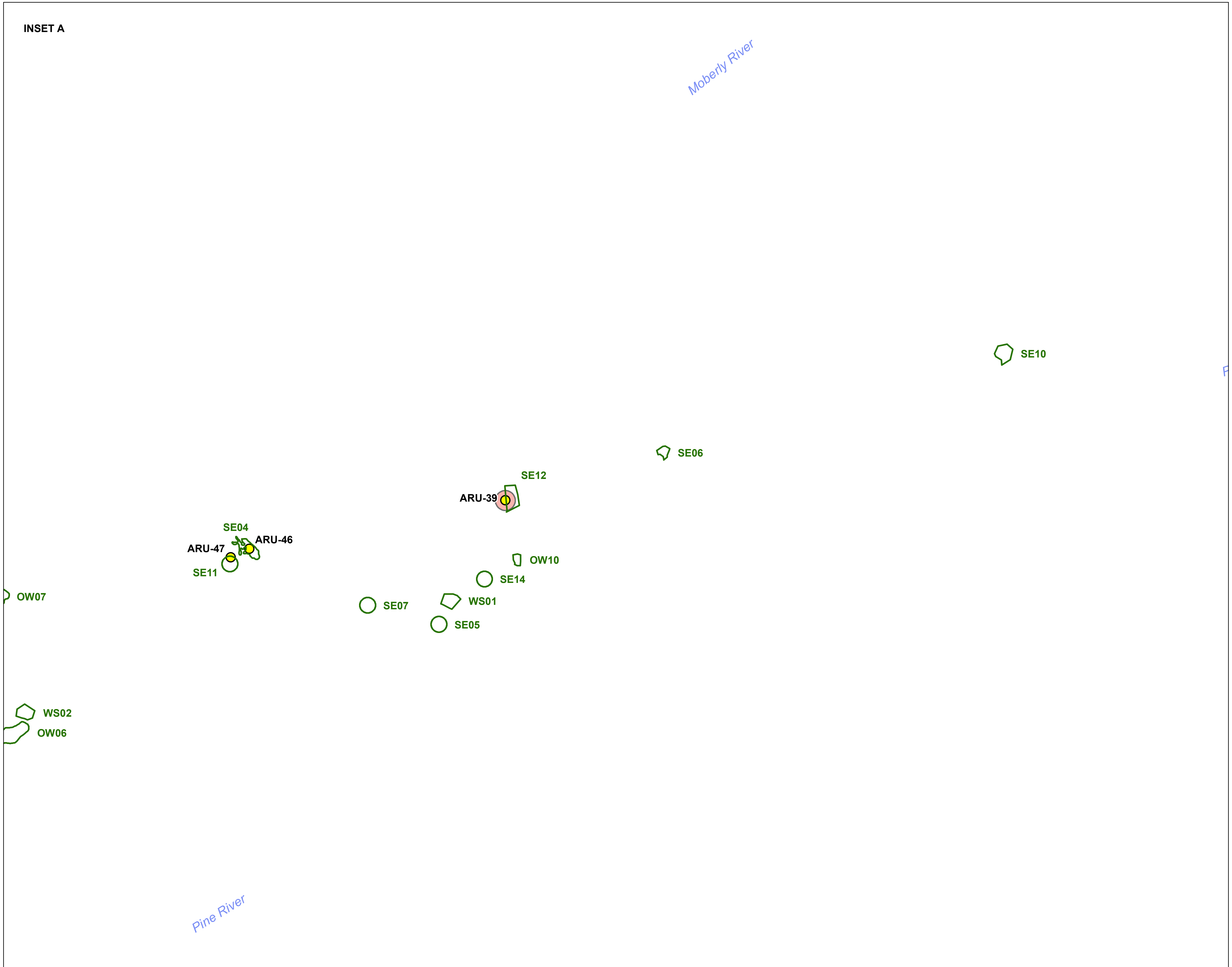
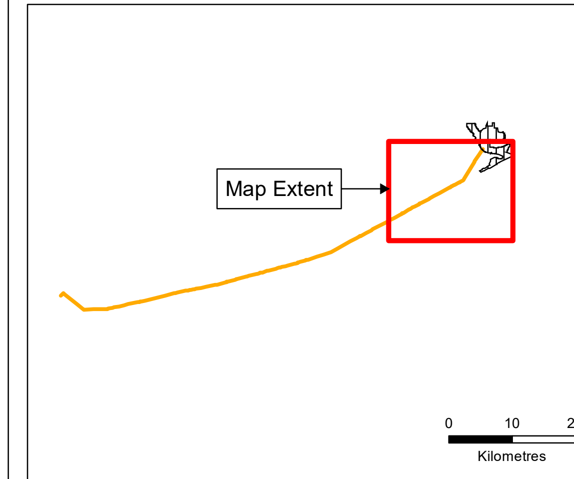
Figure 13 - Eastern Wetland Survey Stations and 2023 Bioacoustics Monitoring Locations in the Wetlands Study Area





Legend

- 2023 ARU Deployment
- Proposed Dam Site
- Wetland Survey Station
- Wetlands Study Area
- Access / Service Road
- Transmission Line Right-of-Way
- Forested Area
- Waterbody / Watercourse

Manually Confirmed Detections of Marsh Bird Species

- Sora

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. OW has been used as the idientfier for Shallow Open Water wetland field locations; however, please note that the wetland classification also includes LA and PD habitat codes.

Sources

- Basemap: ESRI World Topographic Base

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Kilometres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

107578-04	Production Date: Dec 13, 2023	Figure 13

BC hydro

Migratory Waterbird Follow-up Monitoring Program
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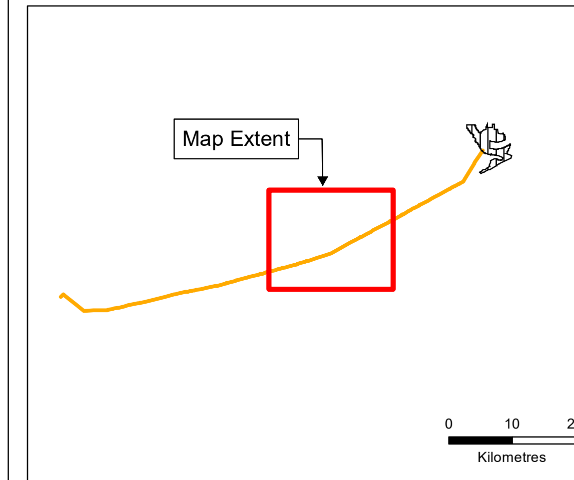
Figure 14 - Central Wetland Survey Stations and 2023 Bioacoustics Monitoring Locations in the Wetlands Study Area



Legend

- 2023 ARU Deployment
- Wetland Survey Station
- Wetlands Study Area
- Access / Service Road
- Transmission Line Right-of-Way
- Forested Area
- Waterbody / Watercourse

Manually Confirmed Detections of Marsh Bird Species

- Sora
- Yellow Rail

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. OW has been used as the idientfier for Shallow Open Water wetland field locations; however, please note that the wetland classification also includes LA and PD habitat codes.

Sources

- Basemap: ESRI World Topographic Base

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107578-04	Production Date: Dec 13, 2023	Figure 14

Migratory Waterbird Follow-up Monitoring Program
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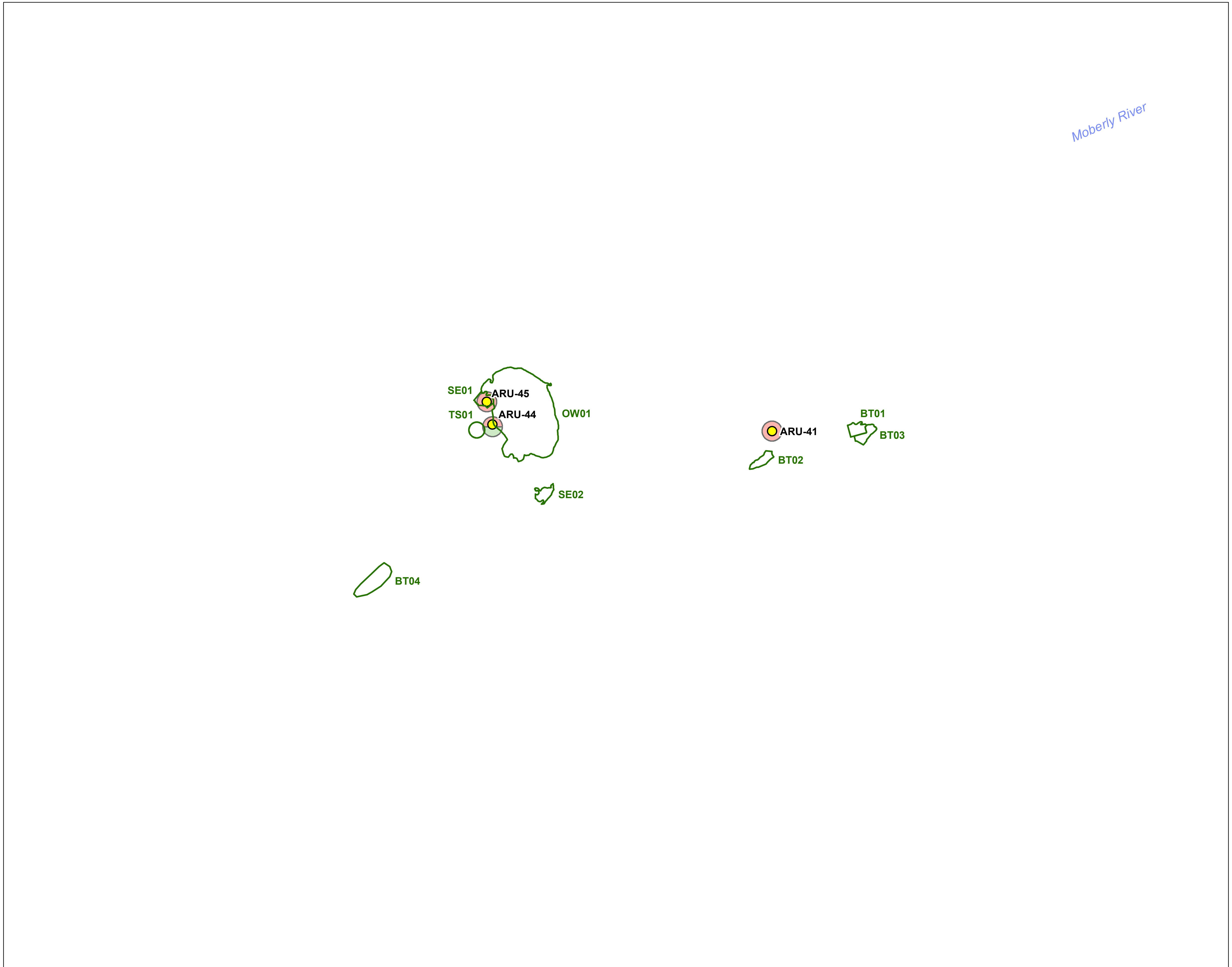
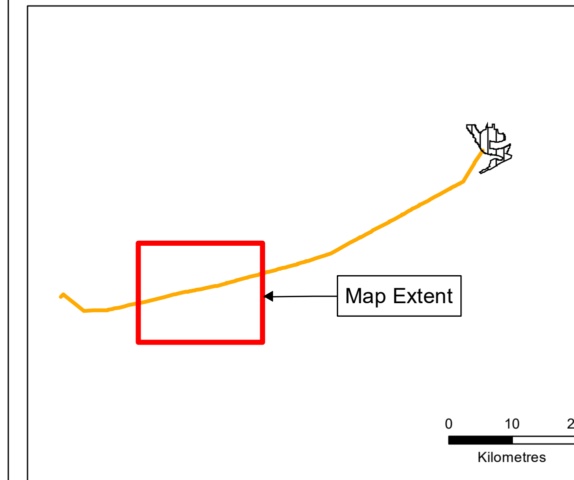
Figure 15 - Western Wetland Survey Stations and 2023 Bioacoustics Monitoring Locations in the Wetlands Study Area





Legend

- 2023 ARU Deployment
- Wetland Survey Station
- Wetlands Study Area
- Access / Service Road
- Transmission Line Right-of-Way
- Forested Area
- Waterbody / Watercourse

Manually Confirmed Detections of Marsh Bird Species

- Sora
- Yellow Rail

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. OW has been used as the idientfier for Shallow Open Water wetland field locations; however, please note that the wetland classification also includes LA and PD habitat codes.

Sources

- Basemap: ESRI World Topographic Base

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0 0.5 1 1.5 2 2.5
Kilometres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

107578-04	Production Date: Dec 13, 2023	Figure 15

BC hydro

Path: S:\Geomatics\Projects\989619\07_waterfowl\mxd\MonitoringProgram2023\Fig15__107578_04_Waterbirds_Wetland_Survey_Stations_West_231213.mxd

4.2.2 Abundance and Density

Summaries of waterbird observations are presented below for habitat types surveyed by transect and standwatch methods. For the purposes of annual reporting, waterbird observation data are summarized in terms of density. For standwatch surveys of permanent water features (e.g., lakes) as well as inundated sedge and inundated willow-sedge habitats (**Table 19**, **Table 20**), density was calculated as the number of waterbirds per square kilometre of open water. For transect surveys, results are presented in terms of the density of waterbirds per kilometre of transect length within sedge and willow-sedge habitats with water levels less than 50 cm (**Table 21**, **Table 22**). The results of bioacoustics monitoring are described in terms of the proportion of monitoring locations where species were confirmed to be present, based on presence/not detected results for target species from each monitoring location (**Table 23**).

4.2.2.1 Transect and Standwatch Surveys

A list of the species and numbers of waterbirds observed during transect and standwatch surveys in 2023 and across all monitoring years is presented within **Appendix B**[3]. Standwatch surveys detected 11,153 waterbirds from 2017 through 2023 (**Appendix B-1**), including 1,798 waterbirds in 2023, of which 85% were identified to species (**Appendix B-2**).

Across years, mean densities of waterbirds were greatest during the middle Spring survey period and were similar across survey periods, with generally declining abundances during the later survey periods in both spring and fall (**Table 19**). Wetlands surveys were not completed in early spring as freezing conditions leave wetlands unavailable for foraging at this time and were not completed during late fall after 2019 as per Native Plant Solutions' guidance informed by power analyses. Estimates of interannual variability for all survey periods are presented in **Appendix E** (**Table E-19**) along with means from late fall calculated from data collected in 2017 through 2019.

Waterbirds observed during standwatch surveys were primarily dabbling ducks and benthic-feeding divers (**Table 19**). Estimates of foraging guild densities within open water habitats specific to survey periods in 2023 are presented in **Table 20**, and estimates of interannual variability are presented in **Appendix E** (**Table E-19**).

[3] Total abundances of species presented in Appendix B and total species richness statistics in tables 23, 24, 25, and 26 exclude incidental records and results of repeated surveys conducted to estimate detection probability. For example, 3 Pacific loon (*Gavia pacifica*) were observed during a repeat survey at OW-01 during the fall of 2022, but this species is not shown in summary statistics within Appendix B or in diversity statistics summarized in Section 4.2.3.

Table 19 Mean Waterbird Densities (Birds/km^2/Survey) within Open Water Habitat Reported by Foraging Guild from Standwatch Surveys, 2017 to 2023

Foraging Guild	Spring		Fall		
	Middle	Late	Early	Early-Middle	Late-Middle
Benthic-feeding Divers	171	110	175	147	126
Dabbling Ducks	695	558	700	674	545
Gulls	2	5	1	<1	<1
Large Dabblers	157	53	23	19	12
Marsh Birds	1	22	9	11	0
Piscivorous Divers	9	21	26	34	23
Shorebirds	76	100	85	16	0
Unknown Waterbirds	<1	15	17	4	30
Total (All Waterbirds)	**1,109**	**883**	**1,036**	**905**	**736**

Note: Mean densities reflect relative rather than absolute densities as they do not account for incomplete detection. Mean relative densities were calculated by averaging relative density across survey rounds first within each period per year, and then across years to avoid bias associated with uneven sampling effort in some periods and years. Results include survey data from permanent open water habitat, flooded vegetated wetlands, and open water areas with interspersed vegetation such as rushes and sedge.

Table 20 Mean Waterbird Densities (Birds/km2/Survey) within Open Water Habitat Reported by Foraging Guild from Standwatch Surveys, 2023

Foraging Guild	Spring		Fall		
	Middle	Late	Early	Early-Middle	Late-Middle
Benthic-feeding Divers	228	18	50	19	27
Dabbling Ducks	705	451	392	758	713
Gulls	0	4	0	0	0
Large Dabblers	34	34	1	3	2
Marsh Birds	0	0	0	0	0
Piscivorous Divers	7	17	30	15	30
Shorebirds	211	86	19	51	0
Unknown Waterbirds	0	0	4	0	1
Total (All Waterbirds)	**1,185**	**610**	**496**	**846**	**774**

Transect surveys of vegetated wetlands with low water levels resulted in detections of 458 waterbirds within sedge and willow-sedge habitat across 2018 through 2023 (**Appendix B-1**)**,** including 38 waterbirds detected during surveys conducted in 2023 (**Appendix B-2**). Due to the proximity of observers, 100% of waterbird individuals were identified to species in 2023.

Mean densities observed within vegetated habitats were highest during late spring in all survey years (**Table 21**), including 2023 (**Table 22**). Estimates of foraging guild densities within open water habitats specific to survey periods in 2023 are presented in **Table 22** and estimates of interannual variability are presented in **Appendix E** (**Table E-21**)**.**

Table 21 Mean Waterbird Densities (Birds/km/Survey) within Vegetated Wetland (Sedge, Willow-Sedge) Habitats Reported by Foraging Guild from Transect Surveys, 2018 through 2023

Foraging Guild	Spring		Fall		
	Middle	Late	Early	Early-Middle	Late-Middle
Benthic-feeding Divers	0.00	0.00	0.00	0.00	0.00
Dabbling Ducks	1.50	6.56	0.06	0.49	1.14
Gulls	0.00	0.00	0.00	0.00	0.00
Large Dabblers	0.36	0.20	0.00	0.00	0.00
Marsh Birds	1.15	3.20	1.44	1.16	0.25
Piscivorous Divers	0.00	0.08	0.00	0.00	0.00
Shorebirds	1.44	2.37	0.00	0.00	0.00
Unknown Waterbirds	0.00	0.00	0.00	0.00	0.00
Total (All Waterbirds)	**4.44**	**12.42**	**1.50**	**1.65**	**1.39**

Note: Mean densities reflect relative rather than absolute densities as they do not account for incomplete detection. Mean relative densities were calculated by averaging relative density across survey rounds first within each period per year, and then across years to avoid bias associated with variable survey effort across survey periods and years.

Table 22 Mean Waterbird Densities (Birds/km/Survey) within Vegetated Wetland (Sedge, Willow-sedge) Habitats Reported by Foraging Guild from Transect Surveys, 2023

Foraging Guild	Spring		Fall		
	Middle	Late	Early	Early-Middle	Late-Middle
Benthic-feeding Divers	0.00	0.00	0.00	0.00	0.00
Dabbling Ducks	0.21	0.57	0.00	0.00	0.00
Gulls	0.00	0.00	0.00	0.00	0.00
Large Dabblers	0.83	0.00	0.00	0.00	0.00
Marsh Birds	2.92	2.86	1.19	0.00	0.00
Piscivorous Divers	0.00	0.00	0.00	0.00	0.00
Shorebirds	5.42	0.00	0.00	0.00	0.00
Unknown Waterbirds	0.00	0.00	0.00	0.00	0.00
Total (All Waterbirds)	**9.38**	**3.43**	**1.19**	**0.00**	**0.00**

Note: Mean densities reflect relative rather than absolute densities as they do not account for incomplete detection. Mean relative densities were calculated by averaging relative density across survey rounds within each period.

4.2.2.2 Bioacoustics Monitoring

Sora was detected at all locations monitored with bioacoustics methods in 2017 through 2021 and, similar to 2022 monitoring (Ausenco 2023), was detected from 7 of 9 ARU deployments in 2023 (**Table 23**). No American bittern vocalizations were recorded at any location in any year. Yellow rail was detected from 15 of the 49 ARU deployments across years, and from 2 of 9 ARU deployments in 2023 (**Table 23**). Virginia rail was detected from 6 of 33 ARU deployments since annual monitoring of this species began in 2020 but was not detected in any of 9 deployments in 2023 (**Table 23**).

Table 23 Bioacoustics Monitoring Locations, Habitat Description, Timing, and Confirmed Detections of Target Species from 2023 and Summarized across all Years of Monitoring (2017 to 2023)

ARU Survey ID	Latitude	Longitude	Habitat type	Wetland Survey Station	Dates of Acoustic Monitoring	Number of Nights	Sora	Yellow Rail	American Bittern	Virginia Rail[1]
2023										
ARU-39	56.120943	-121.027647	Upland forest, sedge, Willow sedge	SE-12	May 8 – May 26	18	Yes	No	No	No
ARU-40	56.056053	-121.233915	Willow sedge, sedge, upland forest	OW-04	May 24 – June 5	12	Yes	No	No	No[2]
ARU-41	55.995499	-121.601662	Tamarack sedge, sedge, open water,	OW-12	May 24 – June 4	11	Yes	No	No	No
ARU-42	56.049881	-121.416568	Sedge, willow sedge, open water	OW-11	June 13 – June 25	12	Yes	Yes	No	No
ARU-43	56.013084	-121.42557	Sedge, open water, upland forest	OW-13	June 13 – July 5	22	Yes	No	No	No
ARU-44	55.997237	-121.673838	Sedge, willow sedge, open water	N/A	June 13 – July 19	36	Yes	Yes	No	No[2]
ARU-45	56.000562	-121.675174	Sedge, open water, willow sedge	SE-01	July 25 – Aug 9	14	Yes	No	No	No
ARU-46	56.114989	-121.094227	Sedge, willow sedge, upland forest	SE-04	July 25 – Aug 7	13	No	No	No	No
ARU-47	56.113801	-121.099148	Sedge, upland forest, willow sedge	SE-11	July 25 – Aug 7	13	No	No	No	No
					2023 Totals	**151**	**7/9**	**2/9**	**0/9**	**0/9**
					2017-2023 Totals	**939**	**45/49**	**15/49**	**0/49**	**6/33**

Notes: [1]ARU data only reviewed for Virginia Rail in 2020 and subsequent years as the species was not assessed or documented within the study area during baseline studies and the study area was assumed to be outside of the species' range in 2019 and prior years. [2]Virginia rail detections possible, but unconfirmed due to similarity with sora calls. [3]Habitat types are the 3 most prevalent within 200 m of ARU, in order of prevalence.

4.2.3 Diversity

In total, 45 waterbird species were detected during standwatch surveys conducted during the spring and fall of 2017 through 2023 (**Table 24**), including 33 species in 2023 (**Appendix B-2**). Transect surveys detected 19 species during 2018 to 2023 (**Table 24**), 6 of which were observed in 2023 (**Appendix B-2**). These totals exclude species detected during repeat surveys and exclude incidental observations such as species flying over and not foraging within the targeted survey areas.

The most diverse foraging guilds observed during standwatch surveys of open water and flooded wetlands were dabbling ducks followed by piscivorous divers with 13 and 10 species observed, respectively, from 2017 through 2023 (**Table 24**). During transect surveys of vegetated wetlands, dabbling ducks were the most species-rich guild observed, with 8 species. No more than 4 species of any other guild were observed during transect surveys and gulls were entirely absent from transect survey records.

Table 24 Cumulative 2017 Through 2023 Species Richness of Waterbird Foraging Guilds Observed During Transect and Standwatch Surveys of Wetland Habitats

Foraging Guild	Transect Surveys 2018 to 2023		Standwatch Surveys 2017 to 2023	
	Number of Species	Proportion of Species	Number of Species	Proportion of Species
Benthic-feeding Divers	1	0.05	7	0.16
Dabbling Ducks	8	0.42	13	0.29
Gulls	0	0.00	4	0.09
Large Dabblers	2	0.11	2	0.04
Marsh Birds	3	0.16	2	0.04
Piscivorous Divers	1	0.05	10	0.22
Shorebirds	4	0.21	7	0.16
Total	**19**		**45**	

Average species richness and evenness were calculated across years for each foraging guild in each survey period assessed in 2023 for standwatch surveys of open water habitat (**Table 25**) and transect surveys of vegetated habitat (**Table 27**). With reduced survey effort during late spring 2023, diversity metrics within open water and vegetated habitats along the transmission line ROW were highest in the middle spring survey period in 2023 (**Table 26, Table 28)**. Across all prior years of surveys, diversity metrics have been highest during late spring (**Table 25**, **Table 27**). Species richness and evenness statistics are provided for the current reporting year in **Table 26** and **Table 28**, and statistics describing interannual variability are available in **Appendix E** for open water and vegetated wetland habitats within **Table E-25** and **Table E-27**, respectively.

Table 25 Mean 2017 Through 2023 Species Richness of Waterbird Foraging Guilds within Open Water Wetland Habitat by Survey Period Observed during Standwatch Surveys

Foraging Guild	Spring		Fall		
	Middle	Late[1]	Early	Early-Middle	Late-Middle
Benthic-feeding Divers	2.9	3.6	2.0	1.9	2.6
Dabbling Ducks	6.6	7.5	5.8	6.6	6.0
Gulls	0.3	0.8	0.6	0.0	0.1
Large Dabblers	1.6	1.8	0.9	1.1	0.9
Marsh Birds	0.4	0.9	0.2	0.6	0.0
Piscivorous Divers	2.1	3.5	3.1	3.4	2.9
Shorebirds	1.3	2.5	1.3	0.6	0.0
Total Species Richness	**15.1**	**20.5**	**13.9**	**14.3**	**12.5**
Species Evenness	**0.8**	**0.8**	**0.8**	**0.8**	**0.7**

Note: Average diversity statistics were determined by calculating mean richness and evenness across survey rounds first within each period per year, and then across years to avoid bias associated with variable survey effort across survey periods and years. [1]Mean diversity statistics for late spring exclude data from 2023 due to reduced effort during wildfire hazards and associated evacuations from the Peace region at that time.

Table 26 Species Richness in 2023 for Waterbird Foraging Guilds within Open Water Habitat by Survey Period Observed during Standwatch Surveys

Foraging Guild	Spring		Fall		
	Middle	Late[1]	Early	Early-Middle	Late-Middle
Benthic-feeding Divers	5.0	-	2.0	2.0	4.0
Dabbling Ducks	10.0	-	7.0	8.0	9.0
Gulls	0.0	-	0.0	0.0	1.0
Large Dabblers	2.0	-	1.0	1.0	1.0
Marsh Birds	0.0	-	0.0	0.0	0.0
Piscivorous Divers	4.0	-	3.0	4.0	5.0
Shorebirds	3.0	-	0.0	2.0	0.0
Total Species Richness	**24.0**	**-**	**13.0**	**17.0**	**20.0**
Species Evenness	**0.8**	**-**	**0.8**	**0.8**	**0.7**

Note: [1]Late spring data for 2023 were excluded due to reduced effort during wildfire hazards and associated evacuations from the Peace region at that time.

Table 27 Mean 2018 Through 2023 Species Richness of Waterbird Foraging Guilds within Sedge and Willow-sedge Wetland Habitats by Survey Period Observed during Transect Surveys

Foraging Guild	Spring		Fall		
	Middle	Late[1]	Early	Early-Middle	Late-Middle
Benthic-feeding Divers	0.0	0.1	0.0	0.0	0.0
Dabbling Ducks	1.4	3.9	0.7	0.6	0.2
Gulls	0.0	0.0	0.0	0.0	0.0
Large Dabblers	0.8	0.4	0.0	0.0	0.0
Marsh Birds	1.4	2.4	1.5	1.2	0.5
Piscivorous Divers	0.0	0.2	0.0	0.0	0.0
Shorebirds	1.6	1.5	0.0	0.0	0.0
Total Species Richness	**5.2**	**8.5**	**2.2**	**1.8**	**0.8**
Species Evenness	**0.7**	**0.8**	-	-	-

Note: Average diversity statistics were determined by calculating mean richness and evenness across survey rounds first within each period per year, and then across years to avoid bias associated with variable survey effort across survey periods and years. Dashes indicate insufficient or inappropriate data for summary statistic calculations. Data from survey rounds during which fewer than 8 transects were surveyed (e.g., late spring, 2023) were excluded.

Table 28 Species Richness in 2023 for Waterbird Foraging Guilds within Sedge and Willow-sedge Wetland Habitats by Survey Period Observed during Transect Surveys

Foraging Guild	Spring		Fall		
	Middle	Late[1]	Early	Early-Middle	Late-Middle
Benthic-feeding Divers	0.0	-	0.0	0.0	0.0
Dabbling Ducks	1.0	-	0.0	0.0	0.0
Gulls	0.0	-	0.0	0.0	0.0
Large Dabblers	1.0	-	0.0	0.0	0.0
Marsh Birds	1.0	-	2.0	0.0	0.0
Piscivorous Divers	0.0	-	0.0	0.0	0.0
Shorebirds	2.0	-	0.0	0.0	0.0
Total Species Richness	**5.0**	**-**	**2.0**	**0.0**	**0.0**
Species Evenness	**0.8**	**-**	**1.0**	**0.0**	**0.0**

Note: Dashes indicate insufficient or inappropriate data for summary statistic calculations. Data from survey rounds during which fewer than 8 transects were surveyed (e.g., late spring 2023) were excluded.

4.2.4 Waterbird Species at Risk

Species observed during 2017 through 2023 standwatch and transect surveys, and that are currently designated as at risk as per provincial, *Species at Risk Act* (SARA), or Committee on the Status of Endangered Wildlife in Canada (COSEWIC) rankings, are listed in (**Table 29**).

Table 29 Wetlands Standwatch and Transect Survey Observations and Conservation Status of Waterbird Species At Risk

English Name	Latin Name	Conservation Listing Status			Count of Birds Observed	
		BC Status	SARA	COSEWIC	2017-2023	2023
Black tern	*Chlidonias niger*	Blue	-	-	26	2
Eared grebe	*Podiceps nigricollis*	Blue	-	-	97	12
Horned grebe	*Podiceps auratus*	-	SC	SC	160	71
Killdeer[1]	*Charadrius vociferus*	Blue	-	-	1	0
Lesser yellowlegs[1]	*Tringa flavipes*	Blue	-	T	104	37
Long-tailed duck	*Clangula hyemalis*	Blue	-	-	22	0
Red-necked phalarope	*Phalaropus lobatus*	Blue	SC	SC	9	0
Surf scoter	*Melanitta perspicillata*	Blue	SC	SC	138	21
Western grebe	*Aechmophorus occidentalis*	Red	SC	SC	12	0
Yellow rail	*Coturnicops noveboracensis*	Red	SC	SC	4	0

Notes: BC Status – British Columbia conservation status rank, SC – Special Concern, T – Threatened, SARA – *Species At Risk Act*, COSEWIC - Committee on the Status of Endangered Wildlife in Canada. [1]Not identified as species at risk in prior annual monitoring reports.

Across years, the most commonly observed waterbird species at risk within wetlands was horned grebe. Surf scoter, lesser yellowlegs, and eared grebes were also regularly recorded with around 100 or more birds observed across years (**Table 29**). Fewer than 30 individuals of other species at risk were counted within wetlands across the 6 survey years (**Table 29, Appendix B-1**). In 2023, horned grebe, lesser yellowlegs, surf scoter, eared grebe, and black tern (*Chlidonias niger*) were recorded during wetlands transect or standwatch surveys (**Table 29, Appendix B-2**).

5.0 Discussion

As per the objectives described in **Section 1.2**, the monitoring program has improved understanding of baseline conditions for waterbirds, including assessment of habitat and documentation of habitat-specific measures of relative abundance and diversity for waterbird foraging guilds. The results obtained are discussed below within the context of these monitoring objectives and prior understanding regarding baseline conditions for waterbirds and their habitat within the Peace River Valley and wetlands on the Moberly Plateau.

5.1 Habitat Assessment

Waterbird habitat associations (e.g., river and wetland habitat types) and habitat characteristic data (e.g., Peace River flow rates) collected during 2017 through 2023 improve understanding of baseline conditions and factors influencing the distribution and abundance of waterbirds. Waterbird location and habitat association data collected during this monitoring program provide increased resolution compared to the data available prior to 2017, in which bird observations were reported within 5 km segments without habitat characteristics.

While TEM provides informative wetland habitat data, it does not include landform information pertinent to waterbird presence on the Peace River, where river dynamics can change habitat from year to year. Re-characterization of habitat types along the Peace River following Project commissioning will provide comparisons of habitat availability relative to Project-related changes to impact treatment areas. LiDAR data of the Peace River Valley may also be considered in future analyses to assess the influence of topographic characteristics such as water depth on waterbirds. Similarly, water levels and flow rates may influence waterbird abundances or diversity. For example, high water levels could result in a re-distribution of dabbling waterbirds from Mainstem and Moderate Flow habitats to more shallow areas such as Minimal and Limited Connectivity habitat types where suitable foraging depths persist. Consideration of flow rate as a co-variate within future BACI models should account for the influence of river levels on waterbird abundance or density, including potential bias from surveys conducted under atypical conditions, thereby increasing power to detect and more accurately characterize any changes in waterbird abundance and diversity.

Once the Site C reservoir begins to fill (currently anticipated during fall 2024), waterbird abundance and diversity metrics in the Inundation Impact area will no longer be influenced by river flow rates. Reservoir levels can be recorded during this period, but fluctuations in reservoir water levels will likely have lesser effects on waterbird distribution.

5.2 Peace River Surveys

Boat surveys of the Peace River in 2017 through 2023 have provided estimates of relative abundance and diversity throughout the spring and fall migrations to meet the waterbird monitoring program objectives (**Section 1.2**). All target taxa, including shorebirds, were observed during boat surveys. Results from Peace River observations in 2017 through 2023 identified 94% of birds to the species level and 98% of records to the foraging guild level at which Project-related effects are to be assessed (**Appendix B-1**). This represents a substantial improvement over survey methods applied prior to 2017, which were unable to detect shorebirds and had species identification rates under 80% (Hemmera 2017). Results of Peace River surveys are discussed below, first summarizing the relative abundance of foraging guilds and highlighting the most abundant species, then discussing patterns of abundance and diversity across habitat types along with the distribution of waterbirds across treatment areas and implications for assessing Project-related change.

Although analyzing trends and patterns of waterbird abundance and diversity across survey periods is not an objective of the study, it is nonetheless worth mentioning the data limitations that affect annual comparisons between survey periods within each season. A greater level of effort was applied during the first 3 years of monitoring (2017 through 2019) to determine the most efficient allocation of survey effort in subsequent years and provide confidence in meeting the study objectives (see the power analysis described in **Appendix A**). Thus, data from these first 3 years of monitoring are the most suitable for evaluating temporal variation in abundance and diversity within seasons (i.e., among survey periods in spring and fall). This data was provided in the 2019 annual report (Hemmera 2020) and **Appendix A**. Subsequent surveys and assessments of project-related change will continue to focus on the spring and fall survey periods monitored since 2020 and are not designed to assess or interpret variability among other periods of spring or fall migration.

The most abundant foraging guilds observed in the Peace River study area were large dabblers followed by dabbling ducks and gulls. Benthic-feeding divers, piscivorous divers, and shorebirds were the least-abundant waterbird guilds observed on the Peace River. At the species level, the most numerous waterbird observed on the Peace River across all years was Canada goose with cumulative counts of over 55,000 recorded across years, followed by mallard with counts totalling over 10,000 (**Appendix B-1**). Observations of over 5,000 Bonaparte's gull (*Chroicocephalus philadelphia*), Franklin's gull (*Leucophaeus pipixcan*), and Common Merganser (*Mergus merganser*) have also been recorded, representing the other 3 most abundant waterbird species observed on the Peace River since 2017 (**Appendix B-1**). Surveys in 1996 and 1999 resulted in similarly high abundances of Canada goose relative to other species, which, as in this study, made up over 50% of the observed waterbirds (Robertson 1999; Robertson and Hawkes 2000; Hawkes et al. 2006).

Data collected in 2017 through 2023 show that all habitats in the Peace River are used by waterbirds, with variations in timing, distribution and abundance for each foraging guild. The greatest densities of waterbirds were consistently observed within Limited Connectivity habitat, such as backchannels with little to no flow, silty sediments, and relatively abundant aquatic vegetation. Higher densities of dabbling ducks and large dabblers within more shallow habitats (e.g., Limited Connectivity and Moderate Flow habitats) align with findings from other studies assessing waterbirds associations with wetlands of various water depths (Colwell and Taft 2000; Baschuk et al. 2012).

In contrast with findings from these prior studies, benthic-feeding and piscivorous divers were also observed in higher densities within shallow Limited Connectivity habitat as compared to deeper waters within Mainstem habitat of the Peace River. This result was documented in 2023 and across all survey years in both spring and fall (see **Tables 9-12**). Greater prey availability for diving birds within shallow habitat could drive this consistently observed pattern of distribution across habitat types. Higher use of these more sheltered habitats may also be explained, or driven in part, by reduced exposure to predators within these more sheltered habitats which may provide preferable habitat to rest away from higher-energy flows within Mainstem habitat.

Despite higher densities within Limited Connectivity habitat, more birds were observed within the Mainstem of the Peace River than in any other habitat type. This is not surprising given that Mainstem habitat comprised the greatest proportion (77%) of the study area.

While overall densities of waterbirds observed across Peace River habitat types were highest in Limited Connectivity habitat regardless of season, densities varied between Mainstem and Moderate Flow habitats between seasons. In spring, waterbirds were observed in nearly 3-fold higher densities within Moderate Flow compared to Mainstem habitat, whereas densities were more even across these habitats during fall. This finding appears to have been driven by relatively low densities of dabbling ducks and large dabblers (e.g., Canada goose) within Moderate Flow habitat in spring, and higher abundances of gulls in the fall in through the fall of 2021 (i.e., in fall 2017 through 2021), which were primarily recorded in Mainstem habitat in both seasons. However, since 2022, abundances and densities of gulls within Mainstem habitat have been lower than in prior years. This result is likely due to the exclusion of areas immediately around the Site C dam, where large flocks of gulls (hundreds and occasionally over 1,000) had been recorded in prior years on gravel bars. Incidental observations of gulls in the area around the Site C construction bridge indicate flocks of gulls persist in this area.

Differences in detection rates across habitat types may contribute to higher apparent densities of some species within Limited Connectivity and Moderate Flow relative to Mainstem habitats given that the distance to detection is typically smaller within shallower habitats and birds are more readily flushed and detected in these circumstances. Thus, it is likely that detection rates of small birds (e.g., benthic-feeding divers, shorebirds, dabbling ducks) was greater within Limited Connectivity and Moderate Flow as compared to Mainstem habitats. Such potential biases related to distance to detection can be accounted for in analyses of Project-related effects through the application of distance sampling (Buckland et al. 2015), for which distance to detection measures have been recorded during surveys. Waterbird records are not tied to the river habitat categories applied in the summary statistics of this report. Thus, habitat types and assignments can be refined or reclassified to account for other factors if they are found to explain variation in waterbird abundance better than the habitat types used here.

The summary of data within treatment areas shows that waterbird densities were similar within the control and impact areas during spring, but densities documented during fall were higher within impact areas. Most importantly for meeting the assumptions of BACI study design, all foraging guilds occurring within impact areas were also documented within the Control area in both spring and fall. While all foraging guilds were present within the Control area, and most guilds were documented in similar densities within the Control area as in impact areas, the numbers and densities of benthic-feeding divers and gulls observed within the Control area have been low relative to the impact areas. High numbers of gulls in the Flow Impact area, particularly during fall in years prior to 2022, explain some of the divergence in gull densities across treatment areas. As described above, most gulls are concentrated around disturbed habitat at the Project construction site and close to the local landfill, but this area could not be surveyed by boat in 2022 or 2023 due to the construction activities in the area. Exclusion of these areas will be accounted for in future analyses of project-related effects. While benthic-feeding divers are found in low densities within the Control relative to other treatment areas, they are present and will still provide some indication of background variations in density under baseline (i.e., ‘before’) and operations period (i.e., ‘after’) conditions.

Surf scoter was the only species at risk regularly observed during Peace River surveys, with a total of 273 detected across years, including 2 during monitoring in 2023. California gull and tundra swan are similar in appearance to other species, so their numbers may have been underestimated. Some California gull detections may have been recorded as unknown gull species. Similarly, some tundra swan detections may have been recorded as unknown swan species or pooled with records of trumpeter swan (*Cygnus buccinator*).

5.3 Wetlands Surveys

Wetland surveys along the transmission line enabled estimation of spring and fall relative abundance and diversity of waterbirds in suitable wetland habitat types. Survey results provide the data required to meet the study's monitoring objectives (**Section 4.2**). A representative suite of sampling stations has been established, and consistent monitoring of these has been conducted in 2018 through 2023. Additionally, 7 consecutive years of monitoring have been conducted within open water wetland habitats surveyed by standwatch methods. These methods provide density and relative abundance data for all wetland habitats where waterbirds have been found to regularly occur and are sufficient to characterize the relative abundance and diversity of waterbirds during spring and fall migration, which is briefly summarized below.

Following adjustments to survey protocols to confirm species ID for flocks of 10 or more birds or >10% of total abundances in a survey, the proportion of birds identified at the species level during standwatch surveys was raised from 77% in 2022 (Ausenco 2023) to 85% in 2023 (**Appendix B-2**). While species level identification was not possible for some of these flocks, observers were able to identify the foraging guild for 97% of the waterbirds observed. Additionally, of the 15% of individuals not identified to species, 6% were identified to genus (e.g., goldeneye [*Bucephala*], scaup [*Aythya*], scoter [*Mellanita*], yellowlegs [*Tringa*]) such that 91% were identified to genus or species. The proportion of waterbird detections identified to foraging guild, genus, and species will be taken into consideration when assessing potential Project effects to waterbird diversity.

The dabbling ducks were the most commonly recorded foraging guild in open water and flooded wetlands surveyed by standwatch methods (**Table 19, Table 20, Appendix B**). Ring-necked duck (*Aythya collaris*), American wigeon (*Mareca americana*), scaup, green-winged teal (*Anas crecca*) and mallard were among the most numerous species observed. Wetland transect survey data indicated that dabbling ducks (e.g., mallard, green- and blue-winged teal [*Spatula discors*], northern shoveler [*Spatula clypeata*]) and marsh birds (e.g., Wilson's snipe [*Gallinago delicata*], and sora) were the most abundant species (**Appendix B-1**). Shorebirds, primarily spotted sandpiper (*Actitis macularius*), lesser yellowlegs, and solitary sandpiper (*Tringa solitaria*), were the next most abundant.

Open water habitats such as lakes and ponds had the greatest number of waterbird observations and the highest diversity, mostly of dabbling ducks. This finding is consistent with the 2006 through 2008 studies in the transmission line ROW area (EIS, appendix R, part 4) and is aligned with prior reports from this monitoring program (Hemmera 2017, 2018, 2019, 2020; Hemmera 2022; Ausenco 2023). While fewer waterbirds were observed within sedge and willow-sedge habitats surveyed by transect methods compared to standwatch surveys of open water and flooded habitats, transect surveys documented abundances of sora and Wilson's snipe which seldom use flooded habitat and, consequently, have seldom been recorded during standwatch surveys.

Survey efforts within the wetlands study area were not entirely consistent across years due to weather and access constraints. Measures of diversity will ultimately be refined by accounting for variation in survey effort in all survey years to provide cleaner comparisons, and including statistical significance tests, across years when assessing Project-related change to waterbird diversity. Similarly, while estimates of density per kilometre of transect are considered sufficient for the purposes of documenting annual data collection in this report and for documenting change over time, future analyses considering transect width and distance sampling will provide more accurate estimates of density.

As in prior monitoring years, the 2023 study was challenged by changes to habitat within the wetlands study area. During 2021, 2022, and 2023, wetland survey station OW-10 was often drained of water, apparently due to the installation or modification of culverts unrelated to the project on the southern edge of these survey station polygons. Access to stations SE-12 and OW-14 was constrained by floating vegetation and tree fall on access roads, respectively. Consequently, in 2023, these areas were only surveyed on rare occasions (OW-10, OW-14) or not at all (SE-12). As noted in **Section 4.2.1.1**, additional habitat was identified for surveys at station OW-12 to compensate for reduced or eliminated survey effort at these other stations.

The ARU survey results are satisfying monitoring objectives to document the presence and distribution of yellow rail, American bittern, sora, and, beginning in 2020, Virginia rail. Results indicate that, within the wetland habitats targeted for monitoring, America bittern is rare or absent, sora is common if not ubiquitous, and Virginia and yellow rail occur regularly, but are less abundant than sora and potentially more selective of sedge-dominated wetlands. In accordance with historical records of yellow rail illustrated in **Figure 5**, this study has regularly documented this species within relatively large areas of non-flooded sedge habitat (Hilton et al. 2013). Results from bioacoustics monitoring suggest that yellow rail also occurs within mixed sedge and willow-sedge habitat adjacent to upland forested habitat as well as sedge-dominated wetlands between open water and forested habitats (e.g., SE-03 and OW-01). Since no records of American bittern were confirmed during 7 years of monitoring or as part of any other Site C wildlife studies, it is unlikely that bioacoustics monitoring will yield meaningful estimates of density or distribution beyond what is already known; the species is rare and typically absent or undetected within suitable habitat in the region. In contrast, sora has been detected in 90% of deployments conducted to date, including in all wetlands and mixed habitat types surveyed and in all portions of the bioacoustics monitoring period (**Table 23**). Sora is also regularly detected during wetlands transect and standwatch surveys, providing additional data from May (middle and late spring survey periods) as well as August (early fall).

Results of bioacoustics monitoring in 2023 and prior years provide some insight regarding potential variability in detection rates for different portions of the monitoring period applied thus far for marsh birds. Yellow rail does vocalize within wetlands through at least through mid-July. However, considering that only 2 of 15 yellow rail detections were recorded after July 15, and no yellow rail detections have been recorded from deployments beginning on July 25 or later, they appear to be less abundant or less vocally active at this time. Two late season deployments starting on July 27, 2022, and July 25, 2023, targeted wetlands in which yellow rail were documented in prior years (SE-04 and SE-11) to test the theory of declining vocalization frequency in later months. No yellow rails were detected from any of these deployments indicating that all future deployments should begin no later than mid-July and monitoring conducted to date in late July and August may be inappropriate for assessing yellow rail presence. In contrast, Virginia rail has been detected from at least 2 deployments in late July and August, so may continue to vocalize later than yellow rail. Across all years, the only 4 ARU deployments from which sora was not detected began in late July. Sora was detected in all deployments beginning as late as July 22, so the species appears to vocalize consistently through mid-July, but perhaps less consistently in late July and August. This year was the first year that Virginia rail vocalizations were not conclusively identified in any ARU deployment recordings, despite ARUs having been deployed at 2 locations where the species was detected in prior years. These stations (SE-04 and SE-11) should be surveyed again during earlier portions of the monitoring period in subsequent years to further inform the species' consistency in occupying sedge habitat. Future bioacoustics monitoring efforts will also target any vegetated wetland habitats present within wetland stations that have not yet been surveyed with ARUs (OW-02, OW-09, OW-10, OW-14).

Monitoring conducted thus far has successfully collected data required to evaluate changes to baseline conditions in habitat, abundance, and diversity of waterbirds, including species at risk, as per the study objectives. Continued monitoring using methods described in this report, and applied in 2023, will meet monitoring program requirements for use in evaluations of project-related change to waterbird habitat and habitat use.

6.0 Closing

We sincerely appreciate the opportunity to have assisted BC Hydro with this project and if there are any questions, please do not hesitate to contact the undersigned by phone or email.

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Appendix A

Ducks Unlimited / Native Plant Solutions
Technical Memorandum - Waterbird Program Analysis:
Statistical Analysis of Survey Effort and Timing,
Combined 2017, 2018, and 2019 Peace River
Waterbird Data

Ducks Unlimited Canada
Conserving Canada's Wetlands

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April 16, 2020

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ATTENTION: Brock Simons

RE: Waterbird Program Analysis:
Statistical Analysis of Survey Effort and Timing,
Combined 2017, 2018 and 2019 Peace River Waterbird Data

Overview

BC Hydro has requested Native Plant Solutions (NPS)/Ducks Unlimited Canada (DUC) to repeat statistical analyses performed in December 2019 on the Peace River Waterbird data, now with combined 2017, 2018 and 2019 data. The intent of this technical memo is to outline the results of the analysis, as part of preparation for the 2020 waterbird monitoring field season. Specifically, DUC reviewed survey effort and survey timing in 2017, 2018 and 2019, based on the data provided by Hemmera on November 19th, 2019 and December 18th, 2019. The review focused on the 2017-2019 River Transect Waterbird data, including statistical analyses of the difference in density observed during survey periods (Statistical Analysis #1) and the sampling effort required to detect change (Statistical Analysis #2). The analysis also determines what effect dropping the UAV portion of the survey program will have on the overall survey effort required.

Background to monitoring methodology

Statistical analysis was conducted on the combined 2017-2019 unmanned aerial vehicle (UAV) and river boat survey data. During each season of migration, the season was split into several periods (spring: early, mid, late; and fall: early, early-mid, late-mid and late). Survey effort in 2019 was kept the same as in 2018 with the goal of better capturing and defining optimal survey periods for each foraging group and determining if the late fall survey period added in 2018 improved detection of Benthic Divers. Table 1 lists the survey periods and dates for each field season.

Within most survey periods, two replicate surveys were conducted, with each survey taking two days to complete. There was an exception in 2018 where three days were required due to ice washing down the Peace River on April 26 in the middle of the survey. There was also an exception in 2019 where three days were required to complete the first survey of the season (April 3, 4, 8). Note that in spring 2017, one survey day was dropped from statistical analysis (April 12), due to poor weather and therefore low bird counts. Survey dates in 2017-2019 were as described in Table 1.

Table 1. Survey periods and dates in 2017, 2018 and 2019.

Period	2017 Dates	2018 Dates	2019 Dates
Spring_Early	Apr. 5, 6	Apr. 13, 14	Apr. 3, 4, 8; Apr. 11, 12
Spring_Mid	Apr. 26, 27; May 3, 4	Apr. 25, 26 & May 1; May 5, 6	Apr. 19, 24; May 1, 2
Spring_Late	May 10, 11; May 14, 15	May 10, 11; May 18, 19	May 9, 10
Fall_Early	Aug. 8, 9; Aug. 14, 15	Aug. 4, 5	Aug. 7, 9
Fall_Early-Mid	Aug. 22, 23; Aug. 28, 29	Aug. 20, 21; Sep. 4, 5	Aug. 19, 20; Sep. 4, 5
Fall_Late-Mid	Sep. 21, 22; Sep. 27, 28	Sep. 20, 21; Oct. 4, 5	Sep. 16, 17; Sep. 30, Oct. 1
Fall_Late	none	Oct. 15, 16	Oct. 16, 17

In this technical memo, the following terminology is used when referring to the waterbird monitoring program:

- **Survey period:** A survey period is the timing of when a survey happens within a season (i.e., spring or fall) to document migrants, including early, early-mid, mid, late-mid and late. The original study design of the Waterbird Migration Follow-up Monitoring Program (BC Hydro 2018) was structured to have two surveys within each period acting as replicates to provide measures of uncertainty around estimates of relative abundance and diversity. For example, late spring is a survey period, containing two surveys.
- **Survey:** A survey is the census of waterbirds over the length of the Peace River, from the Peace Canyon Dam (Hudson's Hope) to the Alberta border (BC Hydro 2018). A survey typically takes two survey days to complete. For example, April 5 and 6 in spring 2017 is an early survey. Survey effort is quantified as the total length (km) of the river impact and control areas surveyed over the course of a survey.
- **Survey day:** A survey takes two survey days (noting the above-mentioned exceptions) to complete, with half of the river study area being surveyed each day and, in most cases, the whole river being surveyed in consecutive days. Each day is referred to in this technical memo as a survey day. For example, 12 survey days were conducted in fall of 2017 (e.g., August 8, 9, 14, 15, 22, 23, 28 and 29, and September 21, 22, 27 and 28).
- **Survey Area:** A survey area is a portion of the river labelled as one of control, flow impact, and inundation impact. For the remainder of this technical memo, flow and inundation impacts will be treated together as the "impact" area.

Statistical Analysis #1 - Statistical analysis of differences in density observed during survey periods (i.e., early, mid and late) in spring and fall

Statistical Analysis #1 tests for differences among early, mid and late periods in both spring and fall survey periods. Based on the results of Statistical Analysis #1, the biological inference that can be made from this is to assess if the timing and number of survey periods in spring and fall of 2017, 2018 and 2019 were capturing peaks in abundance during migration and the specific survey timing recommended for capturing any peaks.

The spring and fall survey periods were analysed separately, fit with foraging group-specific negative binomial regression models, with total bird counts per complete river survey (normally completed over two consecutive days) as the response and survey period (Spring: early vs. mid vs. late; and Fall: early vs. early-mid vs. late-mid vs. late), study area (control vs flow and inundation impact) and year as predictors. The natural log of surveyed river length by study area (km) was used as an offset variable to scale total bird counts for differing effort across surveys. Survey period and study area were treated as additive predictors in the foraging group model since preliminary analyses suggested similar patterns in waterbird abundance peaks across the control and impact areas.

A complete list of species observed during spring and fall surveys in 2017, 2018 and 2019 is provided in Appendix A. Some species and foraging groups (e.g., bald eagles) were not included in the combined analysis due to the low densities observed. Differences in density among survey periods were also analyzed at a foraging group level. The allocation of species to each foraging group is also listed in Appendix A. Discussion of the 2017-2019 data is focused at the foraging group level because of the greater strength of inference analysis at the foraging group level allows (see NPS 2018 technical memo).

During spring migration surveys (Table 2), at a foraging group level, the early period yielded the highest counts for Large Dabblers and Piscivorous Divers and lowest counts for Surface Feeding Terns/Gulls. Late spring surveys yielded the highest counts for Shorebirds, Surface Feeding Terns/Gulls, with lowest counts for Benthic-Feeding Divers and Piscivorous Divers.

During fall migration surveys (Table 3), at a foraging group level, the early survey period yielded the highest counts for Shorebirds and lowest counts for Large Dabblers. Late-mid and late fall surveys yielded the highest counts for Large Dabblers.

Table 2. Spring survey periods results.

Forage Group	Differences in densities observed among Early, Mid, and Late Periods	Estimated number of birds seen per 100 km of river surveyed (standard error)[1]
Foraging Group Level[2]		
Benthic Feeding Divers	Early and Mid > Late	Control: E: 32.8 (12.1); M: 32.1 (12.2); L: 9.2 (3.2) Impact: E: 98.1 (36.8); M: 95.9 (29.5); L: 27.5 (10.1)
Dabbling Ducks	No	Control: 413.2 (49.2) Impact: 289.5 (33.3)
Surface Feeding Terns/Gulls	Mid and Late > Early	Control: E: 0.3 (0.3); M: 10.7 (5.4); L: 14.2 (7.5) Impact: E: 0.9 (0.6); M: 30.4 (14.8); L: 40.1 (21.2)
Large Dabblers (Geese and Swans)	Early > Mid and Late	Control: E: 1,154.0 (136.7); M: 444.3 (48.7); L: 365.8 (40.2) Impact: E: 1,151.3 (136.2); M: 443.3 (44.7); L: 365.0 (40.4)
Piscivorous Divers	Early > Mid > Late	Control: E: 79.6 (16.9); M: 33.5 (6.3); L: 19.2 (3.7) Impact: E: 183.7 (33.8); M: 77.4 (13.3); L: 44.2 (8.5)
Shorebirds	Late > Early and Mid	Control: E: 1.1 (0.6); M: 1.9 (0.9); L: 52.9 (15.7) Impact: E: 1.3 (0.6); M: 2.2 (0.8); L: 63.2 (22.6)

[1] – E: early; M: mid; L: late.

[2] – Highest survey counts for Foraging Groups are indicated in red.

Table 3. Fall survey periods results.

Species or Forage Group	Differences in densities observed among Early, Early-Mid, Late-Mid, and Late Periods	Estimated number of birds seen per 100 km of river surveyed (standard error)[1]
Foraging Group Level[2]		
Benthic-Feeding Divers	No	Control: 1.0 (0.6) Impact: 7.6 (2.9)
Dabbling Ducks	Early-Middle and Late-Middle > Late	Control: E: 16.2 (7.5); E-M: 30.2 (11.3); L-M: 35.9 (12.1); L: 4.4 (2.7) Impact: E: 185.0 (78.2); E-M: 344.2 (117.8); L-M: 409.9 (163.1); L: 50.2 (25.8)
Surface Feeding Terns/Gulls	Early, Early-Middle and Late-Middle > Late	Control: E: 12.3 (6.1); E-M: 24.8 (8.8); L-M: 9.5 (3.6); L: 1.7 (1.1) Impact: E: 591.3 (220.3); E-M: 1,190.9 (480.2); L-M: 458.1 (175.1); L: 82.5 (49.8)
Large Dabblers (Geese and Swans)	Late and Late-Middle > Early; Late-Middle > Early-Middle	Control: E: 255.0 (63.4); E-M: 469.9 (110.9); L-M: 939.5 (193.5); L: 780.6 (263.7) Impact: E: 145.1 (37.1); E-M: 267.3 (55.6); L-M: 534.5 (115.2); L: 444.1 (152.0)
Piscivorous Divers	No	Control: 16.6 (3.9) Impact: 20.7 (4.0)
Shorebirds	Early > Early-Mid > Late-Mid	Control: E: 228.5 (40.4); E-M: 96.7 (15.4); L-M: 3.5 (0.9); L: 0 (--) Impact: E: 112.2 (19.0); E-M: 47.5 (7.6); L-M: 1.7 (0.5); L: 0 (--)

[1] – E: early; E-M: early-mid; L-M: late-mid; L: late.

[2] – Highest survey counts for Foraging Groups are indicated in red.

Statistical Analysis #2 - Statistical power analysis to estimate sampling efforts required to detect change in impact area relative to control

The second objective of the statistical analysis was to conduct a power analysis, based on the available 2017, 2018 and 2019 survey data, to estimate the sampling effort required to detect change of a specific magnitude in the impact area relative to the control area. Based on the results of the statistical analysis, this provides guidance on determining the magnitude and possibilities for allocating effort to detect, with 80% statistical power, a 50% change in foraging group abundance in the impact area contrasted with no change in the control area over time.

For Statistical Analysis #2 a baseline average of relative abundances for the impact and control areas were calculated from the 2017, 2018 and 2019 survey data. Within the 2017-2019 survey data, some foraging groups exhibited differences in counts among survey periods in a season, whereas other foraging groups did not. For the foraging groups for which there were statistically detectable differences in counts across survey periods, relative abundance estimates from particular survey periods are informative baselines as identifiable 'optimal' survey periods, such that averaging across survey periods would conceal important within-season differences in relative abundances. Therefore, for foraging groups exhibiting statistically detectable differences in counts across survey periods, baseline bird densities were estimated using the survey periods that yielded the highest densities. For foraging groups without statistically detectable differences in counts across survey periods (i.e., either due to counts that did not vary much across survey periods over a season, or where counts varied greatly among surveys within a survey period), relative abundance estimates from particular survey periods are not informative baselines. Rather, pooled baseline estimates of abundance across a season are best and will mitigate the impacts of survey-specific variation. Therefore, for foraging groups where there were not statistically detectable differences in counts among survey periods, baseline bird densities were estimated using averages across all surveys.

Relative abundance is the average number of birds that were counted during a survey in a study area (control vs flow and inundation impact), per 100 km length of river surveyed. Given the best estimates of foraging group relative abundances (and their standard errors) from the 2017-2019 survey data, the statistical power analyses estimated the sampling efforts required to detect changes of a specified magnitude in the impact area as contrasted with no change in the control area. For the purposes of this analysis, a 50% change in relative abundance in the impact area was seen as a reasonable target (i.e., both statistical and biological; Hatch 2003). Tables 4 and 5 give the survey effort required to detect 50% change in relative abundance in the impact area versus no change in the control area given 2017-2019 spring (Table 4) and fall (Table 5) survey baselines. Note that survey effort is given in the number of surveys and the estimated number of years to detect change (i.e., should the current survey effort be maintained over time).

In spring (Table 4), the survey effort required to detect a 50% change in relative abundance (i.e., based on the 2017-2019 spring survey data) in the impact area versus no change in the control area was the least for Large Dabblers (Geese and Swans), with increasing survey effort to detect change in Piscivorous Divers, Dabbling Ducks, Benthic-Feeding Divers, and Surface Feeding Terns/Gulls. Note that early and mid surveys are not informative for estimating relative abundance of Shorebirds. In fall (Table 5), the survey effort required to detect a 50% change in relative abundance (i.e., based on the 2017-2019 fall survey data) in the impact area versus no change in the control area was the least for Shorebirds, with increasing survey effort to detect change in Large Dabblers, Dabbling Ducks, Piscivorous Divers, Surface Feeding Terns/Gulls, and Benthic-Feeding Divers.

Table 4. Survey effort required to detect a 50% change in relative abundance in the impact area contrasted with no change in the control area given a 2017-2019 Spring Survey baseline. [1]

Forage Group	Survey Periods Used for Estimating Baseline Abundance (number of complete river surveys in 2017-2019)	2017-2019 Baseline Average Relative Abundance per 100 km (Standard Error)	Estimated survey effort required beyond 2017-2020 baseline period
Benthic-Feeding Divers	Early & Mid (n = 10 surveys)	Control: 32.4 (9.7) Impact: 97.0 (24.8)	12 (3 years; assuming 2 early and 2 mid surveys each year)
Dabbling Ducks	Early, Mid, Late (n = 15 surveys)	Control: 413.2 (49.2) Impact: 289.5 (33.3)	9 (~3 years; assuming 4 complete river surveys per year)
Surface Feeding Terns/Gulls	Mid & Late (n = 11 surveys)	Control: 12.3 (4.9) Impact: 34.9 (13.5)	18 (~9 years; assuming 2 mid surveys per year)
Large Dabblers (Geese and Swans)	Early (n = 4 surveys)	Control: 1154.0 (136.7) Impact: 1151.3 (136.2)	1 (1 year; assuming 2 early surveys per year)
Piscivorous Divers	Early (n = 4 surveys)	Control: 79.6 (16.9) Impact: 183.7 (33.8)	3 (2 years; assuming 2 early surveys per year)
Shorebirds	Late (n = 5 surveys)	Control: 52.9 (15.7) Impact: 63.2 (22.6)	10 (n/a; no additional late surveys planned)

[1] – Red indicates foraging groups that should not be the focus of surveys within this season.

Table 5. Survey effort required to detect a 50% change in relative abundance in the impact area contrasted with no change in the control area given a 2017-2019 Fall Survey baseline. [1]

Forage Group	Survey Periods Used for Estimating Baseline Abundance (number of complete river surveys in 2017-2019)	2017-2019 Baseline Average Relative Abundance per 100 km (Standard Error)	Estimated survey effort required beyond 2017-2020 baseline period
Benthic-Feeding Divers	Early, Early-Mid, Late-Mid, Late (n = 18 surveys)	Control: 1.0 (0.6) Impact: 7.6 (2.9)	> 210 (> 70 years; assuming 3 complete river surveys per year)
Dabbling Ducks	Early, Early-Mid, Late-Mid, (n = 16 surveys)	Control: 26.0 (6.9) Impact: 296.7 (76.3)	9 (3 years; assuming 1 early, 1 early-mid and 1 late-mid survey per year)
Surface Feeding Terns/Gulls	Early, Early-Mid, Late-Mid (n = 16 surveys)	Control: 14.3 (4.2) Impact: 685.8 (173.2)	24 (~8 years; assuming 1 early, 1 early-mid and 1 late-mid survey per year)
Large Dabblers (Geese and Swans)	Early-Mid, Late-Mid, Late (n = 14 surveys)	Control: 701.1 (124.8) Impact: 398.8 (69.0)	2 (1 year; assuming 1 early-mid and 1 late-mid survey per year)
Piscivorous Divers	Early, Early-Mid, Late-Mid, Late (n = 18 surveys)	Control: 16.6 (3.9) Impact: 20.7 (4.0)	15 (5 years; assuming 1 early, 1 early-mid and 1 late-mid survey per year)
Shorebirds	Early (n = 4 surveys)	Control: 228.5 (40.4) Impact: 112.2 (19.0)	2 (2 years; assuming 1 early survey per year)

[1] – Red indicates foraging groups that should not be the focus of surveys within this season.

The sensitivity of these results to exclusion of the survey data collected on back channels via unmanned aerial vehicles (UAVs) was also examined. For each survey and survey area, the proportion of the area surveyed by UAV was excluded from the measure of survey effort (i.e., surveyed river length) and all birds observed during UAV surveys were excluded from total bird counts. A summary of the proportions of area surveyed by UAV and total birds counted by UAV is provided in Table 6. In the fall, UAV surveys accounted for a large proportion of the Large Dabblers counted overall and for Dabbling Ducks counted in the impact area.

Table 6. Average proportion of River Survey Area and Total Birds counted by UAV.

Study Area	River Area	Benthic-Feeding Divers	Dabbling Ducks	Surface-Feeding Terns/Gulls	Large Dabblers	Piscivorous Divers	Shorebirds
Spring Surveys							
Control	0.038	0.082	0.050	0.172	0.120	0.112	0.000
Impact	0.063	0.073	0.165	0.050	0.141	0.060	0.030
Fall Surveys							
Control	0.026	0.000	0.128	0.000	0.476	0.032	0.005
Impact	0.033	0.208	0.459	0.001	0.286	0.128	0.032

Adjusted baseline average relative abundances were calculated, omitting the UAV data, and power analyses re-run to estimate sampling effort required to detect, with 80% statistical power, 50% changes in relative abundance in the impact area versus no change in the control area given 2017-2019 spring (Table 7) and fall (Table 8) survey baselines.

Table 7. Survey effort required to detect a 50% change in relative abundance in the impact area contrasted with no change in the control area given a 2017-2019 Spring Survey baseline (UAV data omitted). [1]

Forage Group	Survey Periods Used for Estimating Baseline Abundance (number of complete river surveys in 2017-2019)	2017-2019 Baseline Average Relative Abundance per 100 km (Standard Error)	Estimated survey effort required beyond 2017-2020 baseline period
Benthic-Feeding Divers	Early & Mid (n = 10 surveys)	Control: 31.3 (9.6) Impact: 95.9 (24.7)	11 (~3 years; assuming 2 early and 2 mid surveys each year)
Dabbling Ducks	Early, Mid, Late (n = 15 surveys)	Control: 392.6 (44.8) Impact: 246.9 (27.3)	8 (2 years; assuming 4 complete river surveys per year)
Surface Feeding Terns/Gulls	Mid & Late (n = 11 surveys)	Control: 7.9 (3.3) Impact: 41.2 (16.9)	80 (40 years; assuming 2 mid surveys per year)
Large Dabblers (Geese and Swans)	Early (n = 4 surveys)	Control: 1121.6 (138.4) Impact: 1096.7 (134.5)	1 (~1 year; assuming 2 early surveys per year)
Piscivorous Divers	Early (n = 4 surveys)	Control: 79.0 (18.9) Impact: 197.3 (41.9)	2 (~2 years; assuming 2 early surveys per year)

Forage Group	Survey Periods Used for Estimating Baseline Abundance (number of complete river surveys in 2017-2019)	2017-2019 Baseline Average Relative Abundance per 100 km (Standard Error)	Estimated survey effort required beyond 2017-2020 baseline period
Shorebirds	Late (n = 5 surveys)	Control: 54.1 (13.1) Impact: 54.5 (15.2)	10 (n/a; no additional late surveys planned)

[1] – Red indicates foraging groups that should not be the focus of surveys within this season.

Table 8. Survey effort required to detect a 50% change in relative abundance in the impact area contrasted with no change in the control area given a 2017-2019 Fall Survey baseline (UAV data omitted). [1]

Forage Group	Survey Periods Used for Estimating Baseline Abundance (number of complete river surveys in 2017-2019)	2017-2019 Baseline Average Relative Abundance per 100 km (Standard Error)	Estimated survey effort required beyond 2017-2020 baseline period
Benthic-Feeding Divers	Early, Early-Mid, Late-Mid, Late (n = 18 surveys)	Control: 0.9 (0.6) Impact: 6.5 (3.2)	> 210 (> 70 years; assuming 3 complete river surveys per year)
Dabbling Ducks	Early, Early-Mid, Late-Mid, (n = 16 surveys)	Control: 24.8 (7.2) Impact: 198.9 (56.0)	12 (4 years; assuming 1 early, 1 early-mid and 1 late-mid survey per year)
Surface Feeding Terns/Gulls	Early, Early-Mid, Late-Mid (n = 16 surveys)	Control: 14.8 (4.4) Impact: 720.8 (184.5)	12 (4 years; assuming 1 early, 1 early-mid and 1 late-mid survey per year)
Large Dabblers (Geese and Swans)	Early-Mid, Late-Mid, Late (n = 14 surveys)	Control: 505.0 (89.2) Impact: 323.9 (57.6)	2 (1 year; assuming 1 early-mid and 1 late-mid survey per year)
Piscivorous Divers	Early, Early-Mid, Late-Mid, Late (n = 18 surveys)	Control: 15.6 (3.9) Impact: 17.8 (3.7)	13 (~4 years; assuming 1 early, 1 early-mid and 1 late-mid survey per year)
Shorebirds	Early (n = 4 surveys)	Control: 230.7 (40.4) Impact: 113.0 (19.0)	2 (2 years; assuming 1 early survey per year)

[1] – Red indicates foraging groups that should not be the focus of surveys within this season.

Given the estimates of survey effort required beyond 2019 and survey periods suited to characterizing relative abundance or use by each foraging group, we can consider different scenarios for survey plans in future years. Factors to consider for future efforts include the following:

- If a foraging group is observed in lower abundances or with greater variability across survey periods, the ability to detect a 50% change in relative abundance in the impact area contrasted with no change in the control area may not be achievable within a reasonable time period, which is defined as ≤ 10 years, or the post-construction monitoring period. The foraging groups shaded in grey tone in Tables 9 and 10 fall into this category. BC Hydro may want to consider tailoring their spring and fall survey plans to exclude certain foraging groups, for which detecting statistically significant differences over time is unlikely during the period of the waterbird monitoring program (e.g., Surface Feeding Terns/Gulls and shorebirds in spring; Benthic-Feeding Divers in fall).
- If peak abundances for a foraging group are observed uniquely in a survey period, the region should be surveyed during that time period. For example, the early survey period is important to characterize relative abundances of Large Dabblers and Piscivorous Divers in spring, compared to the early survey time for Shorebirds in fall.
- For species whose relative abundances or use are well captured during any survey within a survey period (e.g., Dabbling Ducks in spring and fall; Benthic-Feeding Divers and Piscivorous Divers in fall), the particular timing of surveys does not play much of a role. It is simply the overall survey effort that helps to moderate the variability observed across survey occasions.

Tables 9 and 10 consider the impacts of survey timing scenarios given that an early survey is necessary in the spring and late-mid or late surveys may be necessary in the fall. In general, a 50% change in relative abundance in the impact area contrasted with no change in the control area would be detected within 10 years for five of the foraging groups in spring. It will take 8 years of effort of 3 or more fall surveys/year to detect a 50% change in relative abundance in the impact area contrasted with no change in the control area for five of the foraging groups.

Table 9. Impacts of modified Spring Waterbird Survey plans beyond 2020. [1]

Foraging Group	Periods useful for Characterizing Foraging Group Use	Estimated survey effort (number of surveys) required beyond 2017-2020 baseline period	Number of years required if 1 Early Survey is conducted per year (*n= 2 survey days required/spring season)*	Number of years required if 2 Early Surveys is conducted per year *(n= 4 survey days required/spring season)*	Number of years required if 2 Early Surveys, 1 Mid Survey are conducted per year *(n= 6 survey days required/spring season)*	Number of years required if 2 Early Surveys, 2 Mid Surveys conducted are per year *(n= 8 survey days required/spring season)*
Dabbling Ducks	Any	9	9	5	3	3
Large Dabblers	Early	1	1	1	1	1
Piscivorous Divers	Early	3	3	2	2	2
Benthic Feeding Divers	Early, Mid	12	12	6	4	3
Surface Feeding Terns/Gulls	Mid, Late	18	-	-	18	9
Shorebirds	Late	10	-	-	-	-

[1] – Grey indicates foraging groups where 50% change cannot be detected within 10 years, with 80% statistical power, with the survey scenarios described.

Table 10. Impacts of modified Fall Waterbird Survey plans beyond 2020. [1]

Foraging Group	**Periods useful for Characterizing Foraging Group Use**	**Estimated survey effort (number of surveys) required beyond 2017-2020 baseline period**	**Number of years required if 1 Early Survey, 1 Late-Mid Survey is conducted per year** (*n= 4 survey days required/fall season)*	**Number of years required if 1 Early Survey, 1 Late-Mid, 1 Late Survey are conducted per year** (*n= 6 survey days required/fall season)*	**Number of years required if 1 Early Survey, 1 Early-Mid, 1 Late-Mid Survey are conducted per year** (*n= 6 survey days required/fall season)*	**Number of years required if 1 Early Survey, 1 Early-Mid, 1 Late-Mid, 1 Late Survey are conducted per year** (*n= 8 survey days required/fall season)*
Piscivorous Divers	Any	15	8	5	5	4
Large Dabblers	Early-Middle, Late-Middle, Late	2	2	1	1	1
Surface Feeding Terns/Gulls	Early, Early-Middle, Late-Middle	24	12	12	8	8
Dabbling Ducks	Early-Middle, Late-Middle, Late	9	9	5	5	3
Shorebirds	Early	2	2	2	2	2
Benthic-Feeding Divers	Any	> 210	> 105	> 70	> 70	> 53

[1] – Grey indicates foraging groups where 50% change cannot be detected within 10 years, with 80% statistical power, with the survey scenarios described.

Discussion

For the spring 2017-2019 survey data, optimal survey periods were identified for most foraging groups, except for Dabbling Ducks. The early and mid-surveys in spring yielded the highest counts for Benthic-Feeding Divers, Large Dabblers and Piscivorous Divers, while the late survey yielded the highest survey counts for Gulls/Surface Feeding Terns and Shorebirds. As presented in the statistical analyses of the 2017-2019 waterbird data, Dabbling Duck density was variable among surveys, but peak counts did not align with particular survey periods; it is overall survey effort rather than a particular allocation across survey periods that is useful for moderating the effects of survey-to-survey variability in Dabbling Duck counts.

For the fall 2017-2019 survey data, no optimal survey periods were clear for Piscivorous Divers or Benthic-Feeding Divers, due to high survey-to-survey variation in counts that did not align with particular survey periods. Low counts coupled with high variation, as seen with the Benthic-Feeding Divers, results in a high survey effort required to detect change in the fall (Table 5).

In order to efficiently detect, with 80% statistical power, 50% changes in relative abundance in the impact area versus no change in the control area, survey effort should be focused on the survey period(s) that best characterize the relative abundance of each foraging group. Tables 9 and 10 demonstrated various scenarios of survey effort and the subsequent number of years it will take to detect a 50% change in relative abundance in the impact area versus no change in the control for each foraging group.

Based on the results of the power analysis of survey effort scenarios in spring, conducting two early surveys per year will allow for the detection of 50% change in relative abundance in the impact area versus no change in the control within 1-6 years for Dabbling Ducks (n=18 field surveys days required), Large Dabblers (n=2 early field survey days required), Piscivorous Divers (n=6 early field survey days required) and Benthic-Feeding Divers (n=24 early or mid field survey days required) (Table 9). We recommend that Surface Feeding Terns/Gulls or Shorebirds not be the focus in spring surveys, because of the low likelihood of being able to detect statistically significant changes in these foraging groups within the waterbird monitoring program (i.e., during construction and the first 10 years of operations).

Based on the results of power analysis of survey effort scenarios in fall, conducting 1 early and 1 late-mid survey per year will allow for the detection of 50% change in relative abundance in the impact area versus no change in the control within 2-9 years for Piscivorous Divers (n=30 survey days), Large Dabblers (n=4 late-mid survey days), Dabbling Ducks (n=18 late-mid survey days) and Shorebird (n=4 early survey days). Changes in the impact areas (relative to no change in the control areas) for Surface Feeding Terns/Gulls can be detected within 12 years (n=48 survey days) with 1 early and 1 late-mid survey. Adding one more early, early-mid or late-mid survey per fall season does improve the power to detect changes in Surface Feeding Terns/Gulls in a shorter period (n=8 years; 48 survey days; Table 10).

For fall surveys we recommend that the focus is not on Benthic-feeding Divers because of the greater survey effort required to detect this foraging group within the fall season as compared to the spring season. Under the scenarios presented in Table 10 a 50% change in the impact area versus no change in the control for Benthic-Feeding Divers cannot be detected within 10 years.

Each foraging group varies from one another on life characteristics such as nesting and foraging behaviors, diet preferences and habitat preferences. Variation can also be seen within a foraging group as well. For example, Piscivorous Divers have similar food preferences, but vary in nesting behaviors. This makes it difficult to use one foraging group as an indicator for another. Statistically, Shorebirds and Surface Feeding Terns/Gulls have similar peaks in abundance, however they differ from all other foraging groups in this regard, which also makes the use of other foraging groups as an indicator difficult.

Overall, this suggests that to create more efficiency within the Waterbird survey program the early and mid surveys should be the focus during the spring survey period. Reduction in fall survey effort could include eliminating the early-mid and late-mid replicates, and the late period to detect of Surface Feeding Terns/Gulls within 8 years (n=48 survey days), with the caveat that focus of detecting Benthic Feeding Divers will be in the spring season.

The removal of the UAV data had little impact on the required survey effort (Tables 7 and 8) with exception to the Surface Feeding Terns/Gulls in the Spring survey period. Survey effort for this foraging group increased from 9 years to 40 years (given 2 mid surveys) with the exclusion of UAV data. If it is determined to be in the best interest of the survey program to eliminate the UAV portion of the waterbird surveys the detection of Surface Feeding Terns/Gulls should be focused on in the fall season.

References

BC Hydro. 2018. Site C Vegetation and Wildlife Waterbird Migration Follow-up Monitoring Program (v4 January 2018). 30 pp.

Hatch, S. A. 2003. Statistical power for detecting trends with applications to seabird monitoring. Biological Conservation 111:317-329.

Native Plant Solutions (NPS). 2018. Waterbird monitoring 2018 program technical memo: review of survey effort and timing. 12 pp.

Appendix A – Complete list of species and foraging groups observed during 2017/2018/2019 surveys, along the Peace River.

Species Code	Common Name	Latin Name	Foraging Mode Species Group
CONI	Common Nighthawk	*Chordeiles minor*	Aerial Insectivores
AMDI	American Dipper	*Cinclus mexicanus*	Benthic-Feeding Divers
BAGO	Barrow's Goldeneye	*Bucephala islandica*	Benthic-Feeding Divers
BUFF	Bufflehead	*Bucephala albeola*	Benthic-Feeding Divers
COGO	Common Goldeneye	*Bucephala clangula*	Benthic-Feeding Divers
HADU	Harlequin Duck	*Histrionicus histrionicus*	Benthic-Feeding Divers
LTDU	Long-tailed Duck	*Clangula hyemalis*	Benthic-Feeding Divers
RUDU	Ruddy Duck	*Oxyura jamaicensis*	Benthic-Feeding Divers
SUSC	Surf Scoter	*Melanitta perspicillata*	Benthic-Feeding Divers
UNGO	Unknown Goldeneye	-	Benthic-Feeding Divers
UNKN SCOTER	Unknown Scoter	*Mellanita sp.*	Benthic-Feeding Divers
WWSC	White-winged Scoter	*Melanitta fusca*	Benthic-Feeding Divers
GBHE	Great blue heron	*Ardea herodias*	Cranes and Herons
SACR	Sandhill Crane	*Grus canadensis*	Cranes and Herons
AMCO	American Coot	*Fulica americana*	Dabbling Ducks
AMWI	American Wigeon	*Anas americana*	Dabbling Ducks
BWTE	Blue-winged Teal	*Anas discors*	Dabbling Ducks
CANV	Canvasback	*Aythya valisineria*	Dabbling Ducks
CITE	Cinnamon Teal	*Anas cyanoptera*	Dabbling Ducks
GADW	Gadwall	*Anas strepera*	Dabbling Ducks
GRSC	Greater Scaup	*Aythya marila*	Dabbling Ducks
GWTE	Green-winged Teal	*Anas crecca*	Dabbling Ducks
LESC	Lesser Scaup	*Aythya affinis*	Dabbling Ducks
MALL	Mallard	*Anas platyrhynchos*	Dabbling Ducks
NOPI	Northern Pintail	*Anas acuta*	Dabbling Ducks
NSHO	Northern Shoveler	*Anas clypeata*	Dabbling Ducks
REDH	Redhead	*Aythya americana*	Dabbling Ducks
RNDU	Ring-necked Duck	*Aythya collaris*	Dabbling Ducks
UNDA	Unknown Dabbling Duck	-	Dabbling Ducks
UNSC	Unknown Scaup	-	Dabbling Ducks
UNTE	Unknown Teal	-	Dabbling Ducks
BLTE	Black Tern	*Chlidonias niger*	Surface Feeding Terns/Gulls
BHGU	Black-headed Gull	*Chroicocephalus ridibundus*	Surface Feeding Terns/Gulls
BOGU	Bonaparte's Gull	*Chroicocephalus philadelphia*	Surface Feeding Terns/Gulls

Species Code	Common Name	Latin Name	Foraging Mode Species Group
CAGU	California Gull	*Larus californicus*	Surface Feeding Terns/Gulls
FRGU	Franklin's Gull	*Leucophaeus pipixcan*	Surface Feeding Terns/Gulls
HEGU	Herring Gull	*Larus argentatus*	Surface Feeding Terns/Gulls
MEGU	Mew Gull	*Larus canus*	Surface Feeding Terns/Gulls
RBGU	Ring-billed Gull	*Larus delawarensis*	Surface Feeding Terns/Gulls
SAGU	Sabine's Gull	*Xema sabini*	Surface Feeding Terns/Gulls
ICGU	Thayer's Gull	*Larus glaucoides*	Surface Feeding Terns/Gulls
UNGU	Unknown Gull	-	Surface Feeding Terns/Gulls
CACG	Cackling Goose	*Branta hutchinsii*	Large Dabblers
CAGO	Canada Goose	*Branta canadensis*	Large Dabblers
GWFG	Greater White-fronted Goose	*Anser albifrons*	Large Dabblers
SNGO	Snow Goose	*Chen caerulescens*	Large Dabblers
TRUS	Trumpeter Swan	*Cygnus buccinator*	Large Dabblers
TUSW	Tundra Swan	*Cygnus columbianus*	Large Dabblers
UNSW	Unknown Swan	-	Large Dabblers
SORA	Sora	*Porzana carolina*	Marsh Birds
WISN	Wilson's Snipe	*Gallinago delicata*	Marsh Birds
YERA	Yellow Rail	*Coturnicops noveboracensis*	Marsh Birds
ARTE	Arctic Tern	*Sterna paradisaea*	Piscivorous Divers
BEKI	Belted Kingfisher	*Megaceryle alcyon*	Piscivorous Divers
COLO	Common Loon	*Gavia immer*	Piscivorous Divers
COME	Common Merganser	*Mergus merganser*	Piscivorous Divers
COTE	Common Tern	*Sterna hirundo*	Piscivorous Divers
EAGR	Eared Grebe	*Podiceps nigricollis*	Piscivorous Divers
HOME	Hooded Merganser	*Lophodytes cucullatus*	Piscivorous Divers
HOGR	Horned Grebe	*Podiceps auritus*	Piscivorous Divers
PBGR	Pied-billed Grebe	*Podilymbus podiceps*	Piscivorous Divers
RBME	Red-breasted Merganser	*Mergus serrator*	Piscivorous Divers
RNGR	Red-necked Grebe	*Podiceps grisegena*	Piscivorous Divers
UNGR	Unknown Grebe	-	Piscivorous Divers
UNLO	Unknown Loon	-	Piscivorous Divers
UNME	Unknown Merganser	-	Piscivorous Divers

Species Code	Common Name	Latin Name	Foraging Mode Species Group
UNKN TERN	Unknown Tern	-	Piscivorous Divers
WEGR	Western Grebe	*Aechmophorus occidentalis*	Piscivorous Divers
AMKE	American Kestrel	*Falco sparverius*	Raptors
BAEA	Bald Eagle	*Haliaeetus leucocephalus*	Raptors
COHA	Cooper's Hawk	*Accipiter cooperii*	Raptors
GOEA	Golden Eagle	*Aquila chrysaetos*	Raptors
MERL	Merlin	*Falco columbarius*	Raptors
NOHA	Northern Harrier	*Circus cyaneus*	Raptors
OSPR	Osprey	*Pandion haliaetus*	Raptors
RTHA	Red-tailed Hawk	*Buteo jamaicensis*	Raptors
RLHA	Rough-legged Hawk	*Buteo lagopus*	Raptors
SSHA	Sharp-shinned Hawk	*Accipiter striatus*	Raptors
UNAC	Unknown Accipiter	-	Raptors
UNHA	Unknown Hawk	-	Raptors
UNRA	Unknown Raptor	-	Raptors
GRYE	Greater Yellowlegs	*Tringa melanoleuca*	Shorebirds
KILL	Killdeer	*Charadrius vociferus*	Shorebirds
LESA	Least Sandpiper	*Calidris minutilla*	Shorebirds
LEYE	Lesser Yellowlegs	*Tringa flavipes*	Shorebirds
LBDO	Long-billed Dowitcher	*Limnodromus scolopaceus*	Shorebirds
RNPH	Red-necked Phalarope	*Phalaropus lobatus*	Shorebirds
SEPL	Semi-palmated Plover	*Charadrius semipalmatus*	Shorebirds
SESA	Semi-palmated Sandpiper	*Calidris pusilla*	Shorebirds
SOSA	Solitary Sandpiper	*Tringa solitaria*	Shorebirds
SPSA	Spotted Sandpiper	*Actitis macularius*	Shorebirds
UNSA	Unknown Sandpiper	-	Shorebirds
UNSH	Unknown Shorebird	-	Shorebirds
PEEP	Unknown small calidrid	*Calidris sp.*	Shorebirds
UNYE	Unknown Yellowlegs	-	Shorebirds
UNDI	Unknown Diving Bird	-	Unknown Waterbirds
UNDU	Unknown Duck	-	Unknown Waterbirds
UNKN	Unkown spp	-	Unknown Waterbirds

Appendix B

Waterbird Species List, Foraging Guild Categories, and Abundances

Table B-1 Waterbird Species List, Foraging Guild Categories, and Cumulative Abundances from 2017, 2018, 2019, 2020, 2021, 2022 and 2023

Foraging Guild	English Name	Scientific Name	River Boat Survey Abundance [a]	Wetland Standwatch Abundance [b]	Wetland Transect Abundance [c]
Benthic Feeding Divers			**3,105**	**2,031**	**1**
	American Dipper	*Cinclus mexicanus*	1	0	0
	Barrow's Goldeneye	*Bucephala islandica*	135	40	0
	Benthic Feeding Diver sp.	*n/a*	1	62	0
	Bufflehead	*Bucephala albeola*	225	1,257	1
	Common Goldeneye	*Bucephala clangula*	1,893	356	0
	Goldeneye sp.	*Bucephala sp.*	525	72	0
	Harlequin Duck	*Histrionicus histrionicus*	3	0	0
	Long-tailed Duck	*Clangula hyemalis*	1	22	0
	Ruddy Duck	*Oxyura jamaicensis*	5	42	0
	Scoter sp.	*Melanitta sp.*	20	29	0
	Surf Scoter	*Melanitta perspicillata*	273	138	0
	White-winged Scoter	*Melanitta fusca*	23	13	0
Cranes and Herons			**56**	**0**	**0**
	Great Blue Heron	*Ardea herodias*	1	0	0
	Sandhill Crane	*Antigone canadensis*	55	0	0
Dabbling Ducks			**22,746**	**6,412**	**209**
	American Coot	*Fulica americana*	58	379	9
	American Wigeon	*Mareca americana*	2,036	447	9
	Blue-winged Teal	*Spatula discors*	443	416	19
	Canvasback	*Aythya valisineria*	19	121	0
	Cinnamon Teal	*Spatula cyanoptera*	2	0	2
	Dabbling Duck sp.	*n/a*	1,959	479	5
	Eurasian Wigeon	*Mareca penelope*	1	0	0
	Gadwall	*Mareca strepera*	33	36	0
	Greater Scaup	*Aythya marila*	46	55	0
	Green-winged Teal	*Anas crecca*	1,889	576	30
	Lesser Scaup	*Aythya affinis*	47	335	0
	Mallard	*Anas platyrhynchos*	13,801	1,409	64
	Northern Pintail	*Anas acuta*	1,757	88	5
	Northern Shoveler	*Spatula clypeata*	240	251	66
	Northern Shoveler, Blue-winged Teal, or Cinnamon Teal	*Spatula sp.*	2	0	0
	Redhead	*Aythya americana*	16	9	0
	Ring-necked Duck	*Aythya collaris*	74	1,128	0
	Scaup sp.	*Aythya sp.*	166	664	0
	Teal sp.	*n/a*	157	19	0
Gulls and Surface Feeding Terns			**15,615**	**229**	**0**
	Arctic Tern	*Sterna paradisaea*	3	0	0
	Black Tern	*Chlidonias niger*	0	26	0
	Bonaparte's Gull	*Chroicocephalus philadelphia*	5,619	186	0
	California Gull	*Larus californicus*	35	0	0
	Franklin's Gull	*Leucophaeus pipixcan*	5,260	1	0
	Gull sp.	*n/a*	1,420	10	0
	Herring Gull	*Larus argentatus*	226	0	0
	Iceland Gull	*Larus glaucoides*	8	0	0
	Ring-billed Gull	*Larus delawarensis*	2,687	0	0
	Sabine's Gull	*Xema sabini*	1	0	0
	Short-billed Gull	*Larus brachyrhynchos*	354	6	0
	Tern sp.	*n/a*	2	0	0
Large Dabblers			**57,567**	**431**	**9**
	Cackling Goose	*Branta hutchinsii*	81	0	0
	Canada Goose[d]	*Branta canadensis*	55,546	142	7
	Greater White-fronted Goose	*Anser albifrons*	14	0	0
	Large Dabbler sp.	*n/a*	219	0	0
	Snow Goose	*Anser caerulescens*	1,078	0	0
	Trumpeter Swan[d]	*Cygnus buccinator*	626	289	2
	Tundra Swan	*Cygnus columbianus*	3	0	0

Table B-1 Waterbird Species List, Foraging Guild Categories, and Cumulative Abundances from 2017, 2018, 2019, 2020, 2021, 2022 and 2023

Foraging Guild	English Name	Scientific Name	River Boat Survey Abundance [a]	Wetland Standwatch Abundance [b]	Wetland Transect Abundance [c]
Marsh Birds			**4**	**57**	**151**
	Rail sp.	*n/a*	0	1	0
	Sora	*Porzana carolina*	0	45	60
	Wilson's Snipe	*Gallinago delicata*	4	11	87
	Yellow Rail	*Coturnicops noveboracensis*	0	0	4
Piscivorous Divers			**5,389**	**731**	**2**
	Belted Kingfisher	*Megaceryle alcyon*	96	6	0
	Common Loon	*Gavia immer*	46	161	0
	Common Merganser	*Mergus merganser*	5,078	27	0
	Common Tern	*Sterna hirundo*	3	0	0
	Double-crested Cormorant	*Nannopterum auritum*	10	0	0
	Eared Grebe	*Podiceps nigricollis*	6	97	0
	Grebe sp.	*n/a*	2	16	0
	Hooded Merganser	*Lophodytes cucullatus*	33	55	0
	Horned Grebe	*Podiceps auritus*	2	160	0
	Loon sp.	*n/a*	5	0	0
	Merganser sp.	*n/a*	38	0	0
	Pacific Loon	*Gavia pacifica*	3	0	0
	Pied-billed Grebe	*Podilymbus podiceps*	0	57	2
	Piscivorous Diver sp.	*n/a*	3	0	0
	Red-breasted Merganser	*Mergus serrator*	11	6	0
	Red-necked Grebe	*Podiceps grisegena*	50	134	0
	Red-throated Loon	*Gavia stellata*	2	0	0
	Western Grebe	*Aechmophorus occidentalis*	1	12	0
Shorebirds			**2,571**	**276**	**86**
	Greater Yellowlegs	*Tringa melanoleuca*	3	15	3
	Killdeer	*Charadrius vociferus*	31	1	0
	Least Sandpiper	*Calidris minutilla*	15	0	0
	Lesser Yellowlegs	*Tringa flavipes*	17	78	26
	Long-billed Dowitcher	*Limnodromus scolopaceus*	2	0	0
	Pectoral Sandpiper	*Calidris melanotos*	2	0	0
	Peep Sp.	*Calidris sp.*	37	2	0
	Red-necked Phalarope	*Phalaropus lobatus*	11	9	0
	Sandpiper sp.	*n/a*	30	8	0
	Shorebird sp.	*n/a*	86	1	0
	Solitary Sandpiper	*Tringa solitaria*	15	84	28
	Spotted Sandpiper	*Actitis macularius*	2,191	60	28
	Semipalmated Plover	*Charadrius semipalmatus*	11	0	0
	Semipalmated Sandpiper	*Calidris pusilla*	117	0	0
	Wilson's Phalarope	*Phalaropus tricolor*	0	2	0
	Yellowlegs sp.	*Tringa sp.*	3	16	1
Unknown Waterbirds			**2,306**	**986**	**0**
	Diving Bird sp.	*n/a*	50	11	0
	Duck sp.	*n/a*	1,954	932	0
	Unknown sp.	*n/a*	302	43	0
Grand Total			**109,359**	**11,153**	**458**

Notes:

[a] - Includes flying records as birds were often flushed to flight in front of boat. Includes all habitat types, all treatment areas, and data from incomplete surveys.

[b] - Excludes flying records. Includes records of birds observed in open water and sedge habitat.

[c] - Excludes flying records. Includes records of waterbirds observed in sedge, and willow sedge habitat.

[d] - Trumpeter swan and Canada geese, include a small proportion (<5%) of tundra swan and cackling geese, respectively.

Table B-2 Waterbird Species List, Foraging Guild Categories, and Cumulative Abundances in 2023

Foraging Guild	English Name	Scientific Name	River Boat Survey Abundance [a]	Wetland Standwatch Abundance [b]	Wetland Transect Abundance [c]
Benthic Feeding Divers			**296**	**410**	**0**
	Barrow's Goldeneye	*Bucephala islandica*	0	6	0
	Bufflehead	*Bucephala albeola*	9	248	0
	Common Goldeneye	*Bucephala clangula*	117	70	0
	Goldeneye sp.	*Bucephala sp.*	163	25	0
	Ruddy Duck	*Oxyura jamaicensis*	0	12	0
	Scoter sp.	*Mellanita sp.*	1	28	0
	Surf Scoter	*Melanitta perspicillata*	2	21	0
	White-winged Scoter	*Melanitta fusca*	4	0	0
Dabbling Ducks			**1,854**	**1,050**	**9**
	American Coot	*Fulica americana*	0	88	0
	American Wigeon	*Mareca americana*	337	99	0
	Blue-winged Teal	*Spatula discors*	0	68	0
	Canvasback	*Aythya valisineria*	0	13	0
	Dabbling Duck sp.	*n/a*	242	75	0
	Gadwall	*Mareca strepera*	2	24	0
	Greater Scaup	*Aythya marila*	17	8	0
	Green-winged Teal	*Anas crecca*	157	113	0
	Lesser Scaup	*Aythya affinis*	1	100	0
	Mallard	*Anas platyrhynchos*	976	138	9
	Northern Pintail	*Anas acuta*	47	6	0
	Northern Shoveler	*Spatula clypeata*	13	33	0
	Redhead	*Aythya americana*	9	2	0
	Ring-necked Duck	*Aythya collaris*	34	207	0
	Scaup sp.	*Aythya sp.*	19	76	0
Gulls and Surface Feeding Terns			**582**	**8**	**0**
	Black Tern	*Chlidonias niger*	0	2	0
	Bonaparte's Gull	*Chroicocephalus philadelphia*	11	2	0
	Gull sp.	*n/a*	347	4	0
	Herring Gull	*Larus argentatus*	24	0	0
	Iceland Gull	*Larus glaucoides*	2	0	0
	Ring-billed Gull	*Larus delawarensis*	198	0	0
Large Dabblers			**11,753**	**58**	**2**
	Cackling Goose	*Branta hutchinsii*	55	0	0
	Canada Goose	*Branta canadensis*	10,515	20	2
	Greater White-fronted Goose	*Anser albifrons*	3	0	0
	Snow Goose	*Anser caerulescens*	1,075	0	0
	Trumpeter Swan [d]	*Cygnus buccinator*	105	38	0
Marsh Birds			**1**	**1**	**14**
	Sora	*Porzana carolina*	0	1	3
	Wilson's Snipe	*Gallinago delicata*	1	0	11

Table B-2 Waterbird Species List, Foraging Guild Categories, and Cumulative Abundances in 2023

Foraging Guild	English Name	Scientific Name	River Boat Survey Abundance [a]	Wetland Standwatch Abundance [b]	Wetland Transect Abundance [c]
Piscivorous Divers			**744**	**154**	**0**
	Belted Kingfisher	*Megaceryle alcyon*	2	0	0
	Common Loon	*Gavia immer*	15	23	0
	Common Merganser	*Mergus merganser*	717	0	0
	Double-crested Cormorant	*Nannopterum auritum*	6	0	0
	Eared Grebe	*Podiceps nigricollis*	0	12	0
	Grebe sp.	*n/a*	0	1	0
	Hooded Merganser	*Lophodytes cucullatus*	0	8	0
	Horned Grebe	*Podiceps auritus*	0	71	0
	Pacific Loon	*Gavia pacifica*	2	0	0
	Pied-billed Grebe	*Podilymbus podiceps*	0	3	0
	Red-necked Grebe	*Podiceps grisegena*	2	36	0
Shorebirds			**94**	**58**	**13**
	Greater Yellowlegs	*Tringa melanoleuca*	0	3	0
	Lesser Yellowlegs	*Tringa flavipes*	0	25	12
	Pectoral Sandpiper	*Calidris melanotos*	2	0	0
	Sandpiper sp.	*n/a*	1	1	0
	Shorebird sp.	*n/a*	26	0	0
	Solitary Sandpiper	*Tringa solitaria*	0	23	1
	Spotted Sandpiper	*Actitis macularius*	64	2	0
	Yellowlegs sp.	*Tringa sp.*	1	4	0
Unknown Waterbirds			**84**	**59**	**0**
	Diving Bird sp.	*n/a*	34	11	0
	Duck sp.	*n/a*	50	48	0
Grand Total			**15,408**	**1,798**	**38**

Notes:

[a] - Includes flying records as birds were often flushed to flight in front of boat. Includes all habitat types, all treatment areas, and data from incomplete surveys.

[b] - Excludes flying records. Includes records of birds observed in open water and sedge habitat.

[c] - Excludes flying records. Includes records on waterbirds observed in sedge, and willow sedge habitat.

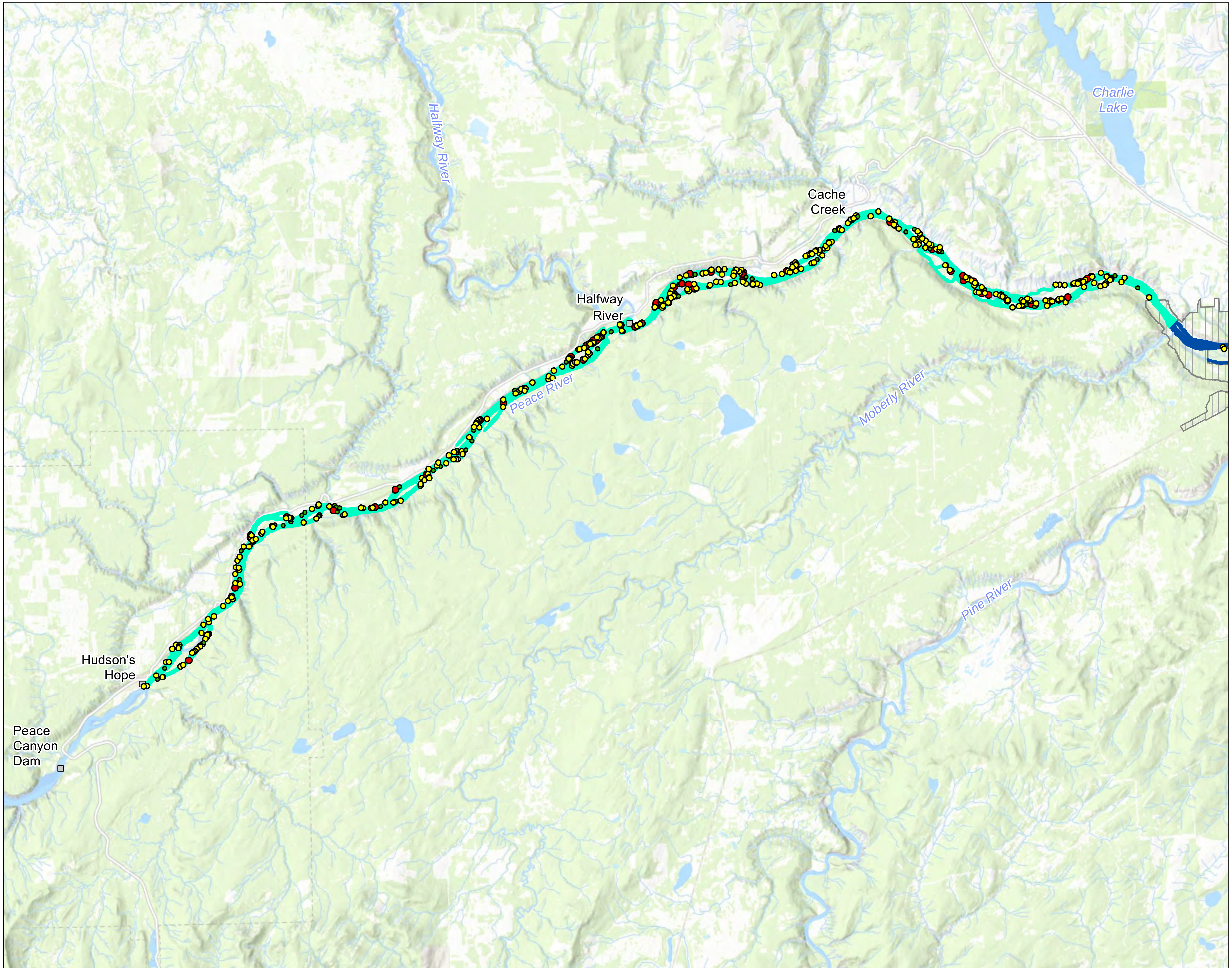
[d] - Trumpeter swan and Canada geese, include a small proportion (<5%) of tundra swan and cackling geese, respectively.

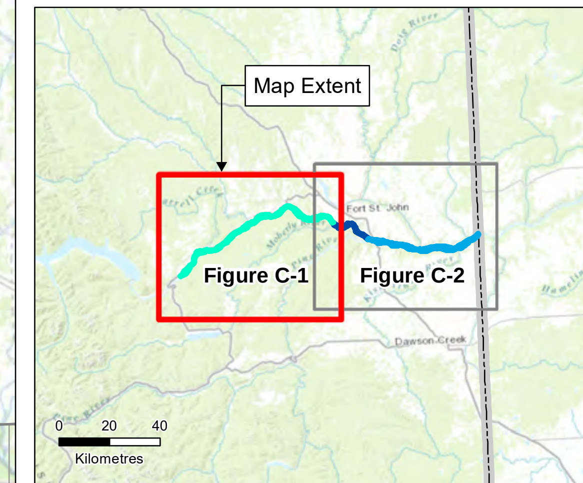
Appendix C

Spatial Representation of Waterbird Observations within the Peace River Study Area in Spring and Fall 2023 (Figures C-1 to C-4)

Migratory Waterbird Follow-up Monitoring Program
2023 Report
Site C, Peace River, BC

Figure C-1 - Waterbirds Recorded within Inundation Impact Area Spring 2023





Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Proposed Dam Site
- Town
- Road
- Forested Area
- Waterbody / Watercourse

Number of Bird Observations

- 1 - 2 birds
- 3 - 9 birds
- 10 or more birds

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Basemap: ESRI World Topographic Base

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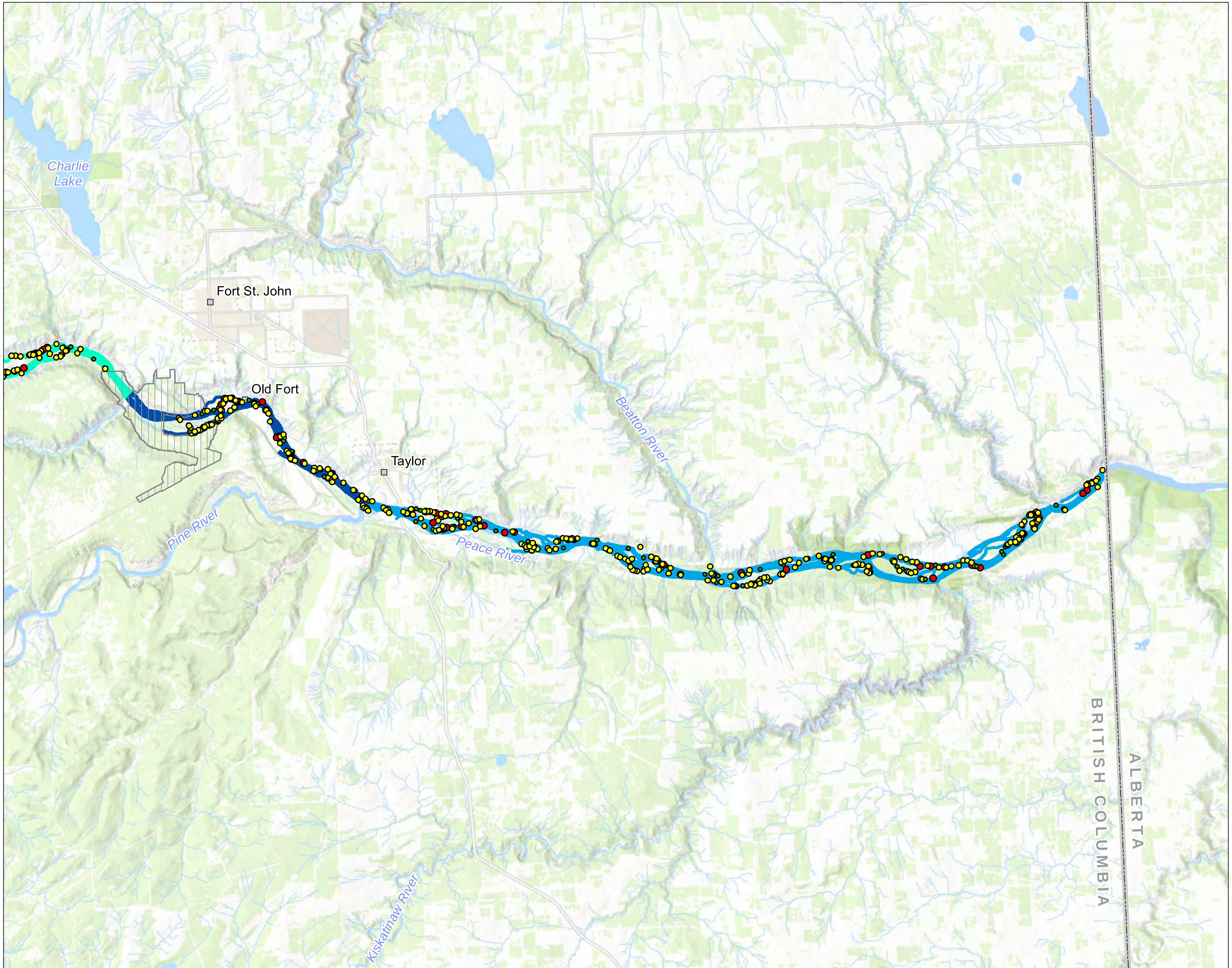
Kilometres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

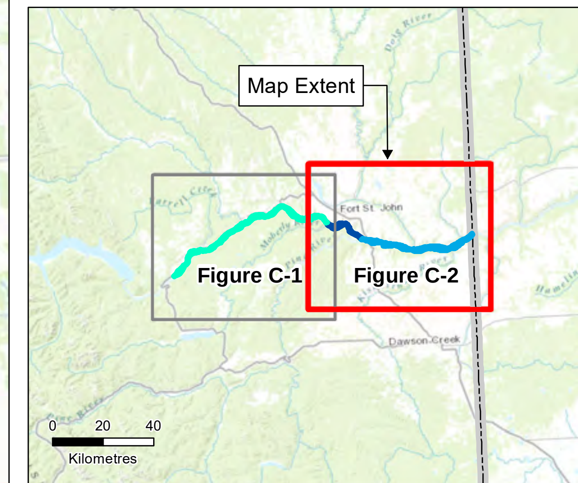
107578-04	Production Date: Dec 8, 2023	Figure C-1

Ausenco BC hydro



Migratory Waterbird Follow-up Monitoring Program
2023 Report
Site C, Peace River, BC

Figure C-2 - Waterbirds Recorded within Flow Regime Impact Area and Control Area Spring 2023



Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Proposed Dam Site
- Town
- Road
- Provincial Border
- Forested Area
- Waterbody / Watercourse

Number of Bird Observations

- 1 - 2 birds
- 3 - 9 birds
- 10 or more birds

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Basemap: ESRI World Topographic Base

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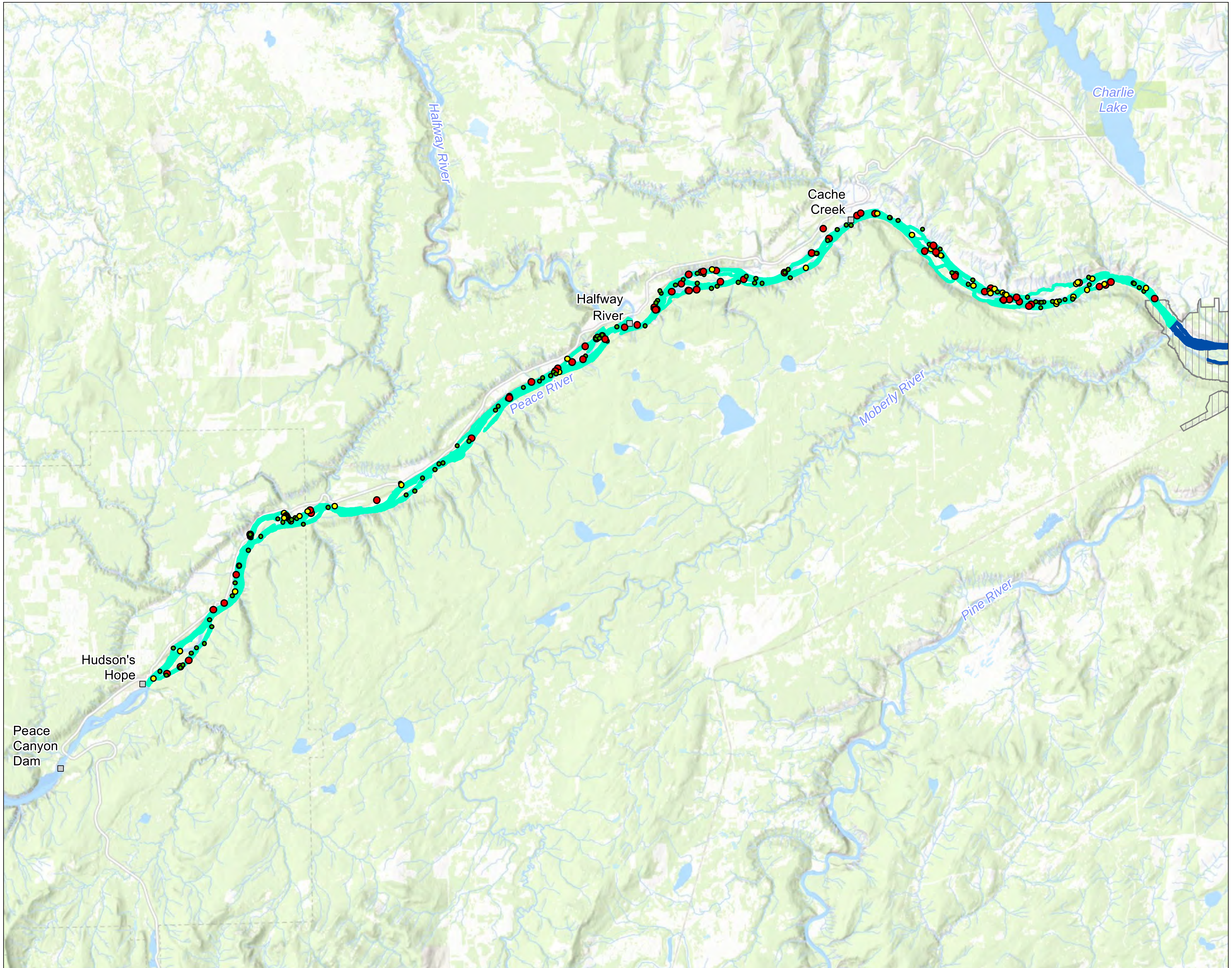
0 2 4 6 8 10
Kilometres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

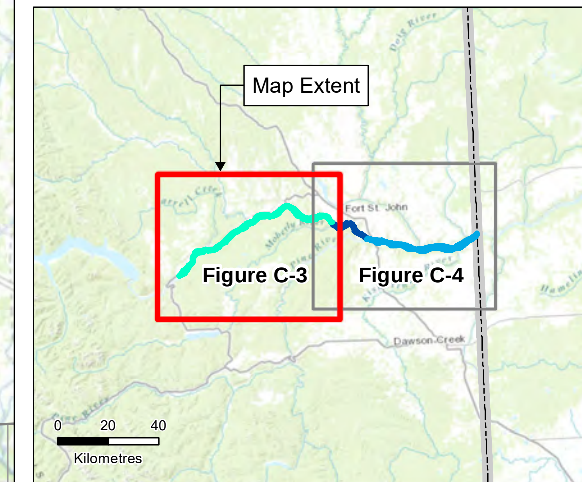
107578-04	Production Date: Dec 8, 2023	Figure C-2

Ausenco BC hydro



Migratory Waterbird Follow-up Monitoring Program
2023 Report
Site C, Peace River, BC

Figure C-3 - Waterbirds Recorded within Inundation Impact Area Fall 2023



Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Proposed Dam Site
- Town
- Road
- Forested Area
- Waterbody / Watercourse

Number of Bird Observations

- 1 - 2 birds
- 3 - 9 birds
- 10 or more birds

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Basemap: ESRI World Topographic Base

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Kilometres

NAD 1983 UTM Zone 10N

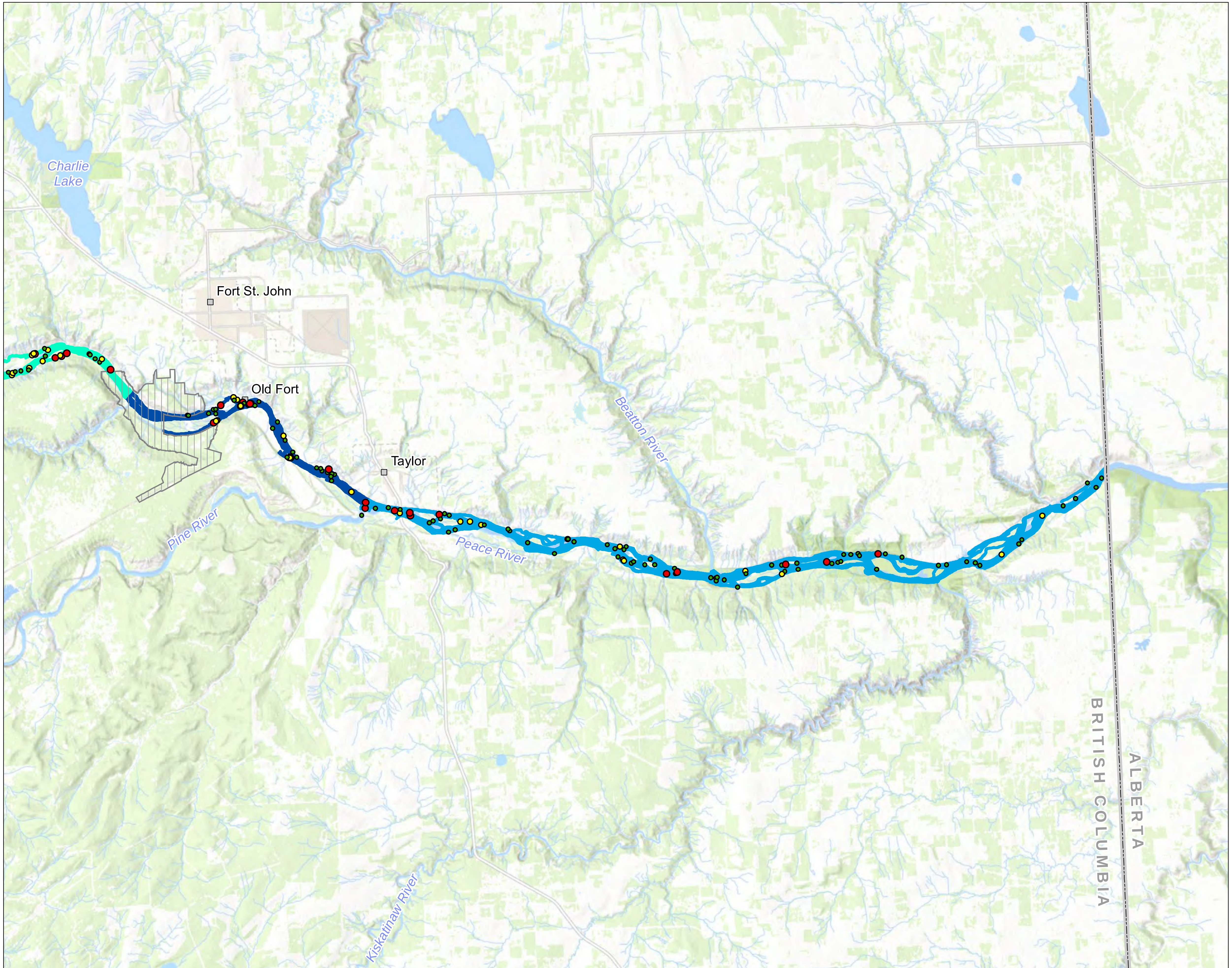
Page Size: 11" x 17"

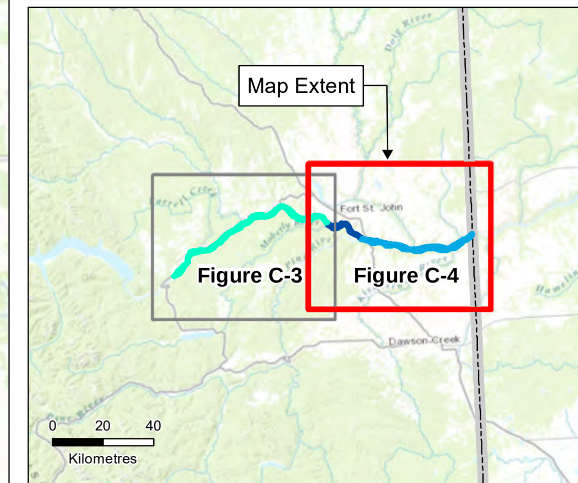
107578-04	Production Date: Dec 8, 2023	Figure C-3

Ausenco BC hydro

Migratory Waterbird Follow-up Monitoring Program
2023 Report
Site C, Peace River, BC

Figure C-4 - Waterbirds Recorded within Flow Regime Impact Area and Control Area Fall 2023





Legend

- Inundation Impact Area
- Flow Regime Impact Area
- Control Area
- Proposed Dam Site
- Town
- Road
- Provincial Border
- Forested Area
- Waterbody / Watercourse

Number of Bird Observations

- 1 - 2 birds
- 3 - 9 birds
- 10 or more birds

Notes

1. Locations should be considered approximate.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Basemap: ESRI World Topographic Base

N

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Kilometres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

107578-04	Production Date: Dec 8, 2023	Figure C-4

Ausenco BChydro

Appendix D

Wetland Survey Station Photos

Photo 1 Aerial Photograph of Wetland Survey Station OW01 (September 9, 2018)

Photo 2 Aerial Photograph of Wetland Survey Station OW02 (September 18, 2018)

Photo 3 Aerial Photograph of Wetland Survey Station SE03 (lower left) and OW04 (upper right; August 22, 2019)

Photo 4 Aerial Photograph of Wetland Survey Station OW06 (October 17, 2018)

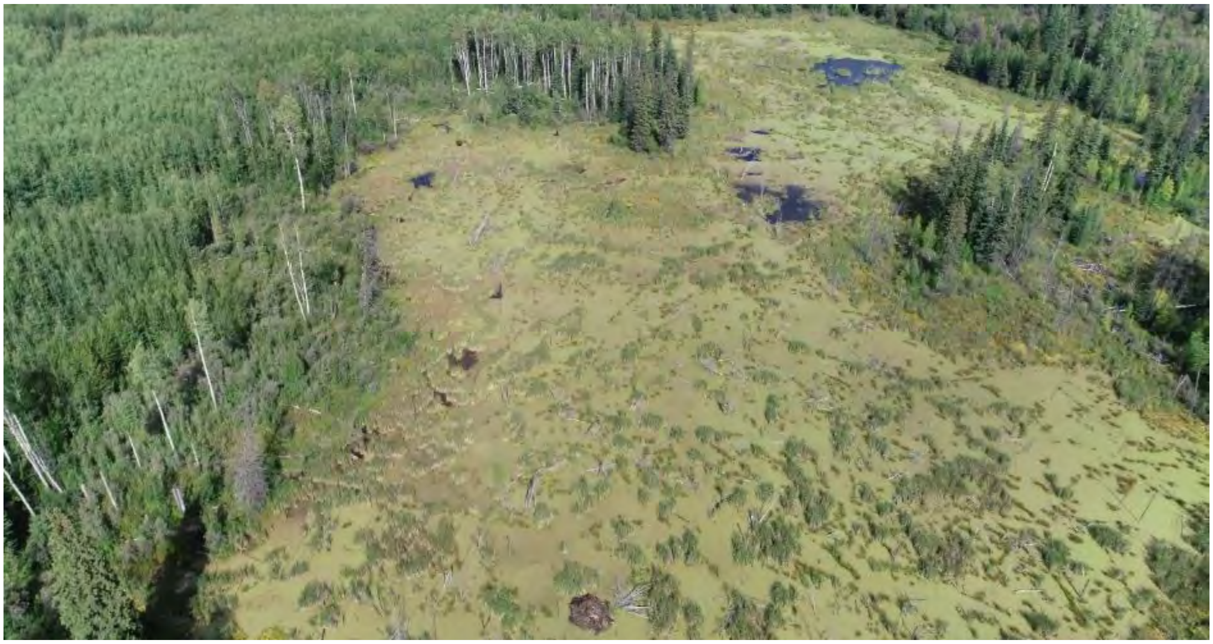


Photo 5 Aerial Photograph of Wetland Survey Station OW07 (August 22, 2019)

Photo 6 Photograph of Wetland Survey Station OW09 (October 17, 2018) Showing Habitat Representative of the Wetland Area Surveyed

Photo 7 Aerial Photograph of Wetland Survey Station OW10 (August 22, 2019)

Photo 8 Aerial Photograph of Wetland Survey Station OW11 (August 22, 2019)

Photo 9 Aerial Photograph of Wetland Survey Station SE02 (August 22, 2019)

Photo 10 Aerial Photograph of Wetland Survey Station SE04 (August 22, 2019)

Photo 11 Aerial Photograph of Wetland Survey Station SE05 (August 6, 2018)

Photo 12 Aerial Photograph of Wetland Survey Station SE06 (August 12, 2019)

Photo 13 Aerial Photograph of Wetland Survey Station SE07 (August 22, 2019)

Photo 14 Aerial Photograph of Wetland Survey Station SE08 (August 22, 2019)

Photo 15 Aerial Photograph of Wetland Survey Station SE09 (August 7, 2018)

Photo 16 Aerial Photograph of Wetland Survey Station SE10 (August 22, 2019)

Photo 17 Aerial Photograph of Wetland Survey Station SE11 (August 6, 2018)

Photo 18 Aerial Photograph of Wetland Survey Station SE12 (August 12, 2019)

Photo 19 Aerial Photograph of Wetland Survey Station SE14 (August 6, 2018)

Photo 20 Aerial Photograph of Wetland Survey Station WS01 (August 6, 2018)

Photo 21 Photograph of Wetland Survey Station WS02 (October 17, 2018) Showing Habitat Representative of the Wetland Area Surveyed

Photo 22 Aerial Photograph of Wetland Survey Station WS03 (August 7, 2018)

Photo 23 Photograph of Wetland Survey Station OW13 (May 16, 2022) Showing Habitat Representative of the Wetland Area Surveyed

Photo 24 Aerial Photograph of Wetland Survey Station OW14 (May 5, 2022)

Photo 26 Photograph of Wetland Survey Station OW12 (October 4, 2022) Showing Habitat Representative of the Wetland Area Surveyed with an open water area in the center surrounded by a larger area of sedge dominated wetlands.

Appendix E

Mean and Standard Deviation Statistics Tables for Relative Abundance and Diversity Results

Note: For ease of reference, table numbering corresponds with associated tables in the main body of the report.

Table E-7 Mean Abundance Estimates (birds/survey round) and Variability (Standard Deviation) of Waterbird Foraging Guilds within the Peace River During Spring and Fall Survey Periods during 2017 Through 2023

Foraging Guild	Spring						Fall								Average of Means
	Early		Middle		Late		Early		Early-Middle		Late-Middle		Late		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Benthic Feeding Divers	156	61	195	170	23	14	3	5	17	37	26	27	5	-	**61**
Dabbling Ducks	1,049	852	714	342	463	106	105	56	275	200	309	347	51	-	**424**
Gulls	2	2	69	101	32	6	648	446	594	397	237	308	102	-	**240**
Large Dabblers	3,025	1,637	750	121	560	121	271	94	657	490	873	751	623	-	**965**
Piscivorous Divers	296	66	105	55	43	4	36	22	35	15	20	7	12	-	**78**
Shorebirds	2	1	14	20	135	20	212	131	102	85	3	3	0	-	**67**
Unknown Waterbirds	65	73	128	69	61	62	14	12	13	18	21	29	13	-	**45**
Total (All Waterbirds)	**4,594**	**-**	**1,975**	**-**	**1,317**	**-**	**1,289**	**-**	**1,693**	**-**	**1,489**	**-**	**805**	**-**	

Note: Sample size is 7 years except for late fall (2 years) and middle and late spring (3 years). SD = standard deviation across years. SD only presented when at least 3 years of data were available. Dashes indicate insufficient or inappropriate data for calculations.

Table E-9 Mean 2017 Through 2023 Spring Densities (birds/km²/survey round), Estimated Abundances, and Variability (Standard Deviation) of Migrant Waterbirds by River Habitat Type and Treatment Area

Foraging Guild	Densities by River Habitat Type						Densities by Treatment Area					
	Limited Connectivity		Moderate Flow		Mainstem		Inundation Impact		Flow Impact		Control	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Benthic Feeding Divers	14.9	9.8	2.4	1.9	1.3	0.9	2.4	1.7	5.1	3.7	1.5	1.2
Dabbling Ducks	85.0	80.2	24.7	27.5	7.6	6.7	8.0	3.3	30.0	35.2	18.3	21.8
Gulls	0.0	0.0	<0.1	0.1	0.4	0.6	0.2	0.4	1.2	2.4	0.1	0.1
Large Dabblers	200.8	93.0	62.2	48.1	22.5	14.8	40.1	22.3	32.8	22.5	38.4	31.3
Piscivorous Divers	15.8	7.1	7.0	4.6	2.6	1.8	6.4	4.2	2.3	1.4	1.5	1.0
Shorebirds	3.9	4.9	0.6	0.8	0.1	0.2	0.4	0.5	0.4	0.6	0.5	0.5
Unidentified Waterbirds	4.5	7.2	1.5	2.3	0.7	0.6	1.3	1.7	0.7	1.0	0.9	1.1
Total (All Waterbirds)	**324.9**	-	**98.5**	-	**35.1**	-	**58.8**	-	**72.6**	-	**61.1**	-
Total Estimated Abundance	**1,057**	-	**736**	-	**1,528**	-	**1,556**	-	**434**	-	**1,331**	-

Note: Sample size is 7 years. SD = standard deviation across years. Dashes indicate insufficient or inappropriate data for calculations. Mean densities reflect relative rather than absolute densities as they do not account for incomplete detection. Means were calculated by averaging density estimates (birds/km²/survey) within each habitat type across survey rounds first within periods of each year, then across periods for each season of each year, and then across years so that differences in sampling effort did not bias means towards results from years with more survey rounds or years with more survey periods. Total mean density is the sum of all foraging guild and unknown waterbird densities. Abundances calculated as density multiplied by area.

Table E-11 Mean 2017 Through 2023 Fall Densities (birds/km²/survey round) and Variability (Standard Deviation) of Migrant Waterbirds by River Habitat Type and Treatment Area

Foraging Guild	Densities by River Habitat Type						Densities by Treatment Area					
	Limited Connectivity		Moderate Flow		Mainstem		Inundation Impact		Flow Impact		Control	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Benthic Feeding Divers	0.4	0.4	<0.1	0.1	0.2	0.2	0.3	0.3	0.2	0.2	0.1	0.2
Dabbling Ducks	31.5	27.4	5.7	11.1	1.1	0.9	5.2	3.0	7.1	10.9	0.7	0.7
Gulls	2.2	3.3	1.0	1.2	9.1	6.1	6.5	5.1	38.9	32.1	0.3	0.2
Large Dabblers	54.1	46.3	9.7	7.2	6.5	5.0	11.5	12.6	11.0	9.6	7.3	6.6
Piscivorous Divers	1.9	2.0	0.6	0.5	0.3	0.2	0.6	0.4	0.3	0.2	0.3	0.3
Shorebirds	6.7	5.1	3.0	1.8	0.8	0.7	1.5	1.1	0.7	0.3	1.9	1.3
Unidentified Waterbirds	2.7	3.1	0.4	0.7	0.1	0.1	0.4	0.4	0.4	0.8	0.1	0.1
Total (All Waterbirds)	**99.6**	-	**20.4**	-	**18.1**	-	**26.0**	-	**58.7**	-	**10.6**	-
Total Estimated Abundance	**324**	-	**152**	-	**788**	-	**688**	-	**351**	-	**230**	-

Note: Sample size is 7 years. SD = standard deviation across years. Dashes indicate insufficient or inappropriate data for calculations. Mean densities reflect relative rather than absolute densities as they do not account for incomplete detection. Means were calculated by averaging density estimates (birds/km²/survey) within each habitat type across survey rounds first within periods of each year, then across periods for each season of each year, and then across years so that differences in sampling effort did not bias means towards results from years with more survey rounds or years with more survey periods. Total mean density is the sum of all foraging guild and unknown waterbird densities. Abundances calculated as density multiplied by area.

Table E-13 Mean 2017 Through 2023 Diversity Metrics for Waterbird Foraging Guilds on the Peace River Across Seasons and Survey Periods, with Variability (Standard Deviation)

Foraging Guild	Spring species richness by survey period						Spring		Fall species richness by survey period								Fall	
	Early		Middle		Late				Early		Early-Middle		Late-Middle		Late			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Benthic Feeding Divers	2.0	0.9	2.8	0.8	3.7	1.0	**2.4**	**0.9**	0.6	0.5	0.8	0.7	1.6	1.5	0.0	0.0	**0.9**	**0.6**
Dabbling Ducks	4.8	0.8	6.3	1.2	7.0	1.0	**5.5**	**0.7**	2.5	0.8	3.8	1.6	3.0	1.8	1.5	0.7	**3.0**	**1.0**
Gulls	0.3	0.6	1.8	1.9	3.5	0.5	**1.0**	**1.0**	4.1	1.7	3.6	1.1	2.8	1.2	3.5	2.1	**3.4**	**0.9**
Large Dabblers	2.1	0.4	2.0	1.0	1.3	0.3	**1.9**	**0.3**	1.1	0.2	1.7	0.5	2.1	1.5	2.0	0.0	**1.6**	**0.5**
Piscivorous Divers	1.4	0.5	2.5	0.5	3.3	0.8	**1.9**	**0.7**	1.9	0.6	2.8	0.7	3.1	1.4	1.5	0.7	**2.5**	**0.7**
Shorebirds	0.4	0.4	0.5	0.5	1.2	0.3	**0.4**	**0.4**	2.3	2.2	1.1	0.4	0.7	0.6	0.0	0.0	**1.2**	**0.5**
Total Species Richness	**11.0**	-	**16.0**	-	**20.0**	-	**13.0**	-	**12.6**	-	**13.8**	-	**13.2**	-	**8.5**	-	**12.8**	-
Species Evenness	**0.4**	-	**0.6**	-	**0.6**	-	**0.5**	-	**0.6**	-	**0.5**	-	**0.5**	-	**0.4**	-	**0.5**	-

Note: Sample size is 7 years except for late fall (2 years) and middle and late spring (3 years). SD = standard deviation across years. Dashes indicate insufficient or inappropriate data for calculations.

Table E-19 Mean 2017 Through 2023 Waterbird Densities (birds/ha/survey) and Variability (Standard Deviation) within Open Water Habitat Reported by Foraging Guild from Standwatch Surveys

Foraging Guild	Spring				Fall							
	Middle		Late		Early		Early-Middle		Late-Middle		Late	
	Mean Density	SD	Mean Density	SD	Mean Density	SD	Mean Density	SD	Mean Density	SD	Mean Density	SD
Benthic Feeding Divers	170.9	1.1	109.6	1.0	174.8	1.8	147.0	2.0	126.2	1.1	41.2	-
Dabbling Ducks	694.7	5.1	557.8	3.1	700.4	3.8	674.5	3.9	545.1	1.9	96.2	-
Gulls and Surface-Feeding Terns	1.5	<0.1	5.4	0.1	1.2	<0.1	0.1	<0.1	<0.1	<0.1	0.0	-
Large Dabblers	157.0	2.6	52.5	0.4	23.3	0.3	18.7	0.2	11.8	0.2	0.8	-
Marsh Birds	0.8	<0.1	21.9	0.3	8.7	0.2	10.6	0.2	0.0	0.0	0.0	-
Piscivorous Divers	8.8	0.1	21.1	0.1	26.0	0.1	33.9	0.4	22.6	0.3	23.8	-
Shorebirds	75.6	1.0	99.5	0.8	84.9	1.4	16.2	0.2	0.0	0.0	0.0	-
Unknown Waterbirds	0.1	<0.1	15.1	0.3	17.2	0.4	4.3	<0.1	29.9	0.5	26.3	-
Total (All Waterbirds)	**1,109**	**-**	**883**	**-**	**1,036**	**-**	**905**	**-**	**736**	**-**	**188**	**-**

Note: Sample size is 7 years except for late fall (2 years). SD = standard deviation across years. Dashes indicate insufficient or inappropriate data for calculations.

Table E-21 Mean 2018 through 2023 Waterbird Densities (birds/km/survey) and Variability (Standard Deviation) within Vegetated Wetland (sedge, willow-sedge) Habitat Reported by Foraging Guild from Transect Surveys

Foraging Guild	Spring				Fall							
	Middle		Late		Early		Early-Middle		Late-Middle		Late	
	Mean Density	SD	Mean Density	SD	Mean Density	SD	Mean Density	SD	Mean Density	SD	Mean Density	SD
Benthic Feeding Divers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Dabbling Ducks	1.50	1.87	6.56	3.58	0.06	0.15	0.49	0.62	1.14	2.79	0.00	-
Gulls	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Large Dabblers	0.36	0.32	0.20	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Marsh Birds	1.15	1.19	3.20	2.36	1.44	0.86	1.16	1.01	0.25	0.27	0.00	-
Piscivorous Divers	0.00	0.00	0.08	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Shorebirds	1.44	2.01	2.37	3.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Unknown Waterbirds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Total (All Waterbirds)	**4.44**	**-**	**12.42**	**-**	**1.50**	**-**	**1.65**	**-**	**1.39**	**-**	**0.00**	**-**

Note: Sample size is 6 years except for late fall (2 years). SD = standard deviation across years. Dashes indicate insufficient or inappropriate data for calculations.

Table E-25 Species Richness of Waterbird Foraging Guilds Observed During Standwatch Surveys of Wetland Habitats in 2017 through 2023, with Variability (Standard Deviation)

Foraging Guild	Spring				Spring		Fall								Fall	
	Middle		Late				Early		Early-Middle		Late-Middle		Late			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Benthic Feeding Divers	2.9	1.5	3.6	1.8	**3.3**	**1.3**	2.0	0.8	1.9	0.7	2.6	0.8	2.0	0.0	**2.2**	**0.5**
Dabbling Ducks	6.6	3.0	7.5	2.8	**7.2**	**2.6**	5.8	2.4	6.6	2.3	6.0	2.8	4.0	1.4	**6.1**	**2.1**
Gulls	0.3	0.5	0.8	0.7	**0.5**	**0.4**	0.6	0.8	0.0	0.0	0.1	0.4	0.0	0.0	**0.2**	**0.2**
Large Dabblers	1.6	0.8	1.8	0.5	**1.7**	**0.5**	0.9	0.4	1.1	0.2	0.9	0.2	1.0	0.0	**1.0**	**0.1**
Marsh Birds	0.4	0.5	0.9	0.7	**0.6**	**0.4**	0.2	0.4	0.6	0.6	0.0	0.0	0.0	0.0	**0.2**	**0.2**
Piscivorous Divers	2.1	1.9	3.5	2.1	**2.9**	**1.8**	3.1	1.3	3.4	1.5	2.9	2.4	2.0	1.4	**3.1**	**1.3**
Shorebirds	1.3	1.3	2.5	1.3	**1.9**	**1.1**	1.3	1.0	0.6	0.8	0.0	0.0	0.0	0.0	**0.6**	**0.2**
Total Species Richness	**15.1**	-	**20.5**	-	**18.1**	-	**13.9**	-	**14.3**	-	**12.5**	-	**9.0**	-	**13.4**	-
Species Evenness	**0.8**	-	**0.8**	-	**0.8**	-	**0.8**	-	**0.8**	-	**0.7**	-	**0.7**	-	**0.8**	-

Note: Sample size is 6 years except for late fall (2 years). SD = standard deviation across years. Dashes indicate insufficient or inappropriate data for calculations.

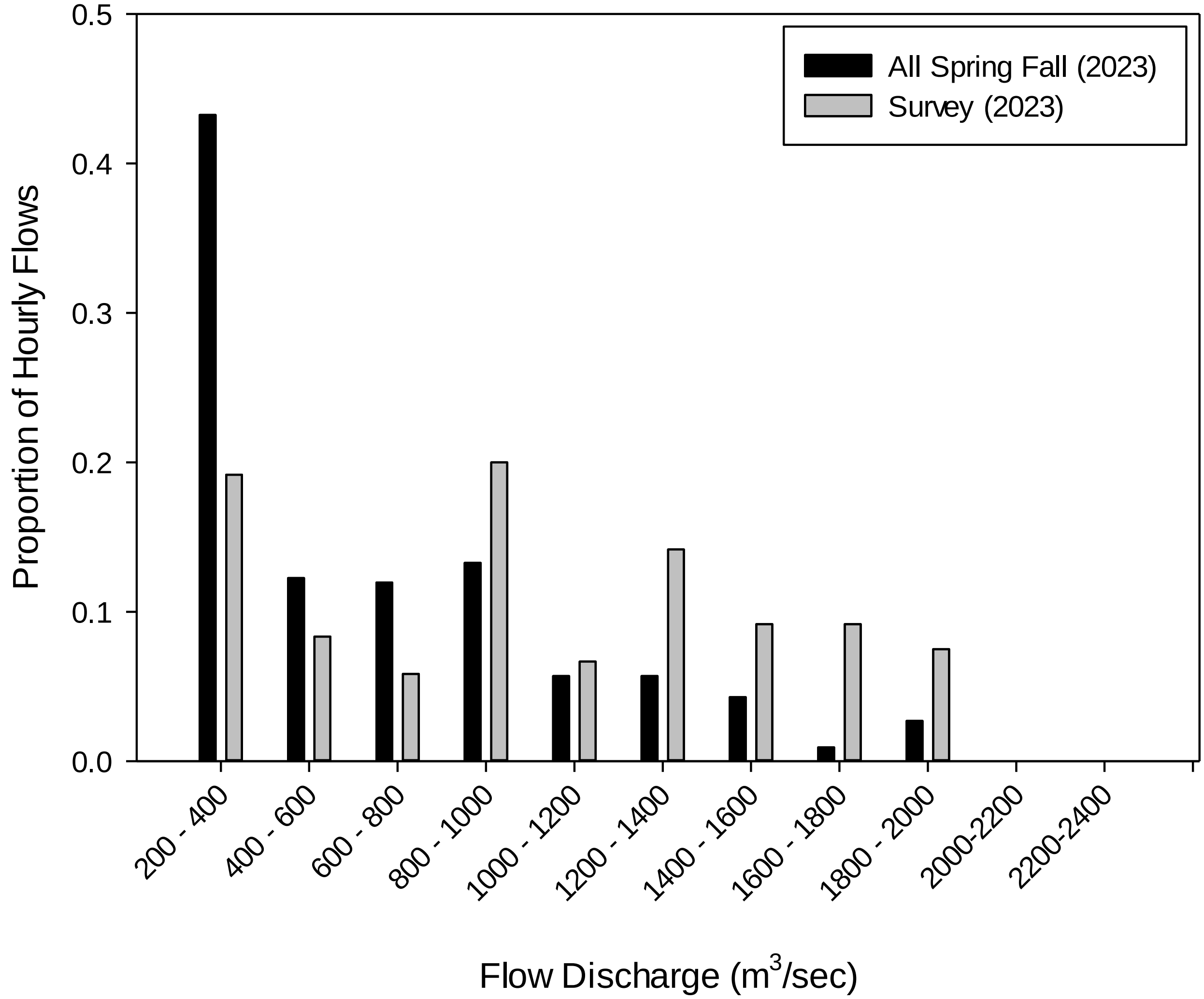
Table E-27 Species Richness of Waterbird Foraging Guilds Observed During Transect Surveys of Wetland Habitats in 2018 through 2023, with Variability (Standard Deviation)

Foraging Guild	Spring				Spring		Fall								Fall	
	Middle		Late				Early		Early-Middle		Late-Middle		Late			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Benthic Feeding Divers	0.0	0.0	0.1	0.2	**0.1**	**0.2**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	**0.0**	**0.0**
Dabbling Ducks	1.4	1.1	3.9	1.5	**2.5**	**1.1**	0.7	1.2	0.6	0.8	0.2	0.4	0.0	-	**0.4**	**0.6**
Gulls	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**
Large Dabblers	0.8	0.4	0.4	0.5	**0.7**	**0.3**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	**0.0**	**0.0**
Marsh Birds	1.4	1.1	2.4	0.8	**1.8**	**0.8**	1.5	0.8	1.2	0.8	0.5	0.5	0.0	-	**1.0**	**0.4**
Piscivorous Divers	0.0	0.0	0.2	0.5	**0.1**	**0.2**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	**0.0**	**0.0**
Shorebirds	1.6	0.5	1.5	0.9	**1.7**	**0.6**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	**0.0**	**0.0**
Total Species Richness	**5.2**	**-**	**8.5**	**-**	**6.8**	**-**	**2.2**	**-**	**1.8**	**-**	**0.8**	**-**	**0.0**	**-**	**1.4**	**-**
Species Evenness	**0.7**	**-**	**0.8**	**-**	**0.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.0**	**-**	**-**	**-**

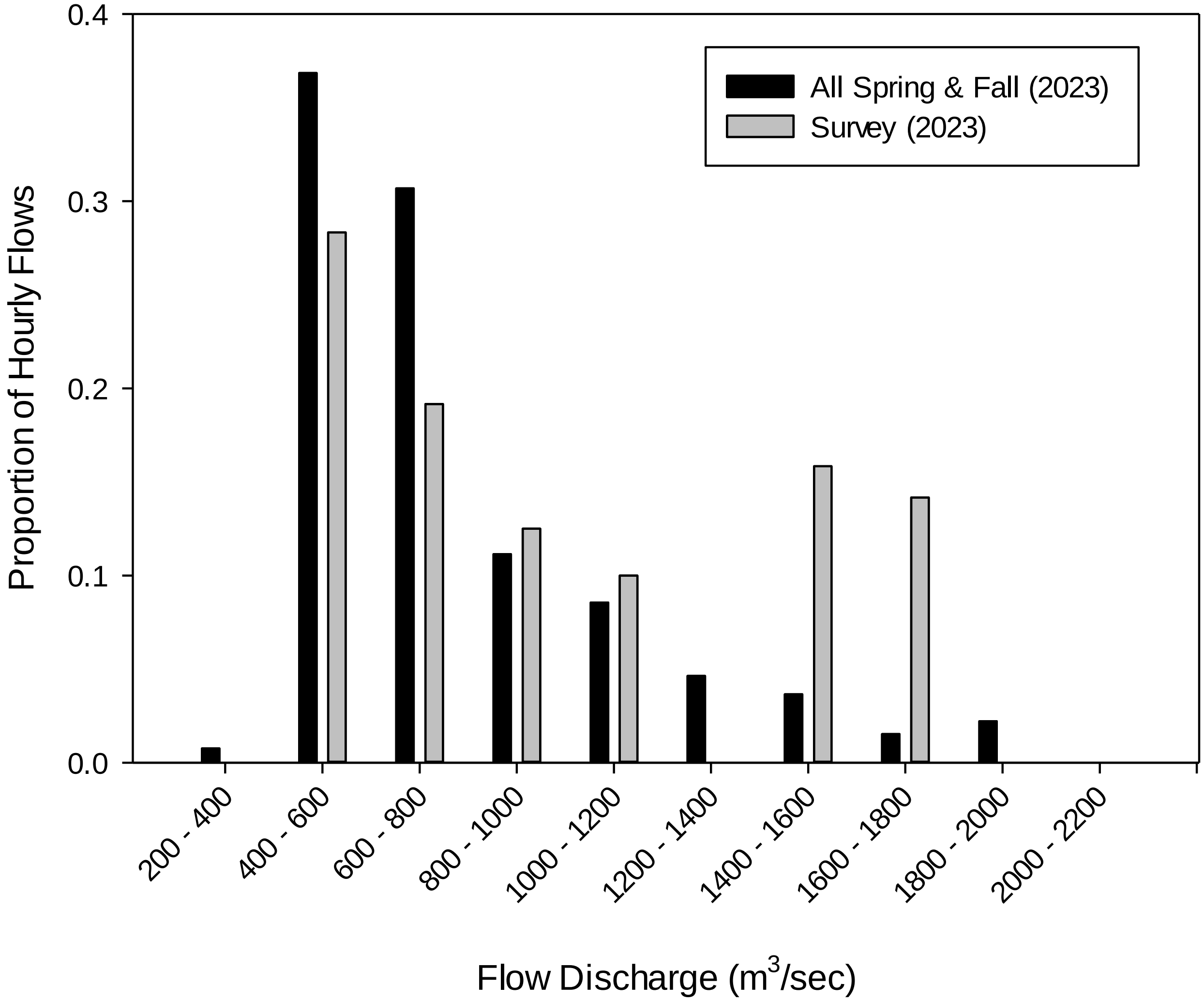
Note: Sample size is 6 years except for early spring (no surveys) and late fall (2 years). SD = standard deviation across years. Dashes indicate insufficient or inappropriate data for calculations.

Appendix F

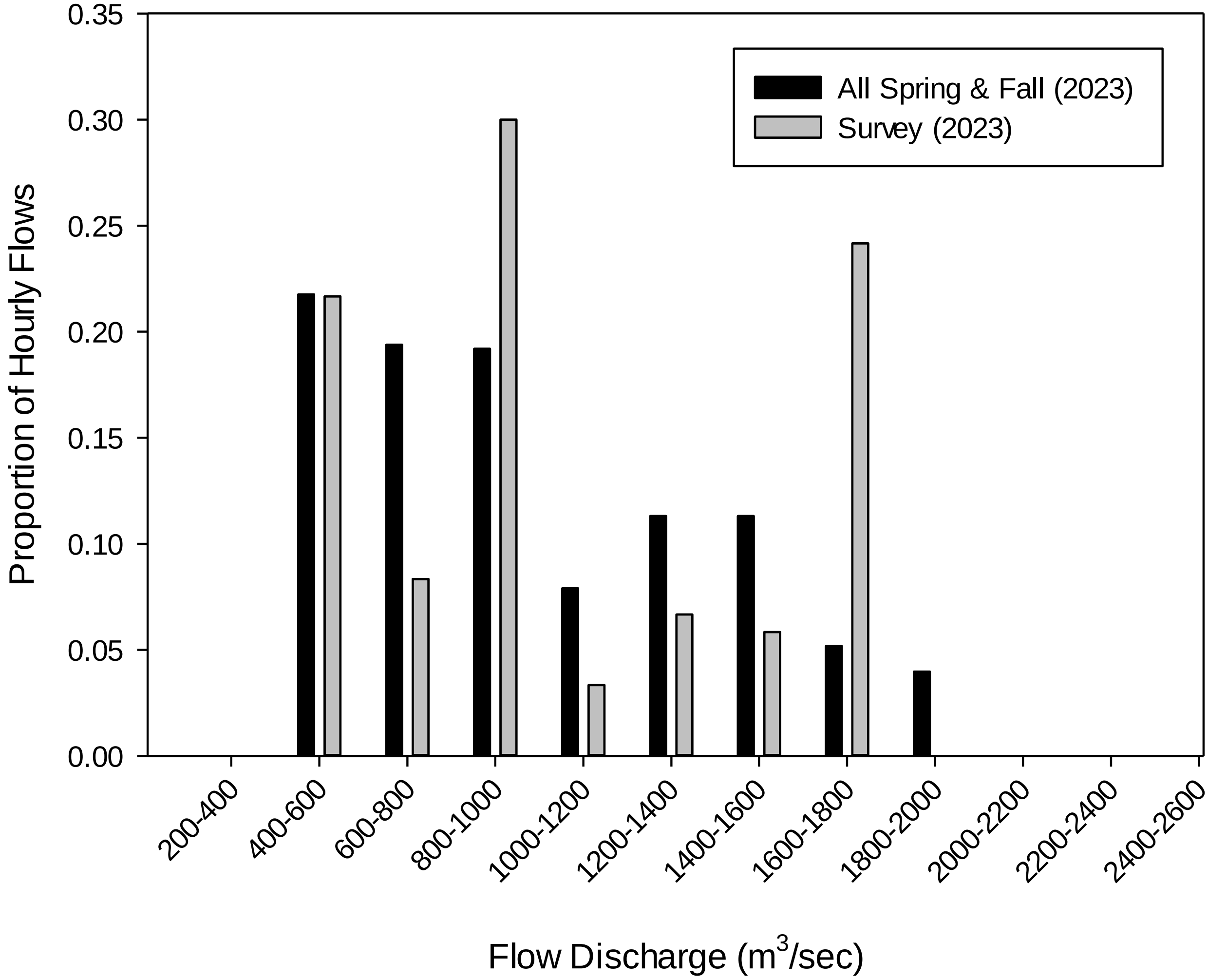
Peace River Flow Rates in 2023 during Surveys Relative to during the Entire Spring and Fall Migration Period



Appendix F-1 **Distribution of 2023 hourly flow rates, shown as proportion of total, in the Inundation Impact area during survey days and across all days during migration periods in spring (April 1 to May 30) and fall (August 1 to October 31)..**



Appendix F-2 Distribution of 2023 hourly flow rates, shown as proportion of total, in the Flow Impact area during survey days and across all days during migration periods in spring (April 1 to May 30) and fall (August 1 to October 31).



Appendix F-3 **Distribution of 2023 hourly flow rates, shown as proportion of total, in the Control area during survey days and across all days during migration periods in spring (April 1 to May 30) and fall (August 1 to October 31).**

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Appendix 5. Pre-construction Rare Plant Surveys 2023 Annual Report

2023 Annual Report

Pre-construction Rare Plant Surveys

Site C Clean Energy Project

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March 26, 2024

Contents

1. INTRODUCTION

1.1. Background

The Environmental Assessment Certificate (EAC #E14-02) for the Site C Clean Energy Project (the Project) sets out the conditions that BC Hydro must comply with during construction and operation of the Project (BC Environmental Assessment Office 2014). Condition 9 states in part:

- *The EAC Holder must, with the use of a QEP [Qualified Environmental Professional], complete an inventory in areas not already surveyed and use rare plant location information as inputs to final design of access roads and transmission lines. These preconstruction surveys must target rare plants as defined in Section 13.2.2 of the EIS [Environmental Impact Statement] —including vascular plants, mosses, and lichens.*
- *The EAC Holder must create and maintain a spatial database of known rare plant occurrences in the vicinity of Project components that must be searched to avoid effects to rare plants during construction activities. The database must be updated as new information becomes available and any findings of new rare plant species occurrences must be submitted to Environment Canada and MOE [Ministry of Environment] using provincial data collection standards.*

In addition, the Federal Decision Statement (FDS) issued under the Canadian Environmental Assessment Act sets out conditions relating to rare plants (Canadian Environmental Assessment Agency 2014). Condition 16 states in part:

- *16.1 The Proponent shall ensure that potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants are addressed and monitored.*
- *16.2. The Proponent shall develop, in consultation with Environment Canada, a plan setting out measures to address potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants.*
- *16.3. The plan shall include:*
    - o *16.3.3. measures to mitigate environmental effects on species at risk and at-risk and sensitive ecological communities and rare plants;*
    - o *16.3.4. conservation measures to ensure the viability of rare plants, such as seed recovery and plant relocation;*
    - o *16.3.6. an approach to monitor and evaluate the effectiveness of mitigation measures and to verify the accuracy of the predictions made during the environmental assessment on species at risk, at-risk and sensitive ecological communities and rare plants; and*

- *16.3.7. an approach for tracking updates to the status of listed species identified by the Government of British Columbia, Committee on the Status of Endangered Wildlife in Canada, and the Species at Risk Act, and implementation of additional measures, in accordance with species recovery plans, to mitigate effects of the Designated Project on the affected species should the status of a listed species change during the life of the Designated Project.*

To partially fulfill EAC condition 9 and FDS conditions 16.1, 16.2, 16.3.3, 16.3.4, 16.3.6 and 16.3.7, BC Hydro is conducting rare plant surveys in previously unsurveyed areas of the proposed transmission line, access roads, and other construction corridors. By documenting additional occurrences of rare plants within the Project footprint, measures to mitigate effects to these occurrences—including seed recovery and translocation—can be identified.

Data collected during these pre-construction rare plant surveys are added to the Project's environmental features spatial database. These spatial data are used during detailed design and construction to identify opportunities for avoidance, areas where extra care is needed, and areas where losses will occur. The first season of pre-construction surveys was completed in the summer and fall of 2015, and the work has been proceeding every year since. This interim report documents the methods and results of the 2023 surveys, and includes summaries of the work completed since 2015 for context.

1.2. Scope

The goals of the study are:

- to develop, maintain, and update a spatial database of rare plant occurrences in the vicinity of Project facilities;
- to determine the location of rare plant occurrences in previously unsurveyed areas that are proposed for ground or vegetation disturbance during construction and operation of the Project;
- to determine the location of rare plant occurrences within two mitigation parcels that will be used to compensate for project effects;
- to record detailed occurrence data in the master rare plant spatial database for all rare plant populations found, and submit these data to the B.C. (British Columbia) Conservation Data Centre (BCCDC) and—for taxa of federal concern—to Environment and Climate Change Canada (ECCC);
- to develop occurrence-specific mitigation measures to eliminate or reduce adverse effects to rare plant populations resulting from the Project;
- to assist construction teams in implementing the ongoing rare plant mitigation measures; and
- to monitor and evaluate the effectiveness of direct mitigation measures implemented to protect Project-area rare plant populations.

1.3. Study Area

Rare plant surveys were conducted in:

- the Highway 29 realignment corridors;
- the transmission line corridor;
- the new or upgraded transmission line access road corridors;
- the new or upgraded access road corridors into the reservoir clearing zone—excluding the reservoir footprint;
- the aggregate extraction areas;
- the haul road running along Ice Bridge and Septimus Roads from Area E to the Dam Site;
- the Project Access Road corridor running from Jackfish Road to the Dam Site;
- the access road extension at the Portage Mountain site;
- the 85th Avenue industrial site;
- the conveyor corridor from the 85th Avenue industrial site to the dam site;
- the 204 hectare Rutledge mitigation parcel along Highway 29 at Dry Creek; and
- the 423 hectare Wilder Creek mitigation parcel located along the Peace River approximately six kilometres (km) downstream from Bear Flat.

Pre-construction rare plant surveys were completed for many of these areas during the 2015 through 2022 field seasons. The 2023 work focussed on the remaining segments of Highway 29 realignment corridors on the north side of the Peace River, access roads on the south side of the Peace River, and on the Area E aggregate extraction site.

2. Methods

2.1. Pre-field Review

Each year in the spring the investigation began with a pre-field review designed to collect and analyze existing data. This information was used to create a field study plan and to identify data gaps in order to direct further research.

For the purpose of the investigation, “rare plants” were defined as the following vascular plants, mosses, and lichens:

- species listed on Schedule 1 of the Canadian Species at Risk Act (SARA) as amended (Government of Canada 2002);

- species assigned a status of Extinct, Extirpated, Endangered, Threatened, or Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2023); and
- species on the BCCDC's provincial Red or Blue lists (Red = Endangered, Threatened, or Extirpated; Blue = Special Concern)(BCCDC 2023a) .

Scientific and common plant names in this document follow the BCCDC's online Species and Ecosystem Explorer (BCCDC 2023a), which also serves as the authority for the Provincial rare plant status determinations and rankings.

Since 2005, BC Hydro has been conducting rare plant surveys in the Project's Regional Assessment Area (RAA)—as defined in the Site C Environmental Impact Statement (Hilton et al. 2013). As such, much is known about the rare flora of the area, and the pre-field review was based heavily on rare plant occurrence data collected over the last 19 years. Currently, 24 different rare plant taxa are reported to occur in the Project area. Consequently, 17 vascular plants, four lichens, and three mosses formed the basis of the target species list for the work, comprising the rare species with the highest likelihood of occurrence.

Since 2011 all rare plant data for the Project have been managed in a master rare plant spatial database. This database contains occurrence information for all known rare plant occurrences in the RAA, as well as rare plant survey tracks, field notes, species information, and other collected data relevant to the rare plant work. Periodically, the master rare plant spatial database has been queried to update the Project's environmental features database (separately maintained by BC Hydro). This environmental features database has been made available to Project engineers for use in mitigation planning.

In order to identify additional rare plant species that could potentially occur in the Project area, each year the dataset of all B.C. vascular plants, mosses, and lichens was downloaded from the BCCDC's Species and Ecosystem Explorer (BCCDC 2023a). Queries were run on the dataset to extract a list of the rare plant species that the BCCDC associates with the Peace River Regional District and the Boreal Black and White Spruce Biogeoclimatic Zone. Each species on this list was further reviewed to determine its potential for occurrence within the areas targeted for survey.

In addition, the BCCDC occurrence dataset of all species and ecosystems at risk (BCCDC 2023b) was periodically downloaded from the B.C. Data Catalogue and added to the master rare plant spatial database. The dataset was queried to investigate historic and verified extant rare plant occurrences within the Project area.

All the above information was compiled to produce a list of target rare plant species potentially occurring within the Project area. This target list included the 24 rare plant taxa currently reported to occur in the Project area, as well as numerous other possible Peace Region species uncovered during the pre-field review of data and literature. The target list was used as a working guideline and was not considered to be an exhaustive list of all potential rare plants in the Project area. For this reason, the botanists considered all described plant taxa while conducting surveys.

Aerial imagery, digital elevation data, and project maps were reviewed to predict the habitat types present in the survey corridors. General plant communities were determined, and the locations of possible high-suitability rare plant habitat were noted.

To refine their search images for the target taxa, the surveyors studied photographs, herbarium specimens, and species descriptions in various published references (Hitchcock et al. 1955; Flora of North America Editorial Committee 1993; Goward et al. 1994; McCune et al. 1995; Douglas et al. 1998; Goward 1999; Brodo et al. 2001; Welsh 2001; Cronquist et al. 2013; Brodo 2016) and online databases (CNALH 2021; Klinkenberg 2022; NatureServe 2023). In addition, they reviewed similar data for species that might be confused with the target taxa. Tables of summary identification characteristics were prepared for field use. The goals were to maximize detectability of the target species and to reduce surveyor bias during the field work.

The final field plan each year was designed to guide the methods, coverage, and timing of the rare plant surveys. Seasonal timing was based on the predicted phenologies of the target species.

2.2. Field Survey

The pre-construction surveys began in June of 2015 and have taken place every year since. Over the nine field seasons, 369 surveyor-days have been spent surveying a total transect distance of 2,065.3 km (Table 1 and Figure 1).

Table 1: Rare Plant Survey Effort

Year	Start Date	End Date	Surveyor-Days	Total Survey Km
2015	June 30	September 7	42	209.8
2016	June 20	August 23	41	191.8
2017	June 23	August 12	12	51.7
2018	June 13	August 29	56	409.3
2019	May 31	August 15	46	250.7
2020	June 4	October 9	56	322.3
2021	June 8	September 4	44	318.3
2022	June 6	August 23	40	156.6
2023	June5	September 13	32	154.8
Totals			**369**	**2,065.3**

Table notes:

- *Surveyor-Days = days spent surveying x number of botanists*
- *Total Survey Km = total survey transect distance*

For all nine years, the surveys were performed by two senior-level rare plant botanists, both of whom have been working with the rare flora of the Project area for the past 12 years. The surveyors primarily used a habitat-directed meander search protocol to cover the areas surveyed. This survey technique is based on floristic, intuitive-controlled meander search types outlined in various rare plant survey guidelines (Whiteaker et al. 1998; ANPC 2000; ANPC 2012; Penny & Klinkenberg 2012; MOECCS Ecosystems Branch 2018). The surveyors, working together or separately, walked the length of the linear corridors, zig-zagging back and forth from one edge of the proposed disturbance area to the other. For non-linear survey areas such as the Industrial 85th Avenue or Portage Mountain sites, the surveyors conducted meander transects to cover the entire area.

When using the habitat-directed meander search protocol:

- surveyors walk variable-width transects that are spaced relatively close together (typically so that the edge of the transect just surveyed is still visible to the surveyor or their partner—this distance varies based on the habitat surveyed and the detectability of the target species);
- surveyors attempt to locate all rare plant occurrences and high-suitability rare plant habitat within a defined unit in a systematic way (e.g., by walking in a zig-zag pattern along linear features, or in a contour pattern when surveying non-linear features); and
- surveyors attempt to traverse a representative cross-section of all low-suitability rare plant habitat within the unit.

The habitat-directed meander search preferentially covers high-suitability ecosystems over the more common low-suitability habitats (MacDougall & Loo 2002). The survey method is floristic in nature, meaning that all plant taxa encountered are recorded and identified to a level necessary to determine their rarity (ANPC 2012). Furthermore, the habitat-directed meander search pattern is of variable intensity, such that when a rare plant occurrence or high-suitability rare plant habitat is located, the surveyors increase the intensity of their survey by narrowing the spacing of the transect pattern they are walking. Depending on the kind of habitat being surveyed and the detectability of the target rare species, this can require very close, hands-and-knees survey work in some areas.

For certain linear corridors that traverse habitat with a low potential for rare plant occurrence, the botanists drove slowly along the corridor in a Utility Terrain Vehicle (UTV) or truck, scanning both sides for rare plants and pockets of high-suitability rare plant habitat. This procedure was only conducted in corridors where the majority of habitat was low-probability rare plant habitat, and at a speed of approximately five kilometres per hour. When high-potential rare plant habitat was encountered—such as wetlands or rock outcrops—the surveyors exited the vehicle and surveyed the habitat on foot. Over the course of the nine field seasons, 85.9 hectares out of the total 2,065.3 hectares covered (4.2%) were surveyed in this manner.

In 2016, surveys were conducted within the Rutledge and Wilder Creek mitigation parcels. These surveys were designed to provide a general overview of the rare plant populations present within the parcels, in order to inform mitigation planning. As such, these areas were surveyed at a lower intensity level, covering a smaller percentage of the suitable habitats than in the areas proposed for disturbance.

Although the habitat-directed meander survey technique described above was used in the mitigation parcels, certain areas of suitable habitat were not covered.

During the fieldwork, the surveyors constantly monitored all areas traversed for changes in habitat and plant association, as well as for previously unrecorded plant species (common and rare). Lists were kept of all plants and plant communities observed; unknown species were collected for later identification in the lab; Global Positioning System (GPS) units were used to mark location points as appropriate; and notes and photographs were taken to record plants of interest, landforms and unique features, habitat quality and disturbance, and areas requiring further survey.

When target rare plants were found during the fieldwork, occurrence information was entered into custom-built digital forms or recorded on printed BCCDC rare plant survey forms (BCCDC 2012). Where paper forms were used, the information was later transcribed into digital format to facilitate analysis of the occurrences. Photographs were taken of both the individual plants and the surrounding habitat. Consistent with the B.C. Resource Information Standards Committee guidelines and the rare plant survey guidelines on the B.C. E-Flora website, a voucher specimen was collected where permitted by the landowner, and when doing so did not compromise the viability of the population (RIC 1999; Penny & Klinkenberg 2012; MOECCS Ecosystems Branch 2018). At each vascular rare plant occurrence, GPS units were used to record the boundary of the occurrence to facilitate mitigation planning.

Delimitation of occurrences is based on *A Habitat-Based Strategy for Delimiting Plant Element Occurrences* (NatureServe 2004). The Element Occurrence (EO) is a fundamental unit of information in the Conservation Data Centre system, and is defined as "an area of land and/or water in which a species or natural community is, or was present." (NatureServe 2002). Based on the NatureServe guidance, rare plants for the Project were typically grouped into a single occurrence when they were located closer than one kilometre from another individual of the same species. In some cases, occurrences were composed of two or more discrete patches within a larger area. These patches were mapped separately to facilitate mitigation planning, but were recorded as a single occurrence when the patches were closer than one kilometre to each other.

Accordingly for the Site C Project, the following definitions were used for rare plant groupings:

- **Occurrence:** an area of land occupied by one or more rare plant individuals of the same species; each individual in an occurrence is located less than one kilometre from its nearest neighbour (if the occurrence contains more than one individual).
- **Patch:** a sub-group within an occurrence, used when two or more discrete clusters of the same rare plant are separated by unoccupied habitat, but are less than one kilometre from the nearest neighbouring cluster.

The botanists conducting the 2019 through 2023 preconstruction surveys were also working on the Site C Experimental Rare Plant Translocation program at the time, selecting and documenting potential recipient sites for translocation outplanting. When new rare plant occurrences were found during potential recipient site selection work, they were documented using the same methods as described above. All of the new rare plant occurrences found during the survey work for either program are reported here to provide a single document that contains all the new rare plant occurrences.

2.3. Mitigation Planning and Implementation Assistance

In order to assist with mitigation efforts and determine Project effects to rare plant species, certain known rare plant occurrences within the project activity zone were revisited during the course of the survey work. The botanists noted any impacts to these occurrences, predicted upcoming threats, and looked for mitigation opportunities to ameliorate adverse effects to the rare plants. This information was used to update the records in the Project rare plant database, assist with on-the-ground mitigation efforts, and provide decision makers with the information necessary to evaluate the threat statuses of the Project-area rare plants.

In certain priority cases, where rare plant occurrences were situated in or near Project construction zones, the botanists worked with BC Hydro planning teams and contractors to develop mitigation measures designed to reduce or eliminate impacts to the occurrences. This took place on an as-needed basis in situations where a species was difficult to identify in the field, or the layout of the occurrence was complex and difficult to map on the ground. The mitigation measures developed were focussed on avoidance or impact reduction, and included flagging occurrences in the field, coordinating with on-site construction personnel, and assisting rare plant salvage operations.

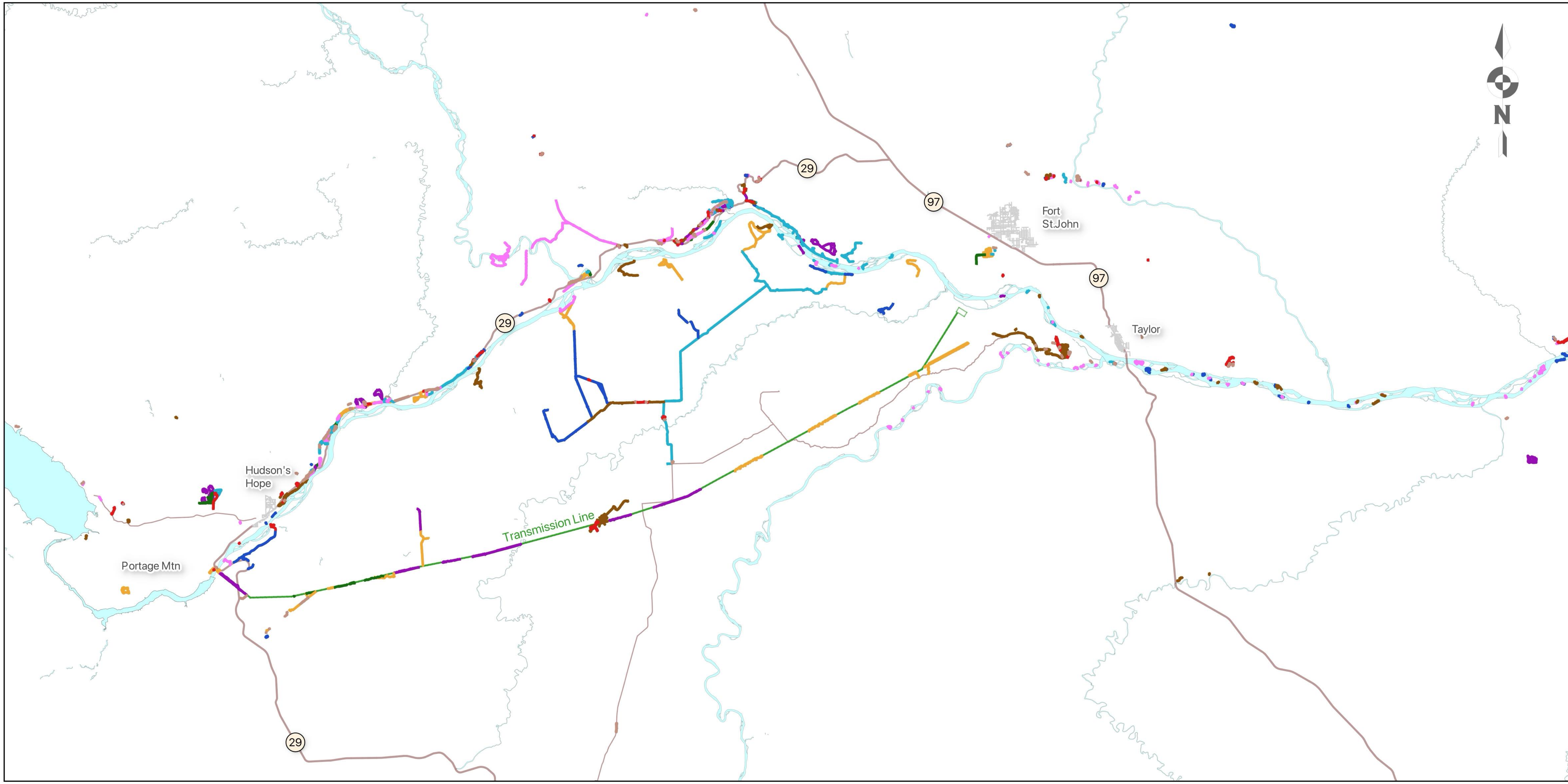
In addition, for one Red-listed species confirmed for the project area in 2018—*Selaginella rupestris* (rock selaginella)—a set of mitigation options was developed for all known occurrences in the RAA.

2.4. Analysis

As field data were collected, they were imported into the master rare plant spatial database. This included rare plant occurrence information, survey transect routes, and field notes. Collected data were encrypted and secured with multi-factor authentication protocols. The information and field photos were backed up to secure off-site servers.

Following the field season, the collected rare plant information was compiled and analyzed in the Project rare plant Geographic Information System (GIS). Voucher specimens were examined and sent to outside experts when additional verification was required. New rare plant locations were compared with BCCDC data to determine if the newly discovered patches could be combined as extensions of previously recorded occurrences.

Once the data had been compiled, verified, and cleaned, a submission package was prepared for the BCCDC. This dataset contained all the new rare plant occurrences found during the previous field season, as well as any updates and extensions to previously reported occurrences. The data were provided in a spatial format compatible with BCCDC submission requirements. Voucher specimens were prepared based on Ministry of Environment and Climate Change Strategy guidelines (MOECCS 2018) and submitted to the appropriate herbarium (typically UBC).



Map Notes:

1. Based on surveys completed through September 2023.
2. Map Datum: NAD83
3. Map Projection: UTM Zone 10 N
4. Water Features Base Data from BC FreshwaterAtlas.
5. Road Base Data from the BC Digital Roads Atlas project.
6. Project-specific spatial data supplied by BC Hydro.

Roads
- Highway
- Secondary
- Urban

Survey Transects
- 2015
- 2016
- 2017
- 2018
- 2019
- 2020
- 2021
- 2022
- 2023

Map Scale 1:350000

0 10 20 30 km

SITE C CLEAN ENERGY PROJECT

BC hydro

EAGLE CAP CONSULTING environmental consulting services

Figure 1
Rare Plant Survey Transects
2015 to 2023

Date	November 15, 2023	DWG NO	2023-11-15-001	Revision 0

The following quality assurance and quality control measures were applied to promote accurate data collection and analysis:

- The master rare plant spatial database, which contains all rare plant data for the project, is a custom-built spatial database (PostgreSQL 14.9 spatially enabled with PostGIS 3.3). The database server software was regularly updated to the latest stable versions and all security patches were applied soon after issue.
- The tables in the database were normalized to reduce data redundancy and improve integrity.
- Primary key constraints were enforced for all relational tables to improve database integrity and allow complex queries to be run.
- Fields were constrained at the database level to ensure type-consistency. Electronic input forms also constrained entered data to provide front-end validation and user guidance.
- Regular updates were pulled from the BCCDC's Ecosystem Explorer and added to the master database to ensure that analyses were performed using the latest BCCDC rare plant statuses and nomenclature.
- The data fields *UTM northing*, *UTM easting*, *lat_long,* and *occurrence area* were calculated programmatically from the rare plant polygons, for accuracy of the derived fields. Point data were also derived programmatically from the rare plant polygons for locational consistency between the spatial fields.
- Multipolygons—a GIS feature class that allows one or more closed plane figures to be recorded for each occurrence—were used as the basic spatial descriptor for the rare plant occurrences recorded after 2008. This allowed for more precise avoidance mitigation than would be possible using single polygons or points.
- Custom-built electronic forms were used by the botanists to enter rare plant data in the field while at the occurrence. Paper versions of the forms were also used in cases where there were difficulties with the electronic entry devices. In these cases, the paper forms were transcribed onto the electronic forms as soon as possible to allow for data validation.
- Every record was reviewed for typographical and transcription errors at the end of the field season.
- Associated species lists were reviewed by a second botanist to ensure identification accuracy.
- Rare plant polygons were reviewed on aerial imagery and ecosystem layers in the GIS to check boundary accuracy by the botanist(s) who recorded the occurrence.
- Voucher specimens were collected where appropriate and verified in the lab and herbarium, or sent to species experts for further verification when taxonomic questions still existed.

3. Results

3.1. Pre-field Review

The 2023 pre-field review identified 97 rare plant taxa with potential for occurrence in the overall Project area (Appendix 1). The list comprises 36 vascular plant species, 44 bryophytes, and 17 lichens. As noted previously, this list was used for planning purposes and was not considered to be an exhaustive listing of all possible rare plant taxa in the project area. The surveyors considered all rare taxa during the surveys, whether they were on the target list or not.

It should also be noted that the BCCDC regularly reviews the statuses of the plant taxa in the province to determine if new information warrants a change in the rarity rankings. As the Site C rare plant work proceeded, the numerous new occurrences that have been found during the surveys have allowed the BCCDC to reassess many of the plant taxa in the RAA. These reassessments are typically published by the BCCDC in May each year, allowing Project botanists time to incorporate the updates into the field plan for the upcoming season.

However, in 2019 the BCCDC status update was not published until July 5, after several weeks of field work had been completed. The update removed 10 RAA plant taxa from the Red or Blue lists, meaning that they no longer met the definition of “rare plants” for the Project (see Section 2.1). This reduced the number of rare plant occurrences within the RAA by more than half, from 261 occurrences before the update, to 124 after the update.

In 2022, the status updates were published on July 21, after the field survey work was underway. Notably, *Oxytropis campestris* var. *davisii* (Davis’ locoweed)—previously one of the principal target species for the rare plant program—was removed from the rare status lists. In addition, another species found in the Site C area—*Drymocallis arguta* (tall wood beauty)—was added to the BC Flora on the Blue list, indicating that the taxon was of conservation concern and therefore met the Project definition of a “rare plant” (BCCDC 2023a).

3.2. Field Survey

The 2023 field surveys discovered or updated 32 occurrences (comprising 82 separate patches) of seven different rare vascular plant taxa: two B.C. Red-listed taxa, and five B.C. Blue-listed taxa. None of the seven species are listed on Schedule 1 of the Species at Risk Act or are considered to be Extinct, Extirpated, Endangered, Threatened, or Special Concern by COSEWIC (Government of Canada 2002; COSEWIC 2023).

In total, 216 occurrences containing 504 patches of 30 currently or formerly listed rare plant taxa have been discovered during the preconstruction surveys since 2015 (Table 2 and Figure 2). Over the course of the nine survey years, the investigators have recorded 704 vascular plant, bryophyte, and lichen taxa (Appendix 2).

Table 2: Rare plants found during the Site C Preconstruction surveys; 2015 through 2023

Taxon	Common Name	Current BC List	Occurrences	Patches
Vascular Plants				
Artemisia longifolia	long-leaved sage	Yellow	7	24
Atriplex gardneri var. *gardneri*	Gardner's sagebrush	Red	2	3
Calamagrostis montanensis	plains reedgrass	Yellow	5	14
Carex backii	Back's sedge	Yellow	4	11
Carex sprengelii	Sprengel's sedge	Blue	4	4
Carex torreyi	Torrey's sedge	Blue	8	14
Carex xerantica	dry-land sedge	Blue	15	38
Castilleja miniata var. *fulva*	tawny paintbrush	Yellow	1	1
Cirsium drummondii	Drummond's thistle	Yellow	4	13
Drymocallis arguta	tall wood beauty	Blue	34	109
Geum triflorum var. *triflorum*	old man's whiskers	Yellow	7	28
Helictochloa hookeri	spike-oat		1	1
Juncus stygius var. *americanus*	bog rush	Yellow	1	1
Lomatium foeniculaceum var. *foeniculaceum*	fennel-leaved desert-parsley	Blue	2	2
Oxytropis campestris var. *davisii*	Davis' locoweed	Yellow	21	33
Pedicularis parviflora	small-flowered lousewort	Yellow	1	2
Penstemon gracilis	slender penstemon	Blue	13	42
Piptatheropsis canadensis	Canada ricegrass	Red	6	21
Polypodium sibiricum	Siberian polypody	Yellow	1	12
Potentilla pulcherrima	pretty cinquefoil	Yellow	4	9
Ranunculus rhomboideus	prairie buttercup	Blue	10	16
Salix petiolaris	meadow willow	Blue	1	1
Selaginella rupestris	rock selaginella	Red	8	14
Silene drummondii var. *drummondii*	Drummond's campion	Yellow	3	3
Sphenopholis intermedia	slender wedgegrass	Yellow	7	13
Symphyotrichum puniceum var. *puniceum*	purple-stemmed aster	Yellow	7	7
Lichens				
Physcia biziana	frosted rosette	Yellow	16	28

Taxon	Common Name	Current BC List	Occurrences	Patches
Physcia stellaris	immaculate rosette	Yellow	8	11
Ramalina sinensis	threadbare ribbon	Yellow	14	25
Usnea cavernosa	pitted beard	Yellow	1	4

Table notes:

- *B.C. List (BCCDC): Red = Endangered, Threatened, or Extirpated; Blue = Special Concern; Yellow = Apparently Secure*
- *Occurrences: Includes newly discovered occurrences as well as occurrences expanded during the preconstruction surveys*

Many of the rare plant taxa found during the pre-construction surveys had been documented previously in other occurrences during the baseline surveys performed for the Project environmental impact assessment. Species descriptions for the 11 taxa that held rare status during the 2023 field season are presented in Appendix 3. Each section also contains an overview of any new occurrences documented in 2023, and up-to-date summary information on all reported occurrences for each of these taxa in the RAA.

In this report all of the rare plant taxa discussed in Appendix 3 were Red- or Blue-listed by the BCCDC for at least part of the 2023 survey season. For clarity, rare species found in previous years that have subsequently been removed from the Red or Blue lists are not included. Although not currently of conservation concern, the occurrence data for these taxa have been retained in the master rare plant spatial database for future reference if needed.

Information on additional taxa and occurrences documented in the RAA prior to 2015 can be found in the following references:

- Site C Project Environmental Impact Statement, Volume 2, Appendix R, Part 1 (Hilton et al. 2013);
- Report: Site C Clean Energy Project: Pre-disturbance Rare Plant Assessment #1: Rolling Work Plan 10 (Eagle Cap Consulting Ltd 2014);
- Report: Site C Clean Energy Project: Wildlife, Vegetation and Mapping Inventory for the Marl Fen Property (Simpson et al. 2014); and
- B.C. Ecosystem Explorer website (BCCDC 2023a).

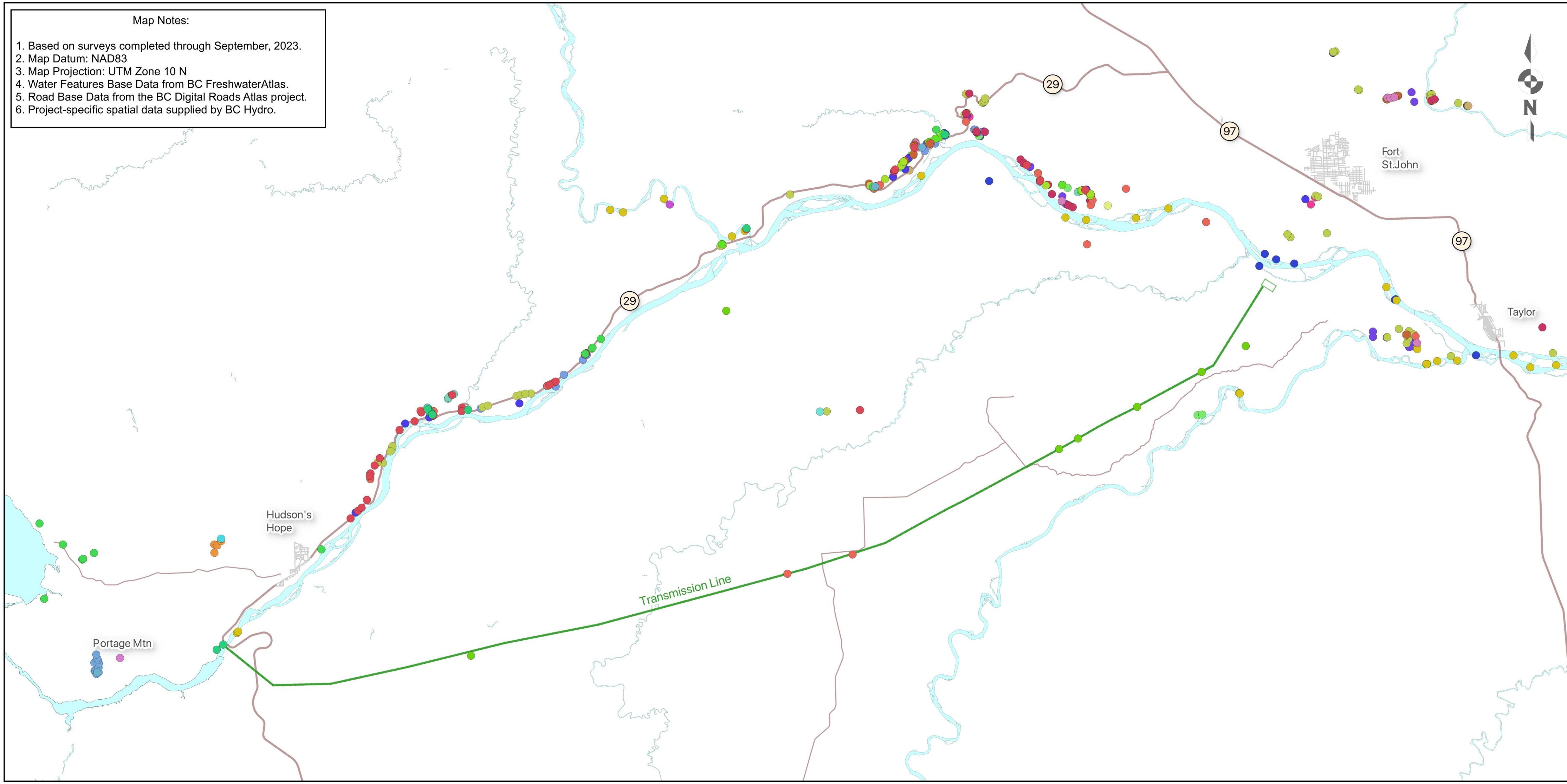
3.3. Mitigation Planning and Implementation

Twenty previously known rare plant occurrences were revisited during the 2023 survey work to verify continued survival, document potential threats, and develop potential mitigation strategies to ameliorate effects. The majority of these (17 of 20) were found to be still extant; one had been extirpated, and two others had incurred ground disturbance from machinery which had destroyed one or more rare plants.

To-date, eight priority rare plant occurrences have required mitigation assistance from the pre-construction rare plant survey team. In 2018, two occurrences of Red-listed species—*Piptatheropsis canadensis* (Canada ricegrass) and *Atriplex gardneri* var. *gardneri* (Gardner's sagebrush)—adjacent to access roads in the Wilder Creek area were flagged, mapped, and photographed to assist the road crews. The forestry contractor responsible for the area was contacted so that crews understood how the occurrences were flagged and the importance of avoiding them in the field. Monitoring surveys conducted in 2019 found that both occurrences had been substantially avoided during the road work and the viability of the occurrences had not been threatened by the activity. The Canada ricegrass occurrence had been completely avoided, and the Gardner's sagebrush occurrence had had only a few individuals destroyed, leaving the majority (an estimated 150 plants) untouched.

In 2019, two priority rare plant occurrences growing together on the same hillside in the Farrell Creek East Highway 29 realignment clearing zone were identified as requiring additional mitigation assistance. The two rare plant occurrences—*Selaginella rupestris* (rock selaginella) and *Penstemon gracilis* (slender penstemon)—had the potential to be extirpated by clearing activities. Due to access restrictions, propagule salvage operations could not occur at this location until BC Hydro acquired rights to the land. In cooperation with the Project environmental team, a mitigation plan was developed delaying clearing activities until 2021, allowing for propagule salvage after land acquisition. In 2021 the preconstruction botany team assisted the Experimental Rare Plant Translocation program team in salvaging some of the rock selaginella and slender penstemon individuals at this location, before the area was cleared for aggregate extraction. The location was revisited in 2022 to assess impacts, as the aggregate extraction work had apparently been completed and the equipment removed. The rock selaginella and slender penstemon occurrences had been significantly reduced in extent and number of individuals: the entire main patch of the rock selaginella had been destroyed (thousands of clumps), and an estimated 75% of the main patch of slender penstemon had been destroyed (hundreds of plants). However, both occurrences were found to extend beyond the area of construction disturbance and may persist if further construction disturbance is avoided. The 2023 revisit to this location confirmed that both the rock selaginella and slender penstemon occurrences are still extant.

In 2020, preconstruction rare plant surveys discovered an occurrence of *Carex sprengelii* (Sprengel's sedge) in an area at Dry Creek that had been recently cleared. The overstory trees and shrubs had been cut and removed, and some ground disturbance had taken place. In the opening, four Sprengel's sedge plants were found, all of which were in late fruit. The remaining undispersed Sprengel's sedge achenes were collected and sent to NATS Nursery in Langley, B.C. to be incorporated into the Project's Experimental Rare Plant Translocation program. The four plants were left in place. In 2021 the occurrence was revisited and all four plants were extant. In addition, a fifth plant was found. The occurrence was revisited in 2022 and 2023, and all the plants were present. The surrounding vegetation had become quite dense and was potentially negatively affecting the viability of the occurrence. It remains to be seen if the Sprengel's sedge plants at this occurrence can persist through the successional stages as the surrounding vegetation regrows.



- Artemisia herriotii
- Atriplex gardneri var.gardneri
- Avenula hookeri
- Calamagrostis montanensis
- Carex backii
- Carex sprengelii
- Carex torreyi
- Carex xerantica
- Castilleja miniata var.fulva
- Cirsium drummondii
- Drymocallis arguta
- Geum triflorum var.triflorum
- Juncus stygius var.americanus
- Lomatium foeniculaceum var.foeniculaceum
- Oxytropis campestris var.davisii
- Penstemon gracilis
- Physcia biziana
- Physcia stellaris
- Piptatheropsis canadensis
- Pohlia elongata
- Polypodium sibiricum
- Potentilla pulcherrima
- Ramalina sinensis
- Ranunculus rhomboideus
- Salix petiolaris
- Selaginella rupestris
- Silene drummondii var.drummondii
- Sphenopholis intermedia
- Symphyotrichum puniceum var.puniceum
- Usnea cavernosa

Map Scale 1:250000

0 10 20 km

SITE C CLEAN ENERGY PROJECT

BC hydro

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Figure 2
Rare Plant Sites Found in Project Vicinity (2015-2023)

Date	November 15, 2023	DWG NO	2023-11-15-0002	Revision 0

Also in 2020, late season field work within the Cache Creek Highway Realignment construction corridor discovered a new occurrence of Canada ricegrass. Nine patches were found in and adjacent to the Leave to Construct (LTC) corridor. Several detailed options were developed to mitigate impacts to the patches. Clearing in this area was scheduled for the fall of 2020, so the rare plant botanists returned to the occurrence to implement and facilitate mitigation measures for the occurrence.

One of the nine patches was in an area that had been cleared. Twelve Canada ricegrass plants were still present along the edges of the former patch—some stems were broken but the remaining base and root portions of the plants were intact. Several of the stem heads contained undispersed fruit and 27 seeds were collected. After microscopic examination, nine of the seeds were found to be apparently viable, and these were sent to NATS Nursery for storage and propagation as part of the Project's Experimental Rare Plant Translocation program. The 12 plants were salvaged and directly replanted at two suitable recipient sites outside of the LTC zone.

The remaining eight patches had not been affected by project activities. Two of these patches were over 300 m from the LTC zone and were not expected to be affected by the Project. The other six were in areas of the LTC zone where construction activities may have been able to avoid disturbing the patches. These six were clearly flagged and staked in the field to facilitate avoidance. Personnel from the construction firms were contacted so that they were aware of the rare plant occurrences and understood how the patches were flagged in the field. In addition, the botanists met with a representative from the Site C environmental team and visited each of the flagged patches.

In 2021, this Canada ricegrass occurrence at Cache Creek was revisited to determine its status. As expected, the patch that had been cleared in 2020 was extirpated under the newly built highway. The area adjacent to one other patch straddling the edge of the right-of-way (ROW) fence had been cleared by highway construction, however, no Canada ricegrass plants had been destroyed. The remaining seven patches had not been directly impacted by highway construction.

The Canada ricegrass occurrence at Cache Creek was checked again during the 2022 field work. No construction effects were observed in seven of the nine original patches. In addition to the patch which was extirpated in 2020, the patch straddling the ROW fence had been completely cleared within the ROW with the result that one plant had been destroyed. However, the estimated 10 remaining plants on the other side of the fence outside of the ROW appeared unaffected. As well, a tenth small patch containing two plants was found further west within the ROW. It is not known if this tenth patch will persist given the high levels of ground and vegetation disturbance that take place within highway ROWs.

During the 2023 field season, an additional visit was made to the Cache Creek Canada ricegrass occurrence: of the 10 patches, seven were not checked due to access restrictions. Of the three patches rechecked, one was confirmed extirpated as previously observed, one partially affected (the loss of a single plant in the ROW corridor, as previously documented), and one extant but with new construction disturbance evident: a ditch had been dug and a power pole had been installed. In spite of this ground disturbance, both the original two Canada ricegrass plants remained unaffected, and four new plants were documented.

Another Canada ricegrass occurrence near the proposed Area E aggregate extraction site was staked and flagged in 2021 to facilitate contractor avoidance. This occurrence is located approximately 60 metres outside of the extraction site boundary, and was not expected to be affected by construction activities. The occurrence was flagged as a precautionary measure to reduce the chance of unintentional impacts. This occurrence was revisited in early summer of 2022 after extraction activities had begun, and although it was too early in the season to locate individual Canada ricegrass plants, the occurrence appeared to be undisturbed by construction activities and the stakes and flagging were still in place. In June of 2023 the occurrence was again revisited and the Canada ricegrass occurrence remained undisturbed.

Also in 2022, the *Ranunculus rhomboideus* (prairie buttercup) occurrence at Watson Slough was salvaged and transplanted to a site outside the project activity zone in anticipation of clearing activities scheduled for the winter of 2022/2023. Project botanists removed the majority of the occurrence (16 plants in nine clumps) and directly transplanted the individuals to a site near a wetland along Upper Cache Road.

The prairie buttercup salvage site was revisited in June 2023. While the translocated plants were found to be surviving and many fruiting, the site (a Crown parcel) had been recently fenced and stocked with grazing cattle. Disturbance from cattle as well as human and beaver activity was observed in most portions of the salvage transects. In particular, many of the prairie buttercup fruiting heads had been cropped off. It is unknown how long these disturbances will continue and to what extent they will affect the success of the translocated plants.

4. Discussion

4.1. Coverage

Survey coverage of the areas proposed for construction disturbance—both the linear corridors and non-linear areas—was considered sufficient to locate the majority of identifiable target rare plant species. The field crew used a habitat-directed search protocol, employing a variable-intensity survey pattern that focussed time and effort on the habitats most likely to contain rare plant occurrences. Transects were spaced so that the majority of rare plant occurrences and high-suitability rare plant habitat would have been visible during the surveys. See Section 2.2 above for a complete description of the survey methods.

For the mitigation parcels—where the goal was to provide only a general overview of the rare plant populations present—the lower intensity meander surveys sampled most of the important habitats at both parcels. Although there are likely additional rare plant occurrences to be found at the mitigation parcels, the surveys provided a general picture of the rare plant resources present.

The logistics of performing rare plant surveys in the project area present certain challenges for coverage and timing. Several of the target rare plant species have extremely limited seasonal identification periods and can only be optimally found during a four-week window that changes slightly from year to year depending on the weather. In addition, access is often unsafe or impossible during substantial periods of the growing season due to severe weather events, flooding, road wash-outs, and impassable wetland conditions. These physical access limitations are particularly constraining on the plateau south of the Peace River, but can also be challenging on the north side of the river. Furthermore, landowner restrictions prevent surveyors' access to certain areas until BC Hydro is able to acquire access rights to the specific survey parcels (and often the roads that lead up to them).

All these factors—target species identification periods, favourable weather and road conditions, legally granted access permission—must coincide for a successful survey visit. Often, repeated attempts are necessary. In a limited number of cases (less than 5% of the affected hectares) it was not possible to access certain planned construction corridors at the appropriate time of year prior to clearing. Nevertheless, these areas were surveyed using the standard methods described in Section 2.2 when rare plant habitat persisted following the clearing.

4.2. Seasonal Timing

Based on the observed phenology of the plants in the areas surveyed and data gathered during previous years' survey work, the seasonal timing of the surveys was sufficient to identify most of the target rare plants. The June and early July work typically focussed on areas north of the Peace River, where floodplain and grassland habitats make up the majority of the high-potential rare plant habitats present. Target species in these habitats often bloom early in the season, and then wither by later in the summer (although some notable exceptions have been observed, such as Canada ricegrass, which is not clearly identifiable until later in the season). The late summer and early fall surveys mainly focussed on areas south of the Peace River, where wetlands are the primary high-potential rare plant habitats. Many of these wetland-associated target rare plants bloom later in the season, and persist longer into the fall than those found in the upland areas.

4.3. Ongoing Work

The majority of the vegetation clearing related to Project construction has been completed, or is scheduled to take place over the winter of 2023/2024. There remain some small areas still to be surveyed for rare plants during the 2024 field season, but the majority of the expected preconstruction survey work has been completed over the past nine field seasons. Changes to the Project construction footprint may necessitate additional rare plant survey work (as has occurred in most of the previous nine field seasons) but at this point no revisions are foreseen.

For 2024 the following tasks are planned to continue addressing the relevant conditions set out in the Provincial Environmental Assessment Certificate and the Federal Decision Statement (see Section 1.1 above):

- continue to maintain and update the spatial database of rare plant occurrences in the vicinity of Project facilities;
- track and analyze new BCCDC data and listings as they are issued to determine the effect (if any) on Project-area rare plant species;
- conduct rare plant surveys in the remaining targeted areas of the Project construction footprint as needed;
- conduct rare plant surveys in new additions to the construction footprint (if any);
- monitor existing rare plant occurrences located near construction zones to determine impacts, and develop mitigation measures if needed;
- assist construction teams in implementing ongoing rare plant mitigation measures where needed;
- submit collected rare plant data to the BCCDC and—for taxa of federal concern—to Environment and Climate Change Canada; and
- collect, prepare and submit voucher specimens from any new rare plants found during the 2024 field season.

5. CLOSURE

Reviewed and approved:

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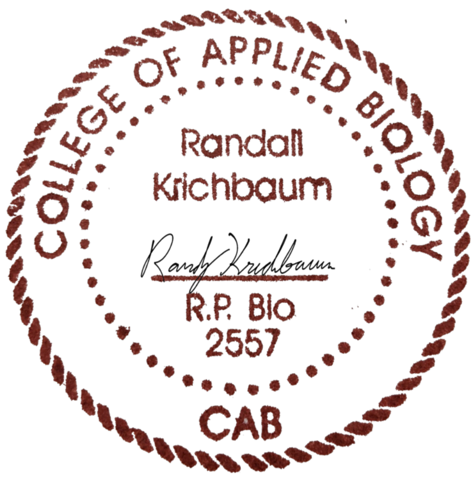
Senior Ecologist
Eagle Cap Consulting Ltd.

<Original signed and sealed March 26, 2024 at Calgary, Alberta>



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7. APPENDICES

7.1. Appendix 1: Rare plant taxa with potential for occurrence in the Site C Project area

Scientific Name	Common Name	BC List	COSEWIC	SARA
VASCULAR PLANTS				
Acorus americanus	American sweet-flag	Blue	-	-
Arctophila fulva	pendantgrass	Blue	-	-
Artemisia alaskana	Alaskan sagebrush	Blue	-	-
Atriplex gardneri var. *gardneri*	Gardner's sagebrush	Red	-	-
Botrychium montanum	mountain moonwort	Blue	-	-
Botrychium paradoxum	two-spiked moonwort	Blue	-	-
Carex bicolor	two-coloured sedge	Blue	-	-
Carex lapponica	Lapland sedge	Blue	-	-
Carex sprengelii	Sprengel's sedge	Blue	-	-
Carex torreyi	Torrey's sedge	Blue	-	-
Carex xerantica	dry-land sedge	Blue	-	-
Drosera linearis	slender-leaf sundew	Blue	-	-
Drymocallis arguta	tall wood beauty	Blue	-	-
Epilobium saximontanum	Rocky Mountain willowherb	Red	-	-
Hesperostipa spartea	porcupinegrass	Blue	-	-
Lomatium foeniculaceum var. *foeniculaceum*	fennel-leaved desert-parsley	Blue	-	-
Nabalus racemosus	purple rattlesnake-root	Red	-	-
Packera ogotorukensis	Ogotoruk Creek butterweed	Red	-	-
Penstemon gormanii	Gorman's penstemon	Blue	-	-
Penstemon gracilis	slender penstemon	Blue	-	-
Piptatheropsis canadensis	Canada ricegrass	Red	-	-
Polygala senega	Seneca-snakeroot	Red	-	-
Polygonum ramosissimum ssp. *prolificum*	proliferous knotweed	Red	-	-
Potentilla furcata	forked cinquefoil	Red	-	-
Ranunculus cardiophyllus	heart-leaved buttercup	Red	-	-
Ranunculus rhomboideus	prairie buttercup	Blue	-	-
Rosa arkansana	Arkansas rose	Blue	-	-

Scientific Name	Common Name	BC List	COSEWIC	SARA
Salix petiolaris	meadow willow	Blue	-	-
Sarracenia purpurea ssp. *purpurea*	common pitcher-plant	Red	-	-
Saussurea angustifolia var. *angustifolia*	northern sawwort	Red	-	-
Selaginella rupestris	rock selaginella	Red	-	-
Silene repens	pink campion	Blue	-	-
Symphyotrichum falcatum var. *commutatum*	white prairie aster	Red	-	-
Tephroseris palustris	marsh fleabane	Blue	-	-
Thalictrum dasycarpum	purple meadowrue	Blue	-	-
Utricularia ochroleuca	ochroleucous bladderwort	Blue	-	-
LICHENS				
Anaptychia crinalis	electrified millepede	Red	-	-
Anaptychia ulotrichoides	amputated millepede	Blue	-	-
Cladonia parasitica	fence-rail pixie	Red	-	-
Collema bachmanianum	Caesar's tarpaper	Blue	-	-
Collema coniophilum	crumpled tarpaper	Red	Threatened	Threatened
Fulgensia desertorum	desert sulphur	Blue	-	-
Fulgensia subbracteata	creeping sulphur	Blue	-	-
Heterodermia speciosa	smiling centipede	Red	-	-
Phaeophyscia adiastola	granulating shadow	Blue	-	-
Phaeophyscia hispidula	whiskered shadow	Red	-	-
Physcia dimidiata	exuberant rosette	Blue	-	-
Physcia tribacia	beaded rosette	Red	-	-
Physciella chloantha	downside shade	Blue	-	-
Squamarina cartilaginea	pea-green dimple	Red	-	-
Squamarina lentigera	snow-white dimple	Red	-	-
Thyrea confusa	candied gummybear	Blue	-	-
Xanthoparmelia camtschadalis	rockfrog	Red	-	-
BRYOPHYTES				
Acaulon muticum	[no common name]	Red	-	-
Amblyodon dealbatus	[no common name]	Blue	-	-
Atrichum tenellum	[no common name]	Red	-	-

Scientific Name	Common Name	BC List	COSEWIC	SARA
Aulacomnium acuminatum	[no common name]	Blue	-	-
Bartramia halleriana	Haller's apple moss	Red	Threatened	Threatened
Blindiadelphus subimmersus	[no common name]	Red	-	-
Bryobrittonia longipes	[no common name]	Blue	-	-
Cnestrum glaucescens	[no common name]	Blue	-	-
Dicranum majus var. *orthophyllum*	[no common name]	Red	-	-
Didymodon rigidulus var. *icmadophilus*	[no common name]	Blue	-	-
Didymodon subandreaeoides	[no common name]	Red	-	-
Drepanocladus turgescens	[no common name]	Blue	-	-
Encalypta brevicolla	[no common name]	Blue	-	-
Encalypta longicolla	[no common name]	Blue	-	-
Encalypta mutica	[no common name]	Blue	-	-
Encalypta spathulata	[no common name]	Blue	-	-
Haplodontium macrocarpum	Porsild's bryum	Red	Threatened	Threatened
Lescuraea saxicola	[no common name]	Blue	-	-
Lewinskya elegans	[no common name]	Blue	-	-
Meesia longiseta	[no common name]	Blue	-	-
Myurella sibirica	[no common name]	Red	-	-
Orthothecium strictum	[no common name]	Blue	-	-
Philonotis yezoana	[no common name]	Blue	-	-
Plagiobryum demissum	[no common name]	Red	-	-
Platyhypnum alpestre	[no common name]	Blue	-	-
Platyhypnum alpinum	[no common name]	Blue	-	-
Pohlia bulbifera	[no common name]	Blue	-	-
Schistidium boreale	[no common name]	Blue	-	-
Schistidium confertum	[no common name]	Red	-	-
Schistidium pulchrum	[no common name]	Blue	-	-
Schistidium robustum	[no common name]	Blue	-	-
Schistidium trichodon	[no common name]	Blue	-	-
Seligeria tristichoides	[no common name]	Blue	-	-
Sphagnum balticum	[no common name]	Blue	-	-
Sphagnum contortum	[no common name]	Blue	-	-
Sphagnum wulfianum	[no common name]	Blue	-	-

Scientific Name	Common Name	BC List	COSEWIC	SARA
Splachnum vasculosum	[no common name]	Blue	-	-
Stegonia latifolia var. *latifolia*	[no common name]	Blue	-	-
Tayloria froelichiana	[no common name]	Blue	-	-
Tayloria splachnoides	[no common name]	Red	-	-
Tetraplodon urceolatus	[no common name]	Red	-	-
Timmia norvegica var. *norvegica*	[no common name]	Blue	-	-
Timmia sibirica	[no common name]	Red	-	-
Weissia brachycarpa	[no common name]	Blue	-	-

Table notes:

- *B.C. List (BCCDC): Red = Endangered, Threatened, or Extirpated; Blue = Special Concern*
- *COSEWIC (Committee on the Status of Endangered Wildlife in Canada): E = Endangered; T = Threatened; SC = Special Concern; DD = Data Deficient*
- *SARA (Species at Risk Act): 1-E = Schedule 1 Endangered; 1-T = Schedule 1 Threatened; 1-SC = Schedule 1 Special Concern*

7.2. Appendix 2: Plant and lichen species recorded during the 2015–2023 surveys

<u>Vascular Plants</u>

Acer glabrum var. *douglasii*
Acer negundo
Achillea alpina
Achillea borealis
Achillea millefolium var. *lanulosa*
Achnatherum nelsonii ssp. *dorei*
Achnatherum richardsonii
Aconitum delphiniifolium
Actaea rubra
Agropyron cristatum ssp. *pectinatum*
Agrostis capillaris
Agrostis exarata
Agrostis gigantea
Agrostis scabra
Alisma triviale
Allium cernuum
Allium cernuum var. *cernuum*
Allium schoenoprasum var. *sibiricum*
Alnus incana ssp. *tenuifolia*
Alnus viridis ssp. *crispa*
Alnus viridis ssp. *sinuata*
Alopecurus aequalis
Alopecurus pratensis
Amelanchier alnifolia
Amerorchis rotundifolia
Anaphalis margaritacea
Androsace septentrionalis
Anemone cylindrica
Anemone multifida var. *multifida*
Anemone patens ssp. *multifida*
Anemone virginiana var. *cylindroidea*
Angelica genuflexa
Antennaria howellii ssp. *canadensis*
Antennaria howellii ssp. *petaloidea*
Antennaria microphylla
Antennaria neglecta
Antennaria parvifolia
Antennaria pulcherrima ssp. *pulcherrima*
Antennaria racemosa
Antennaria rosea
Anthoxanthum hirtum
Apocynum androsaemifolium
Apocynum androsaemifolium var. *androsaemifolium*
Aquilegia brevistyla
Aralia nudicaulis
Arctium minus
Arctium sp.
Arctostaphylos uva-ursi
Arnica chamissonis
Arnica cordifolia
Artemisia biennis
Artemisia campestris ssp. *pacifica*
Artemisia dracunculus
Artemisia frigida
Artemisia herriotii
Askellia elegans
Asparagus officinalis
Astragalus agrestis
Astragalus alpinus var. *alpinus*
Astragalus americanus
Astragalus australis
Astragalus canadensis
Astragalus cicer
Astragalus eucosmus
Astragalus laxmannii var. *robustior*
Astragalus tenellus
Athyrium filix-femina ssp. *cyclosorum*
Atriplex gardneri var. *gardneri*
Avena sativa
Avenula hookeri
Axyris amaranthoides
Beckmannia syzigachne
Betula neoalaskana
Betula papyrifera
Betula pumila
Betula pumila var. *glandulifera*
Bidens cernua
Blitum capitatum
Boechera divaricarpa
Boechera grahamii
Boechera pendulocarpa
Boechera retrofracta
Boechera stricta
Botrypus virginianus
Brassica rapa var. *rapa*
Bromus ciliatus
Bromus inermis
Bromus pumpellianus ssp. *pumpellianus*
Calamagrostis canadensis
Calamagrostis canadensis var. *langsdorfii*
Calamagrostis montanensis
Calamagrostis purpurascens var. *purpurascens*

Calamagrostis stricta ssp. *inexpansa*
Calla palustris
Callitriche palustris
Caltha natans
Campanula rotundifolia
Canadanthus modestus
Capsella bursa-pastoris
Caragana arborescens
Cardamine oligosperma var. *oligosperma*
Carex aquatilis
Carex aquatilis var. *aquatilis*
Carex arcta
Carex atherodes
Carex atratiformis
Carex aurea
Carex backii
Carex bebbii
Carex brunnescens
Carex brunnescens ssp. *brunnescens*
Carex canescens ssp. *canescens*
Carex capillaris
Carex chordorrhiza
Carex concinna
Carex crawfordii
Carex cusickii
Carex deweyana var. *deweyana*
Carex diandra
Carex disperma
Carex duriuscula
Carex eburnea
Carex filifolia
Carex foenea
Carex gynocrates
Carex inops ssp. *heliophila*
Carex interior
Carex lasiocarpa
Carex leptalea
Carex limosa
Carex livida var. *radicaulis*
Carex magellanica ssp. *irrigua*
Carex microptera
Carex obtusata
Carex peckii
Carex pellita
Carex praegracilis
Carex praticola
Carex retrorsa
Carex richardsonii
Carex rossii
Carex sartwellii
Carex siccata
Carex sprengelii
Carex tenera
Carex tenuiflora
Carex torreyi
Carex utriculata
Carex vaginata
Carex viridula ssp. *viridula*
Carex xerantica
Castilleja miniata
Castilleja miniata var. *fulva*
Centaurea stoebe ssp. *micranthos*
Cerastium arvense
Cerastium fontanum
Cerastium nutans
Chamerion angustifolium
Chenopodiastrum simplex
Chenopodium album
Chenopodium album ssp. *album*
Chenopodium album ssp. *striatum*
Chenopodium desiccatum
Chenopodium pratericola
Chrysosplenium tetrandrum
Cicuta bulbifera
Cicuta douglasii
Cicuta virosa
Cinna latifolia
Circaea alpina ssp. *alpina*
Cirsium arvense
Cirsium drummondii
Cirsium foliosum
Cirsium vulgare
Clematis occidentalis ssp. *grosseserrata*
Clematis tangutica var. *tangutica*
Coeloglossum viride var. *virescens*
Collomia linearis
Comandra umbellata
Comandra umbellata var. *pallida*
Comarum palustre
Conyza canadensis
Corallorhiza maculata
Corallorhiza striata var. *striata*
Corallorhiza trifida
Cornus canadensis

Cornus stolonifera
Corydalis aurea ssp. *aurea*
Corylus cornuta
Crepis tectorum
Cypripedium passerinum
Cystopteris fragilis
Dactylis glomerata
Dactylorhiza viridis
Danthonia intermedia ssp. *intermedia*
Danthonia spicata
Dasiphora fruticosa
Delphinium glaucum
Deschampsia cespitosa ssp. *cespitosa*
Descurainia sophia
Diphasiastrum complanatum
Dracocephalum parviflorum
Drosera linearis
Drosera rotundifolia
Drosera rotundifolia var. *rotundifolia*
Dryas drummondii
Drymocallis arguta
Dryopteris carthusiana
Dryopteris expansa
Elaeagnus commutata
Eleocharis mamillata ssp. *mamillata*
Eleocharis palustris
Elymus albicans
Elymus canadensis
Elymus glaucus
Elymus glaucus ssp. *glaucus*
Elymus lanceolatus ssp. *lanceolatus*
Elymus repens
Elymus trachycaulus
Elymus trachycaulus ssp. *subsecundus*
Elymus trachycaulus ssp. *trachycaulus*
Epilobium angustifolium
Epilobium ciliatum
Epilobium ciliatum ssp. *ciliatum*
Epilobium ciliatum ssp. *glandulosum*
Epilobium halleanum
Epilobium hornemannii ssp. *hornemannii*
Epilobium palustre
Equisetum arvense
Equisetum fluviatile
Equisetum hyemale
Equisetum hyemale ssp. *affine*
Equisetum laevigatum
Equisetum palustre
Equisetum pratense
Equisetum scirpoides
Equisetum sylvaticum
Equisetum variegatum ssp. *variegatum*
Erigeron caespitosus
Erigeron glabellus var. *pubescens*
Erigeron philadelphicus
Erigeron philadelphicus var. *philadelphicus*
Eriophorum angustifolium
Eriophorum chamissonis
Eriophorum gracile
Eriophorum sp.
Eriophorum viridicarinatum
Erysimum cheiranthoides
Euphrasia nemorosa
Eurybia conspicua
Eurybia sibirica
Fallopia convolvulus
Festuca rubra ssp. *rubra*
Festuca saximontana
Festuca trachyphylla
Fragaria vesca var. *bracteata*
Fragaria virginiana
Fragaria virginiana var. *platypetala*
Galearis rotundifolia
Galeopsis bifida
Galium boreale
Galium labradoricum
Galium trifidum
Galium trifidum ssp. *trifidum*
Galium triflorum
Gentianella amarella ssp. *acuta*
Geocaulon lividum
Geranium bicknellii
Geum aleppicum
Geum macrophyllum
Geum macrophyllum ssp. *macrophyllum*
Geum macrophyllum var. *perincisum*
Geum triflorum
Geum triflorum var. *triflorum*
Glyceria borealis
Glyceria grandis var. *grandis*
Glyceria striata
Gnaphalium uliginosum
Goodyera repens
Grindelia squarrosa var. *quasiperennis*

Gymnocarpium dryopteris
Halenia deflexa ssp. *deflexa*
Halerpestes cymbalaria
Hedysarum alpinum
Hedysarum boreale
Helictochloa hookeri
Heracleum maximum
Hesperostipa comata ssp. *comata*
Hesperostipa curtiseta
Heuchera richardsonii
Hieracium aurantiacum
Hieracium canadense
Hieracium umbellatum ssp. *umbellatum*
Hierochloë hirta ssp. *arctica*
Hippuris vulgaris
Hordeum jubatum ssp. *jubatum*
Hypopitys monotropa
Impatiens noli-tangere
Juncus alpinoarticulatus ssp. *americanus*
Juncus balticus ssp. *ater*
Juncus bufonius
Juncus dudleyi
Juncus nodosus
Juncus stygius ssp. *americanus*
Juncus vaseyi
Juniperus communis
Koeleria macrantha
Lactuca serriola
Lappula occidentalis var. *occidentalis*
Lappula squarrosa
Larix laricina
Lathyrus ochroleucus
Lemna minor
Lepidium densiflorum
Leucanthemum vulgare
Leymus innovatus ssp. *innovatus*
Limosella aquatica
Linaria genistifolia ssp. *dalmatica*
Linaria vulgaris
Linnaea borealis
Linum lewisii ssp. *lewisii*
Listera borealis
Listera cordata
Lithospermum incisum
Lomatium foeniculaceum var. *foeniculaceum*
Lonicera dioica var. *glaucescens*
Lonicera involucrata
Lotus corniculatus
Lycopodium annotinum
Lycopodium clavatum
Lycopodium dendroideum
Madia glomerata
Maianthemum canadense
Maianthemum racemosum ssp. *amplexicaule*
Maianthemum stellatum
Maianthemum trifolium
Matricaria discoidea
Medicago lupulina
Medicago sativa
Medicago sativa ssp. *falcata*
Melampyrum lineare var. *lineare*
Melica smithii
Melilotus albus
Melilotus officinalis
Mentha arvensis
Menyanthes trifoliata
Mertensia paniculata var. *paniculata*
Mitella nuda
Moehringia lateriflora
Monarda fistulosa var. *menthaefolia*
Moneses uniflora
Monotropa uniflora
Muhlenbergia glomerata
Mulgedium pulchellum
Myriophyllum sibiricum
Nassella viridula
Neslia paniculata
Nuphar sp.
Oplopanax horridus
Opuntia fragilis
Orobanche fasciculata
Orthilia secunda
Orthilia secunda var. *secunda*
Orthocarpus luteus
Oryzopsis asperifolia
Osmorhiza berteroi
Osmorhiza sp.
Oxybasis glauca
Oxytropis campestris var. *davisii*
Oxytropis deflexa
Oxytropis sericea var. *speciosa*
Oxytropis splendens
Packera paupercula
Packera plattensis

Packera streptanthifolia
Parnassia palustris
Pascopyrum smithii
Pedicularis groenlandica
Pedicularis labradorica
Pedicularis parviflora
Penstemon gracilis
Penstemon procerus var. *procerus*
Persicaria amphibia
Persicaria amphibia var. *emersa*
Persicaria amphibia var. *stipulacea*
Persicaria hydropiper
Persicaria lapathifolia
Persicaria sp.
Petasites frigidus var. *palmatus*
Petasites frigidus var. *sagittatus*
Phalaris arundinacea var. *arundinacea*
Phleum pratense ssp. *pratense*
Picea glauca
Picea mariana
Pinus contorta var. *latifolia*
Piptatheropsis canadensis
Piptatheropsis pungens
Plantago major
Platanthera aquilonis
Platanthera huronensis
Platanthera obtusata ssp. *obtusata*
Platanthera orbiculata
Platanthera sp.
Poa alpina ssp. *alpina*
Poa annua
Poa compressa
Poa glauca
Poa glauca ssp. *glauca*
Poa nemoralis ssp. *interior*
Poa palustris
Poa pratensis
Poa pratensis ssp. *pratensis*
Poa secunda
Polygonum achoreum
Polygonum aviculare
Polygonum douglasii
Polygonum fowleri
Polygonum ramosissimum
Polypodium sibiricum
Populus balsamifera
Populus tremuloides
Potamogeton alpinus
Potamogeton gramineus
Potamogeton pusillus ssp. *tenuissimus*
Potentilla anserina
Potentilla gracilis var. *fastigiata*
Potentilla hippiana
Potentilla norvegica
Potentilla pensylvanica
Potentilla pensylvanica var. *pensylvanica*
Potentilla pulcherrima
Primula incana
Prosartes trachycarpa
Prunus pensylvanica
Prunus virginiana ssp. *melanocarpa*
Prunus virginiana var. *demissa*
Pseudoroegneria spicata
Puccinellia distans
Puccinellia nuttalliana
Pulsatilla nuttalliana
Pyrola asarifolia
Pyrola chlorantha
Pyrola minor
Ranunculus acris
Ranunculus aquatilis var. *aquatilis*
Ranunculus aquatilis var. *diffusus*
Ranunculus cymbalaria
Ranunculus gmelinii
Ranunculus macounii
Ranunculus rhomboideus
Ranunculus sceleratus
Ranunculus sceleratus var. *multifidus*
Rhinanthus minor
Rhododendron groenlandicum
Ribes hudsonianum var. *hudsonianum*
Ribes lacustre
Ribes oxyacanthoides ssp. *oxyacanthoides*
Rorippa palustris
Rorippa palustris ssp. *palustris*
Rosa acicularis ssp. *sayi*
Rosa woodsii ssp. *woodsii*
Rubus arcticus ssp. *acaulisha*
Rubus chamaemorus
Rubus idaeus ssp. *strigosus*
Rubus parviflorus var. *parviflorus*
Rubus pedatus
Rubus pubescens
Rumex britannica

Rumex crispus
Rumex fueginus
Rumex occidentalis
Rumex triangulivalvis
Salix arbusculoides
Salix bebbiana
Salix candida
Salix discolor
Salix drummondiana
Salix interior
Salix lasiandra var. *lasiandra*
Salix maccalliana
Salix myrtillifolia
Salix pedicellaris
Salix petiolaris
Salix planifolia
Salix prolixa
Salix pseudomonticola
Salix pseudomyrsinites
Salix pyrifolia
Salix scouleriana
Salix serissima
Salsola tragus
Sanicula marilandica
Saxifraga tricuspidata
Schedonorus arundinaceus
Schizachne purpurascens
Schoenoplectus tabernaemontani
Scirpus atrocinctus
Scirpus microcarpus
Scutellaria galericulata
Secale cereale
Selaginella rupestris
Senecio eremophilus var. *eremophilus*
Senecio vulgaris
Shepherdia canadensis
Silene drummondii var. *drummondii*
Silene latifolia
Sisymbrium altissimum
Sisyrinchium montanum var. *montanum*
Sium suave
Solidago altissima ssp. *gilvocanescens*
Solidago bellidifolia
Solidago glutinosa
Solidago lepida var. *lepida*
Solidago lepida var. *salebrosa*
Solidago missouriensis
Solidago multiradiata
Solidago simplex var. *simplex*
Sonchus arvensis
Sonchus arvensis ssp. *uliginosus*
Sorbus scopulina var. *scopulina*
Sparganium emersum
Sparganium natans
Sparganium sp.
Sphenopholis intermedia
Spiraea betulifolia ssp. *lucida*
Spiraea lucida
Spiranthes romanzoffiana
Sporobolus cryptandrus
Stachys palustris ssp. *pilosa*
Stellaria borealis
Stellaria borealis ssp. *borealis*
Stellaria longifolia
Stellaria longipes var. *longipes*
Stellaria media
Stuckenia pectinata
Symphoricarpos albus
Symphoricarpos occidentalis
Symphyotrichum boreale
Symphyotrichum ciliolatum
Symphyotrichum ericoides var. *pansum*
Symphyotrichum laeve var. *geyeri*
Symphyotrichum lanceolatum var. *hesperium*
Symphyotrichum puniceum var. *puniceum*
Tanacetum vulgare
Taraxacum officinale
Thalictrum venulosum
Thinopyrum intermedium
Thlaspi arvense
Tofieldia pusilla
Tragopogon dubius
Triantha glutinosa
Trifolium hybridum
Trifolium pratense
Trifolium repens
Triglochin maritima
Triglochin palustris
Tripleurospermum inodorum
Triticum aestivum
Turritis glabra
Typha latifolia
Urtica dioica ssp. *gracilis*
Utricularia intermedia

Vaccinium caespitosum
Vaccinium membranaceum
Vaccinium myrtilloides
Vaccinium oxycoccos
Vaccinium vitis-idaea ssp. *minus*
Valeriana dioica ssp. *sylvatica*
Verbascum thapsus
Veronica americana
Veronica beccabunga ssp. *americana*
Veronica peregrina var. *xalapensis*
Veronica scutellata
Viburnum edule
Vicia americana
Viola adunca var. *adunca*
Viola canadensis var. *rugulosa*
Woodsia scopulina
Zizia aptera

Bryophytes

Abietinella abietina
Antitrichia curtipendula
Aulacomnium palustre
Barbula convoluta var. *convoluta*
Brachythecium salebrosum
Brachythecium sp.
Bryum argenteum
Ceratodon purpureus
Climacium dendroides
Dicranum polysetum
Dicranum undulatum
Didymodon fallax
Didymodon ferrugineus
Distichium capillaceum
Ditrichum flexicaule
Drepanocladus aduncus
Encalypta rhaptocarpa
Funaria hygrometrica
Hamatocaulis vernicosus
Hedwigia ciliata
Hylocomium splendens
Hymenostylium recurvirostre var. *recurvirostre*
Leptobryum pyriforme
Marchantia polymorpha
Marchantia quadrata
Mnium thomsonii
Orthotrichum anomalum
Orthotrichum obtusifolium
Orthotrichum speciosum
Philonotis fontana var. *fontana*
Plagiomnium cuspidatum
Plagiomnium ellipticum
Plagiomnium sp.
Pleurozium schreberi
Pohlia nutans
Polytrichum commune
Polytrichum juniperinum
Ptilium crista-castrensis
Pylaisiella polyantha
Sanionia uncinata
Sphagnum capillifolium
Sphagnum magellanicum
Sphagnum sp.
Syntrichia norvegica
Syntrichia ruralis
Tomentypnum nitens
Tortula mucronifolia

Lichens

Bryoria capillaris
Bryoria fuscescens
Bryoria lanestris
Bryoria sp.
Buellia elegans
Caloplaca cerina
Caloplaca holocarpa
Cetraria ericetorum
Cladina rangiferina
Cladina sp.
Cladonia carneola
Cladonia pocillum
Cladonia sp.
Collema furfuraceum
Diploschistes muscorum
Enchylium tenax
Endocarpon pusillum
Evernia mesomorpha
Flavocetraria cucullata
Hypogymnia occidentalis
Hypogymnia physodes
Icmadophila ericetorum
Lathagrium undulatum var. *granulosum*
Lecanora impudens
Leptogium saturninum
Leptogium teretiusculum
Lobaria pulmonaria
Melanelixia subaurifera

Melanohalea exasperatula
Melanohalea septentrionalis
Melanohalea subolivacea
Nephroma resupinatum
Parmelia fraudans
Parmelia sulcata
Parmeliopsis ambigua
Parmeliopsis hyperopta
Peltigera aphthosa
Peltigera britannica
Peltigera didactyla
Peltigera elisabethae
Peltigera extenuata
Peltigera lepidophora
Peltigera leucophlebia
Peltigera malacea
Peltigera neckeri
Peltigera sp.
Phaeophyscia orbicularis
Phaeophyscia sciastra
Phaeophyscia sp.
Physcia adscendens
Physcia aipolia
Physcia alnophila
Physcia biziana
Physcia caesia
Physcia phaea
Physcia stellaris
Physcia tenella
Physconia muscigena
Physconia perisidiosa
Platismatia glauca
Ramalina dilacerata
Ramalina obtusata
Ramalina sinensis
Rinodina sp.
Stereocaulon tomentosum
Tuckermannopsis americana
Tuckermannopsis sp.
Umbilicaria americana
Usnea cavernosa
Usnea filipendula
Usnea lapponica
Usnea scabrata
Usnea sp.
Usnea substerilis
Vulpicida pinastri
Xanthomendoza fallax
Xanthoparmelia wyomingica
Xanthoria candelaria

7.3. Appendix 3: Species accounts for rare plant taxa found during preconstruction surveys

7.3.1. Atriplex gardneri var. *gardneri* (Gardner's sagebrush)

Gardner's sagebrush (Figure 3), a small perennial sub-shrub with a woody base, is a member of the Chenopodiaceae (goosefoot family). Variety *gardneri* is found on fine-textured saline soils and dry grassy slopes in the Great Plains and Intermountain regions of central North America (Douglas et al. 1998; Welsh 2003). In B.C., Gardner's sagebrush is known only from the Peace River region (BCCDC 2023a).

Gardner's sagebrush has a rank of S2 (Imperilled) in B.C. and is on the province's Red list (BCCDC 2023a). The taxon has a global classification of G5 (Secure).

Figure 3: *Atriplex gardneri* var. *gardneri* (Gardner's sagebrush)

No new occurrences of Gardner's sagebrush were reported in the Site C Regional Assessment Area (RAA) in 2023.

There are a total of four known occurrences (comprising five patches) of Gardner's sagebrush in the RAA. Three of these occurrences (comprising four patches) are situated north of the Peace River near the Alberta border, and, excluding the patch located in 2020, are older records without information on the number of individuals or areal coverage. The patch found in 2020 contained an estimated 50 male and female plants over an approximate area of 50 square metres (m^2). The fourth occurrence of Gardner's sagebrush, discovered in 2018 during Site C survey work, is some 60 km to the west near Wilder Creek. Here, an estimated 150 male plants were found scattered over an area of 618 m^2; no female plants were observed at this occurrence.

All four of the Gardner's sagebrush occurrences are situated on open, dry, south-facing grassland slopes. The dominant associated species include native grasses such as various wildryes (*Elymus* spp.), junegrass (*Koeleria macrantha*), and green needlegrass (*Nassella viridula*), and native forbs such as prairie sagewort (*Artemisia frigida*) and asters (*Symphyotrichum* spp.).

7.3.2. Carex sprengelii (Sprengel's sedge)

Sprengel's sedge (Figure 4) is a perennial herb belonging to the Cyperaceae (sedge family); plants have tall stems with fibrous bases and bear achenes in drooping heads. The species forms loose clumps in a variety of dry to wet habitats, including openings, slopes, and alluvial woodlands, often on calcareous substrates (Douglas et al. 1998; Ball & Reznicek 2002). Sprengel's sedge was only known from three locations in B.C. prior to the Site C rare plant survey work: two near Williams Lake, and one in the Peace River region (BCCDC 2023a).

Figure 4: *Carex sprengelii* (Sprengel's sedge)

Sprengel's sedge has a rank of S3 (Vulnerable) in B.C., and is on the provincial Blue list (BCCDC 2023a). Globally, the taxon is classed G5 (Secure).

No new occurrences of Sprengel's sedge were reported in the Site C RAA in 2023, however one occurrence at Dry Creek was revisited. Prior to its discovery in 2020 the overstory of trees and shrubs had been removed from this area; in subsequent years the regenerating woodland vegetation was found to be quite dense. During the 2023 revisit, all Sprengel's sedge plants were found alive and with no new disturbance. However, one had not flowered and of those in flower, only the largest plant had produced multiple flowering stems.

In total, there are six known occurrences (comprising 11 patches) of Sprengel's sedge in the RAA. Four of these occurrences (comprising eight patches)—found during survey work for the Site C project—are situated between Dry Creek and Wilder Creek, on flat to south-facing slopes north of the Peace River. An estimated 38 plants have been observed growing in a total approximate area of 17 m^2, in various shrub and woodland habitats. All of these locations are moist to mesic, and the Sprengel's sedge plants are generally found in relatively shaded microhabitats. Associated species are similar, including prairie saskatoon (*Amelanchier alnifolia*), prickly rose (*Rosa acicularis*), chokecherry (*Prunus virginiana*), aspen (*Populus tremuloides*), and native and weedy herbs such as smooth brome (*Bromus inermis*), northern bedstraw (*Galium boreale*), and American vetch (*Vicia americana*).

The remaining two occurrences of Sprengel's sedge in the RAA are derived from BCCDC records that lack certain population data. An occurrence of 20 plants in two patches was discovered between a hay field and a shrubby south-facing escarpment above the Pine River in 2016; areal extent, associated species, and other details of this occurrence were not documented. Additionally, a sixth occurrence of Sprengel's sedge, first observed in 2010, is reported approximately 80 km southwest, in moist balsam poplar (*Populus balsamifera*) woods north of the Moberly River. No clear information is available on the number of individuals or areal coverage (BCCDC 2023a).

7.3.3. Carex torreyi (Torrey's sedge)

Torrey's sedge (Figure 5) is a soft-hairy perennial in the Cyperaceae (sedge family) found growing in montane meadows, shrublands, and moist woods across central North America (Douglas et al. 1998; Ball & Reznicek 2002). In B.C. the species is found only in the Peace River region (BCCDC 2023a). Torrey's sedge is ranked S3? (Vulnerable?) in B.C. and is on the province's Blue list (BCCDC 2023a). The species is ranked G4G5 (Apparently Secure or Secure) globally.

One new occurrence and one occurrence expansion of Torrey's sedge were documented in the study area in June 2023. The new occurrence, of three plants in fruit, was discovered in low, dense shrub along the base of a grassland slope just east of the Beatton River northeast of Fort St. John. The occurrence expansion consisted of additional information gathered for an occurrence first reported in 2019, on a grassland slope north of the confluence of the Peace and Alces Rivers. At the original 2019 patch, an additional 27 plants were counted and the areal coverage increased from one to 19 m^2; a new patch of a single plant was also recorded farther down the slope at this occurrence.

Figure 5: *Carex torreyi* (Torrey's sedge)

There are a total of 13 occurrences (comprising 21 patches) of Torrey's sedge reported in the RAA. An estimated 562 plants have been observed growing in a total area of approximately 446 m^2. Twelve of the occurrences are situated north of the Peace River; the 13th occurrence (not reconfirmed since the 1960 report) is located more than 45 km south, near Dawson Creek, B.C. All of the occurrences were found on mesic to xeric south-facing slopes in open shrub grassland complexes. Associated species are similar at the occurrences and include native shrubs such as prickly rose, prairie saskatoon, and snowberry (*Symphoricarpos* spp.); native and non-native graminoids such as smooth brome, bluegrasses (*Poa* spp.), and sedges (*Carex* spp.); and a diverse mix of native and weedy forbs.

7.3.4. Carex xerantica (dry-land sedge)

Dry-land sedge (Figure 6), a perennial herb with silvery-gold heads of the Cyperaceae (sedge family), is found across central North America in xeric steppe and montane habitats such as dry grasslands and hillsides, open forests, and rock outcrops (Douglas et al. 1998; Ball & Reznicek 2002). In B.C., dry-land sedge has been collected in the Peace River area as well as scattered locations in the central interior and central Rocky Mountains (Klinkenberg 2022; BCCDC 2023a).

Figure 6: *Carex xerantica* (dry-land sedge)

Dry-land sedge is classed as S3 (Vulnerable) in B.C., and is on the provincial Blue list (BCCDC 2023a).

One new occurrence and three occurrence expansions of dry-land sedge were recorded in the study area in June 2023. The new occurrence (comprising three patches) was found along the upper portions of a steep low-shrub grassland opening in mixed woodland south of Chetwynd, B.C. An estimated 100 plants in fruit were found growing in an area of approximately 436 m^2. This occurrence represents a marked southwestern expansion of the taxon's range in B.C. and is located just south of the RAA.

The three occurrence expansions of dry-land sedge consisted of additional information being recorded for previously-reported occurrences. At an occurrence northeast of Fort St. John, a new patch of one plant in late fruit was documented at an occurrence first reported in 2020. A second small occurrence extension, of just a few plants, was found east of Taylor, B.C., at an occurrence first reported in 2021.

The third new dry-land sedge occurrence expansion consisted of a new patch for a large occurrence first observed in 2012, on a native grassland bench near the confluence of the Peace and Pine Rivers. At the new patch, an estimated 50 or more dry-land sedge plants in flower were recorded in an approximate area of 1,800 square metres, along a road track in a disturbed grassland opening. The original patch of this 2012 occurrence of dry-land sedge has been fragmented into four patches by aggregate extraction for the construction of the Site C dam; therefore, including the newly-found patch, this occurrence now consists of a total of five patches.

In total, there are 22 known occurrences of dry-land sedge (comprising 58 patches) in or near the RAA. An estimated 14,333 plants have been observed growing in an approximate total area of 15.32 ha. Eighteen of the occurrences were found on south-facing slopes north of the Peace River from Bear Flat east to the Alberta border, and two occurrences were documented from a large bench and adjacent south-facing slopes on the south side of the Peace River. Dry-land sedge has also been collected on a slope above the Pouce Coupe River, over 25 km to the south, and the new 2023 occurrence is located approximately 80 km southwest of Fort St. John.

The dry-land sedge occurrences are invariably located in xeric grassland habitat, generally in the vicinity of low shrub thickets. The dominant associated species include native shrubs such as prairie saskatoon, prickly rose, and snowberry; native dryland sedges such as hay sedge (*Carex siccata*); and native grasses such as junegrass, short-awned porcupinegrass (*Hesperostipa curtiseta*), spike-oat (*Helictochloa hookeri*), wildryes, and needlegrasses (*Achnatherum* spp. and *Nassella viridula*). A diverse mix of native and non-native forbs are also present at dry-land sedge occurrences.

7.3.5. Drymocallis arguta (tall wood beauty)

Tall wood beauty (Figure 7) is a glandular hairy perennial in the Rosaceae (rose family). The species grows in a wide variety of open, mesic habitats across North America east of the Rocky Mountains (Ertter et al. 2014). The taxonomy of tall wood beauty was clarified by the 2014 publication of Flora of North America, but its presence in B.C. has not been well documented and the species was only added to the B.C. flora in July of 2022 (Ertter et al. 2014; BCCDC 2023a). Records and collections of tall wood beauty from B.C. require review to determine those that represent *D. convallaria* (white cinquefoil), a similar-looking plant that is common west of the continental divide (Ertter et al. 2014; Klinkenberg 2022; Beaty Biodiversity Museum 2023).

Tall wood beauty has been given an initial classification of S3 (Vulnerable) in B.C., and is on the provincial Blue list (BCCDC 2023a). Globally the taxon is considered Secure (G5).

Nine new occurrences and 10 occurrence expansions of tall wood beauty were documented in the study area in June, August, and September 2023.

Five new occurrences (comprising in total 22 patches) were found north of the Peace River. The first, on a grassland opening within mixed woodland 30 km northwest of Fort St. John, consisted of an estimated 40 plants scattered across an area of approximately 2,605 m^2. Plants at this occurrence were recovering from a wildfire that had taken place a few weeks prior to the survey. Another occurrence, of just two plants, was located along a recreation trail near Cecil Lake Road just north of Fort St. John, at the south edge of shrubby aspen woodland.

Figure 7: *Drymocallis arguta* (tall wood beauty)

The remaining new occurrences found on the north side of the Peace River were all observed in the Farrell Creek to Lynx Creek areas, at the western end of the study area. Most patches in these occurrences were situated along segments of the Highway 29 realignment corridor. However, some were located in areas of either the proposed Site C reservoir footprint or on land that will become an island in the proposed reservoir. An estimated 252 tall wood beauty plants were recorded in patches totaling 1,545 m^2 in size; of these plants, approximately one-third are in locations expected to be flooded under the proposed reservoir.

Four new occurrences of tall wood beauty were documented south of the Peace River. The largest occurrence consisted of an estimated 750 plants in six patches with an areal coverage of 1,544 m^2. The plants were growing along the upper portions of a steep low-shrub grassland opening in mixed woodland south of Chetwynd, B.C. This occurrence represents a marked southwestern expansion of the taxon's known range in B.C., and is located just south of the Site C RAA.

Another new occurrence was located on a shrub-grassland slope southeast of the confluence of the Kiskatinaw and Peace Rivers, in the eastern end of the study area. Here, an estimated 100 tall wood beauty plants were found over an approximate area of 260 m^2. The remaining two new occurrences found south of the Peace River consisted of one plant each: one along Jackfish Road north of Cheywynd, and one above the confluence of the Pine and Peace Rivers near Taylor, B.C. Both plants were growing in open shrub-grassland habitat.

During the 2023 field season, ten of the tall wood beauty occurrences first reported in 2022 were revisited: thirty-three new patches were discovered, and three original patches were significantly expanded.

Targeted field checks were performed for five of the 2022-reported occurrences since the original documentation had been based solely on field notes and/or photographs. The majority of these occurrences were found to be substantially larger than previously known. At one occurrence, on a grassland bench west of the confluence of the Pine and Peace Rivers, thousands of tall wood beauty plants were discovered in three patches totalling nearly seven hectares in size. At two other occurrences, one near the Alberta border and one just west of the Halfway River, many hundreds of additional plants were observed, with an approximate areal coverage of 1,720 m^2. The remaining two occurrences that received targeted field-checks, near roads in the Fort St. John area, were expanded slightly, with an estimated 36 additional plants recorded occupying an area of approximately 100 square metres.

Five other 2022-reported occurrences of tall wood beauty were revisited in 2023 during the course of other field work. Three of these occurrences are situated in segments of the Highway 29 realignment corridor, near Cache Creek and Farrell Creek. While portions of each occurrence had either been disturbed or extirpated by construction work, many additional plants were discovered in various new patches at each location. The final two revisited occurrences are located outside of active project construction zones, on land parcels being used as recipient sites for the Site C Experimental Rare Plant Translocation Program. Hundreds of additional tall wood beauty plants were recorded in multiple patches.

In total, 34 tall wood beauty occurrences (comprising 109 patches) are known in or near the RAA, ranging from near the Williston Reservoir in the west to the Alberta border in the east, and extending north and south as described for the 2023 occurrences above. An estimated 12,532 plants have been documented growing in an approximate total area of 9.83 hectares. The plants are usually found on open slopes, but occasionally occur on level ground; in a few instances the substrate is quite rocky. Tall wood beauty always grows in association with low to mid-height native shrubs, usually species such as prairie saskatoon, prickly rose, and snowberry. A diverse mix of native and non-native graminoids are also found at the occurrences: dominant taxa include bluegrasses, wildryes, needlegrasses, smooth brome, junegrass, short-awned porcupinegrass, and sedges. Associated forb species include northern bedstraw, asters, and woolly yarrow (*Achillea borealis*).

7.3.6. Lomatium foeniculaceum var. *foeniculaceum* (fennel-leaved desert-parsley)

Fennel-leaved desert-parsley (Figure 8), a low perennial herb with a long taproot, is a member of the Apiaceae (carrot family) (Douglas et al. 1998). The taxon is found on dry, open slopes across much of central North America (Hitchcock et al. 1961; NatureServe 2023). Fennel-leaved desert parsley var. *foeniculaceum* is restricted to the Peace River region in B.C. (BCCDC 2023a).

Figure 8: *Lomatium foeniculaceum* var. *foeniculaceum* (fennel-leaved desert-parsley)

In B.C., fennel-leaved desert-parsley var. *foeniculaceum* carries a rank of S3 (Vulnerable) and is on the province's Blue list (BCCDC 2023a). The taxon's global classification is G5T5 (Secure for both the species and the variety).

No new occurrences of fennel-leaved desert-parsley were reported in the Site C RAA in 2023.

A total of seven occurrences (comprising 12 patches) of fennel-leaved desert-parsley are known from the RAA, ranging in the Peace River corridor from the Cache Creek area east to near the mouth of the Kiskatinaw River. An estimated 980 plants have been documented in an approximate total area of 8,626 m^2. All fennel-leaved desert-parsley occurrences occur on dry, south-facing grassland slopes. Associated species include low shrubs such as prairie saskatoon and snowberry, and herbs such as thick-spike wildrye (*Elymus lanceolatus* ssp. *lanceolatus*), short-awned porcupinegrass, green needlegrass, and pale comandra (*Comandra umbellata* ssp. *pallida)*.

7.3.7. Penstemon gracilis (slender penstemon)

Slender penstemon (Figure 9) is a perennial herb of the Plantaginaceae (plantain family)—formerly of the Scrophulariaceae (figwort family)—that inhabits mesic to dry plains and grasslands (Hitchcock et al. 1959; Douglas et al. 1998; Freeman & Rabeler 2016). The species is commonly found throughout much of central North America, but in B.C. is restricted to the Peace River area (Hitchcock et al. 1959; BCCDC 2023a; NatureServe 2023).

Figure 9: *Penstemon gracilis* (slender penstemon)

Slender penstemon is ranked S3 (Vulnerable) in B.C., and is on the province's Blue list (BCCDC 2023a). The species' global status is G5 (Secure) (NatureServe 2023).

Two previously-reported occurrences of slender penstemon were expanded in the study area in June and August 2023. East of Taylor, B.C., at an occurrence first located in 2016, one new patch of a few plants was documented on a relatively intact native shrub-grassland slope.

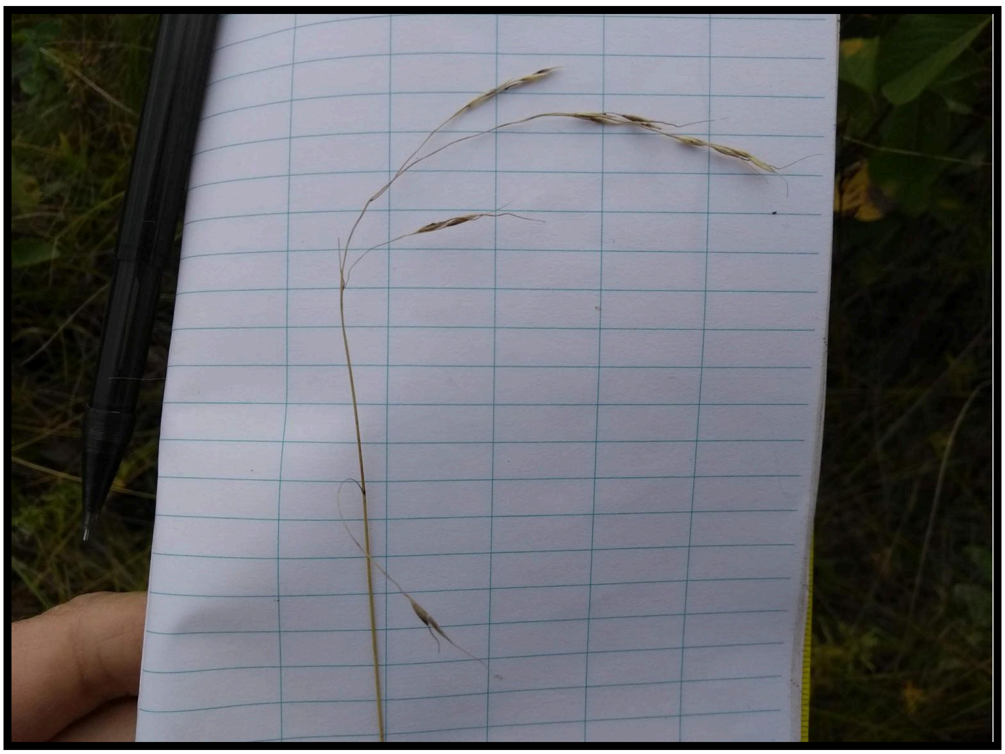
The second occurrence expansion was an adjustment to a large occurrence first mapped in 2018 on a steep, relatively intact shrub-grassland slope above Highway 29 east of Farrell Creek. While recent construction disturbance has removed much of this occurrence (containing hundreds of slender penstemon plants), an estimated 30 additional plants were documented during the 2023 revisit, resulting in the edge of one patch of this occurrence being extended approximately five metres.

In total, there are 28 occurrences of slender penstemon (comprising 63 patches) reported in the RAA. All of the occurrences are situated north of the Peace River, from the Farrell Creek area east to the Alberta border. An estimated 3,905 plants have been documented in an approximate total area of 6.52 hectares. All of the occurrences were found on south-facing slopes in xeric grassland habitat, often in the vicinity of low shrub thickets. Dominant associated species include the native shrubs prairie saskatoon, kinnikinnick, and common snowberry (*Symphoricarpos albus*), native graminoids such as junegrass, wildryes, and dryland sedges, and a diverse mix of native and non-native forbs.

7.3.8. *Piptatheropsis canadensis* (Canada ricegrass)

Canada ricegrass (Figure 10) is a delicate perennial bunchgrass of the Poaceae (grass family). The species grows in grasslands and open woods. In eastern North America, the taxon is specifically reported from dry, sparsely-vegetated soils which are usually sandy or rocky, as well as moist peaty barrens. Prior to the 2018 Site C rare plant survey work, no verified extant occurrences of Canada ricegrass were known from B.C. (BCCDC 2023a). Of note: the genus *Piptatheropsis* was only recently described (Romaschenko et al. 2011), therefore Canada ricegrass is still referred to by the name *Piptatherum canadense* in some literature (Lapin 2004; Barkworth 2007; NatureServe 2023).

Figure 10: *Piptatheropsis canadensis* (Canada ricegrass)



Canada ricegrass is ranked S1 (Critically Imperilled) in B.C., and is on the province's Red list (BCCDC 2023a). The taxon's global classification is G4G5 (Apparently Secure or Secure) (NatureServe 2023).

One new occurrence and one occurrence expansion of Canada ricegrass were documented in the study area in August 2023. The new occurrence was discovered east of Taylor, B.C., on relatively intact native shrub-grassland. Here, 31 plants in fruit were mapped in an area of approximately 205 m^2. The occurrence expansion consisted of a small increase to an occurrence first reported in 2020, in the Highway 29 realignment corridor near Cache Creek. This occurrence of Canada ricegrass comprises many small patches on various remnants of native shrub-grassland; the westmost patch was extended slightly with the discovery of four additional plants.

There are a total of six known occurrences of Canada ricegrass (comprising 21 patches) in the RAA. The occurrences are located from the Cache Creek area east to near the Beatton River. An estimated total of 311 plants have been documented in an approximate total area of 1,406 m^2. All of the Canada ricegrass occurrences are situated on level to gently sloped, open, good quality native shrub-grassland or remnants of such, usually in close proximity to aspen woodlands. Soils at the occurrences can be moist to dry. The Canada ricegrass plants grow scattered in dense vegetation consisting of a diverse assemblage of low shrubs and herbs. Dominant associated species are native plants and include the shrubs prairie saskatoon, prickly rose, and chokecherry; graminoids such as spreading needlegrass (*Achnatherum richardsonii*), slender wheatgrass (*Elymus trachycaulus* ssp. *subsecundus*), false melic (*Schizachne purpurascens*), and hay sedge; and forbs such as northern bedstraw and anemones (*Anemone* spp.). A few non-native species are also present, particularly Kentucky bluegrass.

7.3.9. Ranunculus rhomboideus (prairie buttercup)

Prairie buttercup (Figure 11) is a soft-hairy perennial of the Ranunculaceae (buttercup family). The species grows in grasslands, prairies, open woods and thickets across north-central North America (Whittemore & Parfitt 1997; Douglas et al. 1998). In B.C., prairie buttercup is only known from the Peace River region (BCCDC 2023a).

Prairie buttercup has a ranking of S2S3 (Imperilled and Vulnerable) in B.C., and is on the province's Blue list (BCCDC 2023a). Globally, the taxon is ranked G5 (Secure).

One new occurrence of prairie buttercup was documented in the study area in June 2023. Seventeen plants were found in two patches along trails in shrubby woodland openings near the Beatton River, northeast of Fort St. John.

In total, 13 occurrences of prairie buttercup (comprising 19 patches) have been reported in the RAA. Ten of the occurrences (comprising 16 patches)—discovered during the Site C rare plant survey work—are situated north of the Peace River from the Cache Creek area east to the Beatton River, and contain an estimated 227 plants in an approximate total area of 465 m^2. One other occurrence of one plant, observed west of the confluence of the Peace and Pine Rivers in 2018, was also found during Site C-related work. The remaining occurrences are historical records not recently verified and with no information available on precise location, number of individuals or areal coverage. The habitat for prairie buttercup is somewhat variable: soils can range from moist to dry, shrub cover can be dense to sparse, and occurrence microsites can be flat to sloped. Dominant associated species include a wide variety of native forbs such as northern bedstraw and American vetch as well as weedy grasses such as smooth brome and Kentucky bluegrass. Native shrub species are also present, the most commonly reported being rose (*Rosa* spp.) and prairie saskatoon.

Figure 11: *Ranunculus rhomboideus* (prairie buttercup)

7.3.10. Salix petiolaris (meadow willow)

Meadow willow (Fig 12), a shrub or small tree of the Salicaceae (willow family), has long, slender leaves and is found in moist to wet habitats across north-central North America (Douglas et al. 1998; Argus 2010). In B.C., the species has only been collected in the northeast part of the province (Klinkenberg 2022; BCCDC 2023a).

Meadow willow is ranked S3 (Vulnerable) in B.C. and is on the Blue list for the province (BCCDC 2023a); the species is classed as G5 (Secure) globally.

No new occurrences of meadow willow were reported in the Site C RAA in 2023.

There are a total of six reported occurrences of meadow willow in the RAA, of which only one is a recent record. This occurrence consists of an approximately 160 m^2 patch of 22 meadow willow shrubs on the southern edge of a large wetland on the plateau between the Peace and Moberly Rivers. The plants were growing in partial shade in a thicket of diverse tree and shrub species along a weedy road edge. Associated species included *Salix discolor* (pussy willow), *Salix lasiandra* var. *lasiandra* (Pacific willow), *Salix bebbiana* (Bebb's willow), balsam poplar, western snowberry, and prickly rose.

Figure 12: *Salix petiolaris* (meadow willow)

The remaining five occurrences of meadow willow have not been recently field verified. Four records date from 1967 to 1976 and provide little or no information besides a collection point: two are east of Fort St. John, and two are located to the south near Dawson Creek, B.C. The fifth occurrence was reported in 2008 from along a forest road south of Hudson's Hope, B.C., but subsequent attempts to relocate this occurrence have not been successful and it is presumed that either the location data or the identification are incorrect.

7.3.11. Selaginella rupestris (rock selaginella)

Rock selaginella (Figure 13) is a small, mat-forming evergreen perennial in the Selaginellaceae (spike-moss family). The taxon is found in a variety of open, dry, rocky or gravelly habitats in eastern and central North America (Valdespino 1993; Douglas et al. 1998). In B.C., rock selaginella is known only from the Peace River region (Klinkenberg 2022; BCCDC 2023a).

Rock selaginella is ranked S2 (Imperilled) in B.C., and is on the Red list for the province (BCCDC 2023a). The taxon is classed as G5 (Secure) globally.

Figure 13: *Selaginella rupestris* (rock selaginella)

One new occurrence (in three patches) of rock selaginella was documented as part of the Site C work in the study area in August 2023. An estimated 250–1,000 plants over an approximate area of 741 m^2 were found growing along the upper portions of a steep low-shrub grassland opening in mixed woodland south of Chetwynd, B.C. This occurrence represents a marked southwestern expansion of the taxon's known range in B.C., and is located just south of the Site C RAA.

In total, there are 13 known occurrences of rock selaginella (comprising 21 patches) in or near the RAA. Nine of the occurrences—discovered or resurveyed as part of the Site C rare plant work—are located north of the Peace River, from Williston Reservoir east to the Alberta border, and contain an estimated 3,530 individuals in an approximate total area of 7,466 m^2. The tenth occurrence reported from Site C work is described above. The remaining three occurrences of rock selaginella in or near the RAA were reported in 2020 and 2023, from work not related to the Site C project. All three occurrences are situated near or west of Chetwynd, in dry grassland openings on steep slopes or hillcrests.

The rock selaginella occurrences are dry and usually rocky; most of the occurrences are in open shrub-grassland habitat on south-facing hillsides or hillcrests, and slopes are often quite steep. Dominant associated species include the shrubs prairie saskatoon, kinnikinnick, and common juniper (*Juniperus communis*); graminoids such as junegrass, thickspike wildrye, and various dryland sedge species; and forbs such as prairie sagewort, northern bedstraw, and woolly yarrow. The exceptions are two occurrences found in open forest near the east end of Williston Reservoir, where the rock selaginella was growing with mosses on rock in shaded, dry microsites.

Appendix 6. Experimental Rare Plant Translocation Program 2023 Annual Report

Experimental Rare Plant Translocation Program
2023 Annual Report

Date: March 27, 2024

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ACRONYMS & ABBREVIATIONS

Term	Definition
B.C. CDC	B.C. Conservation Data Centre
EIL	Erosion Impact Line
ERPT	Experimental Rare Plant Translocation
ENSCONET	European Native Seed Conservation Network
PAZ	Potential Activity Zone
PRS	Potential Recipient Site
QA/QC	Quality Assurance and Quality Control
spp.	The abbreviation "spp." (plural) indicates "several species".
sp.	The abbreviation "sp." Refers to a single species.

1. INTRODUCTION

As part of the federal and provincial regulatory approvals of the Site C project, BC Hydro committed to the creation of an Experimental Rare Plant Translocation (ERPT) program to support the viability of target rare plant species affected by the project.

The ERPT program is designed to establish new populations of target rare plant species in areas that are secure, contain analogous habitat to the source populations, and are within the Peace Region. This program uses an experimental approach to identify critical factors affecting germination, establishment, growth, and survival of the target species, the results of which inform the scope of the design such that informed variations on salvage, propagation, and transplant methods can be employed. The ERPT program is updated on an ongoing basis to incorporate relevant information related to target rare plant species and translocation methods as it emerges.

The program is founded on collaborative working relationships with First Nation-owned, local businesses, and other consultants, and benefits from the shared knowledge and experience. The knowledge acquired and lessons learned can be employed to maximize the success of the program and can be shared among these partners to increase the overall understanding of these systems within the community of contributors.

This report summarizes the measures and activities undertaken in 2023 for the ERPT program. Included is a summary of the plant species of conservation concern included in the program and the general methods and activities completed for the four phases of the program: Phase 1 - propagule collection; Phase 2 - *ex-situ* propagation; Phase 3 - translocation implementation; and Phase 4 - post-translocation care, maintenance, and monitoring. Information gained from the 2023 program will inform improvements to project methods and management in 2024.

1.1 Plant Species included in the Program and their Conservation Ranks

An informed understanding of a species' conservation status requires consideration at global, national, and local scales. The conservation status for each target species was determined using standardized methodologies for species assessments from government agencies at these multiple relevant conservation scales. The conservation status for each target rare plant species was derived from the listing under the *Species at Risk Act*, the NatureServe Global Conservation Status (e.g., G1, G1G2), the NatureServe Subnational Rank (e.g., S1, S2), and the British Columbia Conservation Data Centre (B.C. CDC) Rank (i.e., Red-listed, Blue-listed or Yellow-listed).

1.1.1 Listing under the Species at Risk Act

Under Canada's federally regulated *Species at Risk Act* (SARA), protected species at risk are listed under Schedule 1 as special concern, threatened, endangered, extirpated, or extinct.

1.1.2 NatureServe Conservation Priority Global Rank

NatureServe establishes ranks that characterize the relative rarity and threats of a native species within the specified geographic boundaries (i.e., G - range-wide [= global]; Table 1.1-1; or S - within-province or state [= subnational]; Table 1.1-2).

Table 1.1-1. NatureServe Global Conservation Status Ranks and Definitions

NatureServe Subnational Rank [1]	Definition
G1 (Critically Imperiled)	Critically imperiled globally because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation.
G1 (Critically Imperiled) to G2 (Imperiled)	A Range Rank (i.e., G1G2) is used when existing information on an element straddles the criteria defining two separate ranks. See associated rank definitions.
G1 (Critically Imperiled) to G3 (Vulnerable)	A Range Rank (i.e., G1G3) is used when existing information on an element straddles the criteria defining two separate ranks. See associated rank definitions.
G2 (Imperiled)	Imperiled globally because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation globally.
G2 (Imperiled) to G3 (Vulnerable)	A Range Rank (i.e., G2G3) is used when existing information on an element straddles the criteria defining two separate ranks. See associated rank definitions.
G3 (Vulnerable)	Vulnerable globally due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
G3 (Vulnerable) to G4 (Apparently Secure)	See associated rank definitions.
G4 (Apparently Secure)	Uncommon but not rare; some cause for long-term concern due to declines or other factors
G4 (Apparently Secure) to G5 (Secure)	See associated rank definitions.
G5 (Secure)	Common, widespread, and abundant globally.
GNA (Not Applicable)	A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

[1]*The NatureServe ranks and definitions at the national (N ranks) and global level (G ranks) are available on the NatureServe website.*

1.1.3 B.C. Conservation Data Centre Priority Rank

The B.C. Conservation Data Centre (B.C. CDC) establishes a conservation priority rank for species within the province based on rarity, intrinsic vulnerability, environmental specificity, threats, and long- and short-term trends in population size. Species that the B.C CDC defines as at-risk are categorized as either Red-listed or Blue-listed depending on their rank status, location, and level of protection (Table 1.1-2).

Table 1.1-2. NatureServe Subnational and B.C. CDC Conservation Status Ranks and Definitions

NatureServe Subnational Rank[1]	Definition	B.C. CDC Rank
S1 (Critically Imperiled)	Critically imperiled in the province because of extreme rarity (often five or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the province.	Red-listed (any species that is Candidate for extirpated, endangered, or threatened status in BC.
S1 (Critically Imperiled) to S2 (Imperiled)	A Range Rank (i.e., S1S2) is used when existing information on an element straddles the criteria defining two separate ranks. See associated rank definitions.	
S1 (Critically Imperiled) to S3 (Vulnerable)	See associated rank definitions.	
S2 (Imperiled)	Imperiled in the nation or province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or province.	
S2 (Imperiled) to S3 (Vulnerable)	See associated rank definitions.	Blue-listed (any species or ecosystem that is of special concern)
S3 (Vulnerable)	Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.	
S3 (Vulnerable) to S4 (Apparently Secure)	See associated rank definitions.	
S4 (Apparently Secure)	Uncommon but not rare; some cause for long-term concern due to declines or other factors.	Yellow-listed (any species or ecosystem that is at the least risk of being lost)
S4 (Apparently Secure) to S5 (Secure)	See associated rank definitions.	
S5 (Secure)	Common, widespread, and abundant in the nation or state/province.	
SNA (Not Applicable)	A conservation status rank is not applicable because the species is not a suitable target for conservation activities.	n/a

[1]A Range Rank (i.e., S2S3) is used when existing information on an element straddles the criteria defining two separate ranks.

1.1.4 Plant Species included in the ERPT Program

The British Columbia (B.C.) Conservation Data Centre (B.C. CDC) annually assesses the provincial conservation ranks of vascular plants and bryophytes in the province. This annual assessment incorporates new information about the abundance and distribution of the province's flora, as well as newly recognized threats (or lack thereof) to known populations. The ranking update published by the B.C. CDC in 2023 (B.C. CDC 2023a) changed the conservation status rank of six taxa in the province relative to their status in 2022. No changes were made to the ranks of any of the species within the ERPT program.

The plant species included in the program along with their associated conservation ranks are listed in Table 1.1-3.

Table 1.1-3. Species included in the Experimental Rare Plant Translocation Program

Scientific Name	Common Name	B.C. CDC Provincial Rank	NatureServe Provincial Status	NatureServe Global Status
Canada mountain-ricegrass	*Piptatheropsis canadensis*	Red	S1 (2019)	G4G5 (2016)
Davis' locoweed	*Oxytropis campestris* var. *davisii*	Yellow	S3S4 (2022)	G5T3 (2015)
Dryland sedge	*Carex xerantica*	Blue	S3 (2019)	G5 (2016)
Prairie buttercup	*Ranunculus rhomboideus*	Blue	S2S3 (2019)	G5 (2016)
Rocky Mountain willowherb	*Epilobium saximontanum*	Blue	S3 (2019)	G5 (1984)
Rock selaginella	*Selaginella rupestris*	Red	S2 (2019)	G5 (2016)
Slender penstemon	*Penstemon gracilis*	Blue	S3 (2019	G5 (2016)
Sprengel's sedge	*Carex sprengelii*	Blue	S3 (2019)	G5 (2016)
Torrey's sedge	*Carex torreyi*	Blue	S3? (2019)	G4G5 (2016)
Tall wood beauty	*Drymocallis arguta*	Blue	S3	G5 (2015)

2. GENERAL METHODS

2.1 PHASE 1. PROPAGULE COLLECTION

The standards for collecting and storing propagules for *ex-situ* conservation (e.g., timing, sampling, labelling, cleaning, processing, stratification, sowing, provenance) incorporate guidance outlined in Maslovat (2009) and by the European Native Seed Conservation Network (ENSCONET 2009).

The 2023 propagule collection phase involved collecting seeds from existing populations and sowing of seeds at a nursery, with the resulting seedlings targeted for out-planting at recipient sites.

2.1.1 *In-situ* Seed Collection

Field botanists collected seeds from naturally occurring populations within the Peace Region. Propagule collection occurred throughout the growing season and took into consideration local plant phenology Where feasible, field teams collected at least 25 seeds to increase the opportunities to propagate the plants at native plant nursery.

2.1.2 *Ex-situ* Seed Collection

Nursery staff collected seeds from the nursery stock derived from previous year's seed collection efforts. Nursery staff sorted the seeds to remove non-viable seeds (i.e., empty, or poorly developed), and the remaining seeds were cleaned and dried (where necessary) to maximize viability. Cleaning included the removal of waste material from around the seed capsule, and the use of sieves, hand separation, and air separation. Seeds were then placed in cold storage at the nursery to maintain seed quality and longevity. The provenance, seed collection procedures, and quantity collected were recorded.

2.2 PHASE 2. *EX-SITU* PROPAGATION

In general, *ex-situ* propagation involved stratification and propagation for each individual target species in a nursery environment in 2018 to 2021. Curation protocols and recommendations (ENSCONET 2009) and professional horticultural experience were used to inform the methods for this aspect of the program (see description below).

Through the pre-treatment process, seeds have been treated to simulate the natural conditions for breaking seed dormancy and initiating germination. Seeds were scarified and/or stratified as relevant. Scarification treatments included a short hot-water bath or sandpaper, while stratification included immersing the seeds into cold temperatures with moisture to simulate natural germination conditions. Seeds that were not intended for planting in the subsequent year were not treated and are being stored as insurance for potential future use.

Propagation methods were developed based on the ecological conditions observed at the source populations, and included several measures and considerations (Vallee et al. 2004; Maslovat 2009) such as:

- examination of the ecological and, if available, translocation literature to determine experimental trials, including optimum founder size (i.e., number of individuals and composition of life stages), reproductive status relevant to propagation for each rare plant species, and outplanting requirements;
- review of common garden experiments as a potential source of horticultural information for a specific target species;
- exploration and implementation of a range of techniques (e.g., varying soil substrate) to determine the most effective propagation options for each target species;
- multiple germination trials to determine viability; and
- holding back source propagules in an *ex-situ* collection as material for future propagation.

All utilized *ex-situ* propagation methods have been documented, including the following:

- provenance (i.e., origin of material collected);
- type of material collected (e.g., seed, live plant);
- location and date of collection; and

  growing conditions such as potting media, temperature of propagation area, watering, and treatment of seeds.

2.3 Phase 3. Translocation

Translocation implementation included four components: (i) recipient site selection; (ii) transport and plant preparation; (iii) selection of planting locations with the habitat matrix; and (iv) translocation at recipient sites.

2.3.1 Recipient Site Selection

Selection of suitable recipient sites, based on the species-specific preferred habitat characteristics, was informed by the extensive existing information collected for Site C along with the expert knowledge of qualified botanists and ecologists who performed the field verification work (see Appendix A provided by Eagle Cap). Selected sites contained habitat analogous to the source populations and were situated in areas that are unlikely to be developed in the foreseeable future. All sites selected are located within the Peace Region.

Qualified botanists from Eagle Cap undertook the process of identifying additional suitable recipient sites for three target species: Sprengel’s sedge, Torrey’s sedge, and prairie buttercup. In addition, a limited number of recipient sites were identified for the 2022 blue-listed tall wood beauty for future consideration. The following text summarizes the recipient site selection process (refer to Appendix A for further details).

Before verifying and selecting recipient sites in the field, a desktop review was conducted to identify potential locations. The desktop review included literature reviews for each priority species to evaluate current and relevant species information such as habitat and translocation requirements, with a particular focus on reviewing new information that had been published since 2022. The updated B.C. CDC database was reviewed to ensure that all existing occurrences known were incorporated into the analysis, and queries were run on the project rare plant database to extract any habitat information that had been recorded during earlier years of the ERPT program.

The habitat requirements of the four target species were grouped into three main types that represent potentially suitable habitats for translocation, with the following characteristics (Appendix A):

1. moist, shrubby or wooded, level to moderate slope, shading open to full, aspect variable, densely vegetated, may dry out later in season, relatively rich clay/silt soil;
2. mesic to dry, open, south-facing hillcrest or gentle slope; relatively dense low-shrub grassland vegetation with a green appearance on aerial imagery; or
3. moist to dry, shrubby to open, level to sloped, aspect variable, fair to good condition native low- to mid-height shrub grassland or edges of deciduous or mixed woodlands.

Aerial imagery and GIS attributes were visually evaluated to identify locations with potentially suitable ecological and logistical characteristics that would maximize opportunities for successful translocation. GIS layers that were assessed for these analyses included: (i) aerial imagery of the Peace River region; (ii) property ownership (provided by BC Hydro); (iii) known element occurrences of the target species; (iv) potential recipient sites identified during earlier years of the project; (v) the Site C Project Activity Zone (PAZ); and (vi) the Site C preliminary Erosion Impact Line (EIL). This analysis resulted in the following criteria that were identified as indicative of suitable Potential Recipient Sites (PRS):

1. accessible by road or boat during the entire growing season;
2. outside of the Site C PAZ;
3. not located below the reservoir preliminary Erosion Impact Line (i.e., a precautionary estimate of the amount of erosion that could occur over a 100-year period);
4. located on Crown land or BC Hydro land near the Peace River;
5. within range of cell service;
6. not requiring access through a locked gate or other landowner permission;
7. contains appropriate habitat for the priority species;
8. contains low density of non-native plants;
9. has low levels of existing and reasonably foreseeable future anthropogenic disturbance;

10. greater than one kilometre from known sites of the same taxon;
11. not already occupied by rare plant species; and
12. located close to a water source.

This list of desirable PRS qualities describes a hypothetical ideal site such that not all criteria are likely to be satisfied. For example, field botanists attempted to avoid occupied sites when reviewing potential planting locations; however, this was only partially successful because suitable planting sites were often found to host target rare plant species. As a result, no site is likely to fulfill all the listed criteria, and trade-offs will always be necessary to ensure that the project can proceed.

Recipient sites were selected primarily based on known species-specific habitat characteristics, and in part based on distance to other planting sites, with the aim of distributing them over a wide geographical extent. In some instances, a site was found to contain suitable habitat for several ERPT target species in proximity, and so separate assessments of the microsite features were completed for each target species. Several of the target species occur together in wild populations, and thus their co-occurrence is consistent with natural conditions.

The desktop exercise generated eight potential planting areas with unique PRS points (suitable microsites) pre-identified to create more efficiency during field verification. Seven of the eight potential planting areas were checked, as one of the planting areas had been checked and verified previously. Field verification resulted in eight new PRS points from five planting areas deemed the most suitable: one for Sprengel's sedge, two each for Torrey's sedge and tall wood beauty, and three for prairie buttercup (Appendix A). Supplemental planting areas (i.e., specific microsites) were marked within suitable habitat to optimize plant placement.

Despite challenges with avoiding sites in the vicinity of other rare plant populations and finding areas with water sources, the potential planting areas met the majority of the stated requirements. Three of the planting areas consisted of habitats that supported multiple target species (Appendix A) and the remaining five sites were specifically selected for a single taxon. Thirteen new rare plant sites were discovered during field verification: nine patches of tall wood beauty, two patches of prairie buttercup, one patch of Torrey's sedge, and one patch of slender penstemon.

2.3.2 Transport and Plant Preparation

Adult plants (i.e., medium to large plants in 1-gallon pots) were shipped from NATS nursery on June 5, 2023, and arrived at Dunvegan Gardens (Dunvegan) in Fort St. John on June 8, 2023. The plants were housed at the garden centre and were stored and watered in the bed of the work truck (Plate 2.3-1) throughout the week until transplanted at recipient sites.

Plate 2.3-1. Plants retrieved from Dunvegan on June 8, 2023

2.3.3 Selection of Planting Locations within the Habitat Matrix

Planting locations within the larger habitat matrix at a recipient site were identified as those that were relatively easy to access, corresponded with known ecological conditions that support the species, supported plant diversity that is similar to the source populations, were on stable substrates that are not expected to undergo erosion or deposition, had low abundance of invasive plants, and were not accessible to cattle or used intensely by native herbivores. There was limited variability in the planting patterns within species, thereby minimizing constraints on comparability across sites within species. Within species, the planting plans sought to:

- establish plant groupings such that there were similar conditions in terms of microsite conditions (e.g., soils, slope, aspect);
- create plant groupings to encourage pollinator visitation; and
- space individuals to minimize potential trampling during planting and monitoring and to minimize interspecific competition for resources (e.g., minimize density-dependent effects on survival).

2.3.4 Translocation at Recipient Sites

The specific timing windows for planting were determined based on past years' experience regarding the average first and last frost-free days for Fort St. John, as well as plant phenology, the development stage of the propagated plants, the local weather, and soil moisture conditions.

Translocation in 2023 occurred from June 8 to 12. Implementation of the translocation planting included the following:

- placement of plants into optimal microhabitats at the recipient sites, and in a spatial pattern suitable to the rare plant's biology as observed at the source populations or otherwise known;
- installation of durable, long-lasting tags to label individual plants and flagging tape to label plant groupings;
- code systems to differentiate various experimental trials as needed to retain as much information as possible on the pathway of a given plant (e.g., from seed collection to planting) to facilitate annual assessments of success;
- marked boundaries for plants, plant groupings, and translocation site boundaries using GPS points and imported into the project GIS system;
- care and maintenance at the time of planting, such as watering and creation of microhabitat as necessary;
- documentation of each translocation effort (including time spent on each phase), which included the methods used to prepare and transport the material from the nursery to the recipient site, pre-translocation site preparation, environmental conditions, method of re-introduction, care and maintenance activities, planting density, and spatial pattern; and
- post-translocation follow-up to assess the health and status of a sample and to check for other possible problems, such as desiccation, pest insects, trampling, herbivory, or vandalism at a translocation site.

2.4 Phase 4. Monitoring

Two levels of monitoring were conducted in 2023: interim monitoring and population[1] monitoring (previously referred to as year-end monitoring). Interim monitoring occurred at a frequency that permitted the timely identification of threats such as vandalism, desiccation, or herbivory, and allowed for subsequent mitigation measures to address these issues. Population monitoring included an assessment of: (i) **Survivorship** - to determine if individuals are surviving beyond the initial transplant year; (ii) **Maturity** - to determine if individuals are maturing to the flowering and fruiting stages; (iii) **Reproduction** - to determine if individuals are successfully producing seeds; and (iv) **Recruitment** - to

[1] In this report, populations are defined as the group of plants originating from the translocation efforts.

determine if seeds from the population germinate successfully at the site and contributing to a second generation. The following population traits were assessed during the monitoring program:

- plant presence (summarized as number of live/dead/absent individuals);
- vegetative growth (width or height) and/or health (qualitative assessment);
- flower production per individual;
- seed production per individual; and
- spatial extent of the population.

Interim monitoring activities also re-evaluated sites for one or more of the following to identify successes and failures to improve the survival of future plantings:

- invasive species presence, especially in close proximity to the translocated plants, and/or any species that may have inadvertently been introduced to the site during the translocation;
- herbivory or other possible problems (e.g., pest insects, trampling, ungulate grazing);
- human disturbance; and
- microsite habitat preferences.

Information gained from monitoring implementation of the various experimental translocation approaches used will help to identify which approaches are effective and to isolate inadequacies in specific methods, all within an adaptive management framework.

2.5 Quality Assurance and Control

Quality assurance and quality control (QA/QC) measures were used for collecting data within the field program so that methods were consistently replicated across all trials and years, and so that pertinent variables or any variations in methodology were recorded. The data form was designed to accommodate data collection at the transect, plot, or individual plant level across years (Appendix B). The data form included the following fields:

1. site details (i.e., Site ID, geographical location, slope, aspect, and elevation);
2. species information (i.e., species name, nursery of origin, seed lot, key metrics for survivorship, maturity, and reproduction);
3. potential threats (i.e., herbivory, drought, others); and
4. map outlining the relative location of each individual plant and plant grouping.

Photos were taken using the Solocator App (Civi Corp Pty Limited 2023), which were date- and time-stamped and included the UTM location of the site.

3. RESULTS

3.1 PHASE 1. PROPAGULE COLLECTION

The 2023 *in-situ* collection efforts focused on acquiring propagules for tall wood beauty (blue-listed in 2022; B.C. CDC 2023b) for future propagation and translocation as required.

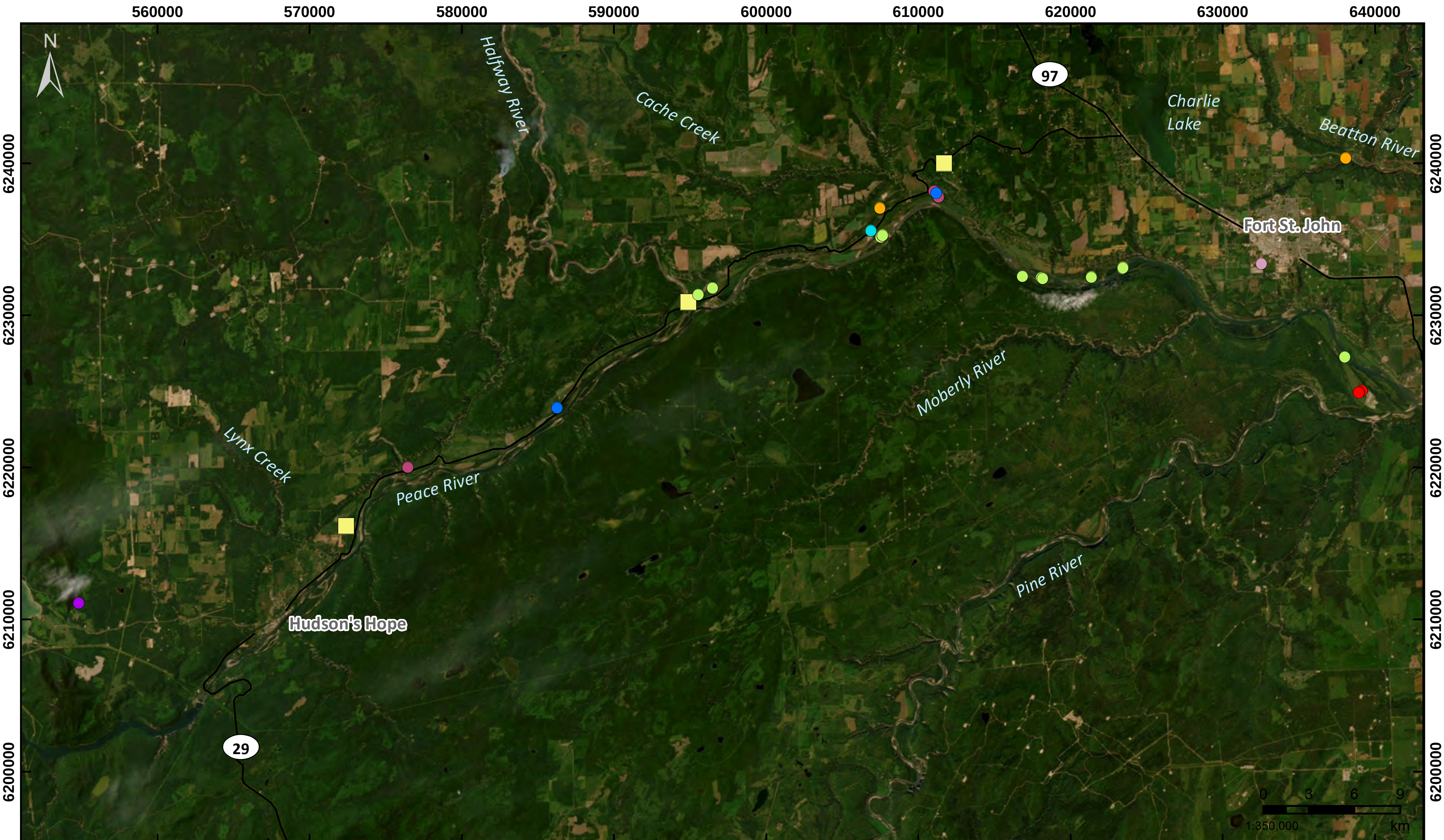
Ex-situ propagule collection efforts focused primarily on Canada rice-grass. Seeds were also opportunistically collected from prairie buttercup, slender penstemon, and Davis' locoweed to augment the existing seedbank housed at NATS nursery (Table 3.1-1).

Table 3.1-1. Summary of Successful 2023 Propagule Collection Efforts

Common Name	Species Name	Propagule Amount and Type	Collection Timing	Collection Type	Collection Location
Tall wood beauty	*Drymocallis arguta*	~5,000 seeds	September 7, 2023	*in-situ*	Cache Creek Hill
		~3,000 seeds	September 7, 2023	*in-situ*	West of Halfway River
		~2,000 seeds	September 9, 2023	*in-situ*	East of Lynx Creek
Prairie buttercup	*Ranunculus rhomboideus*	~9,000 seeds (9 g)	June 20, 2023	*ex-situ*	NATS nursery potted plants
Slender penstemon	*Penstemon gracilis*	~180,000 seeds (18 g)	July 27, 2023	*ex-situ*	NATS nursery potted plants
Canada mountain-ricegrass	*Piptatheropsis canadensis*	~355 seeds (1 g)	September 9, 2023	*ex-situ*	NATS nursery potted plants
Davis' locoweed	*Oxytropis campestris var. davisii*	~1,120 seeds (1.4 g)	September 9, 2023	*ex-situ*	NATS nursery potted plants

*Quantity provided from the nursery is an estimate based on seed weight.

In-situ propagule collection efforts by Eagle Cap were successful for one target species, tall wood beauty, in which approximately 10,000 seeds were collected from three locations (Figure 3.1-1). In early September, approximately 5,000 seeds were collected from 30 plants at the Cache Creek Hill site, approximately 3,000 seeds were collected from 15 plants at the site west of the Halfway River, and approximately 2,000 seeds were collected from ten plants east of Lynx Creek. Torrey's sedge seeds were not collected in 2023 as seed production was low.



Site C Project

Experimental Rare Plant Translocation
Propagule Collection Locations
Figure 3.1-1

Date: 2023-12-06
Map Number: BCH-065
Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Datum: North American 1983

ECOLOGIC

2017-2022	2023	Target Species
●		Sprengel's sedge (*Carex sprengelli*)
●		Torrey's sedge (*Carex torreyi*)
●		Dryland sedge (*Carex xerantica*)
●		Davis' locoweed (*Oxytropis campestris var. davisii*)
●		Slender penstemon (*Penstemon gracilis*)
●		Canada mountain-ricegrass (*Piptatheropsis canadensis*)
●		Prairie buttercup (*Ranunculus rhomboideus*)
●		Rock selaginella (*Selaginella rupestris*)
●	■	Tall wood beauty (*Drymocallis argutai*)

3.2 PHASE 2. *EX-SITU* PROPAGATION

Propagation efforts in 2023 focused on three species: Canada mountain-ricegrass, Torrey's sedge, and rock selaginella. Nursery staff primarily focused on refining stratification methods for Torrey's sedge, which has had relatively low germination rates in all of the previous trials since 2020. Nursery staff also focused on expanding the existing stock of Canada mountain-ricegrass and rock selaginella.

3.3 PHASE 3. TRANSLOCATION IMPLEMENTATION

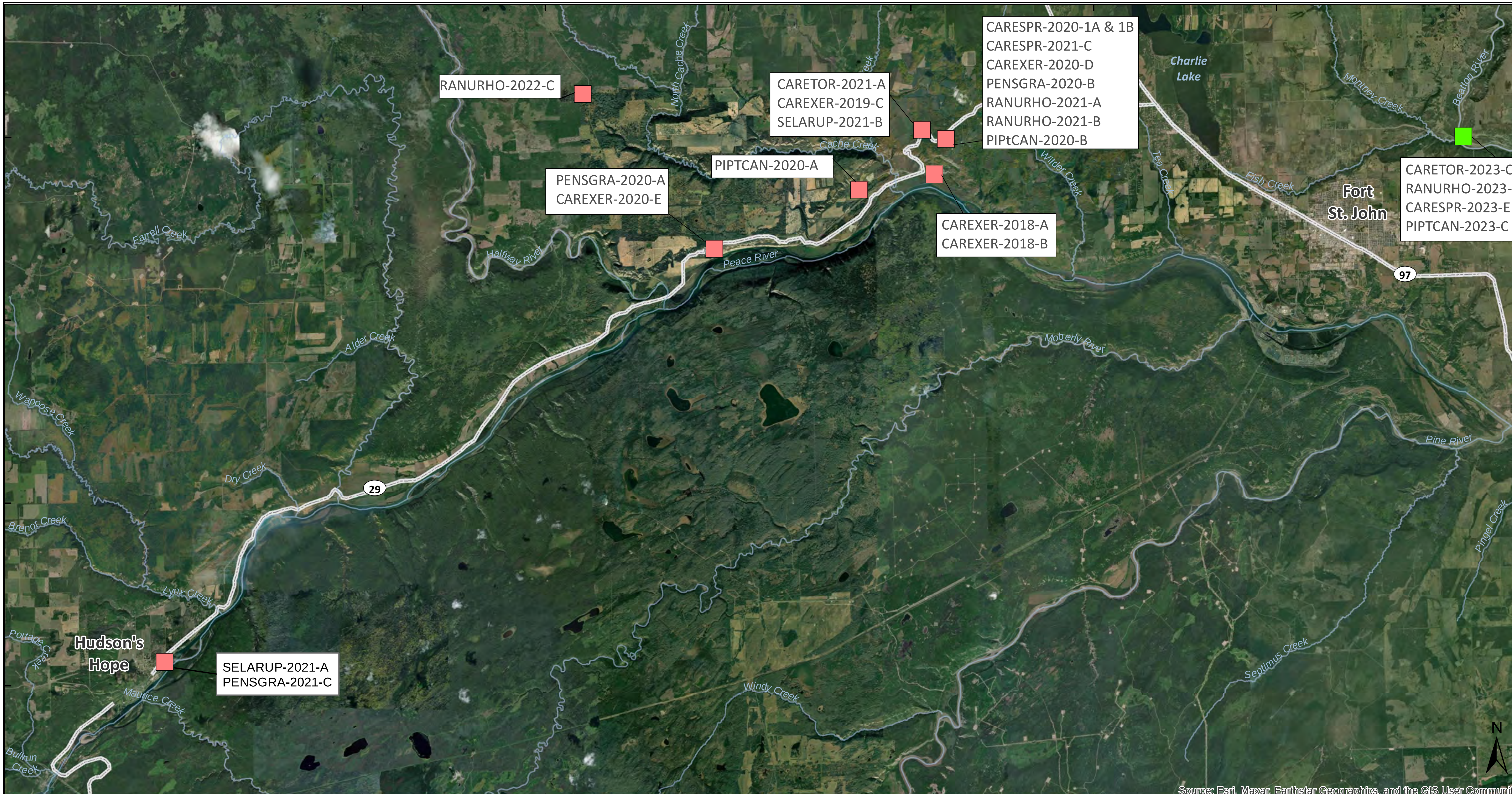
Translocation implementation focused on planting trials at recipient sites that have greater long-term security than the locations of the source material. The recipient sites are within the known distribution range for the target plant within the Peace Region and have similar habitat to the location of the source material. Translocation efforts have also focused on out-planting larger individuals because adult translocated plants have shown higher survival than translocated seedlings (Dalrymple et al. 2012; Bush 2022).

Translocation trials were completed in June 2023 with a total of 63 individuals (1 Gallon [G]) planted at three locations (Leahy Pit Road, Beatton Valley Trails, and bottom of Cache Creek Hill) and a total of eight recipient sites between them (Figure 3.3-1 and Figure 3.3-2; Table 3.3-1). The Leahy and Beatton Valley locations are new translocation sites. At the time of translocation, the Peace region, as well as much of the province, was experiencing hot and dry conditions that persisted throughout the year as well as a record-breaking wildfire season that included the largest recorded wildfire in BC just north of Fort St. John (the Donnie Creek wildfire). To date, more than 1,500 plants from a diversity of eight different rare plant species have been translocated for this project.

Table 3.3-1. Summary of Individuals Translocated by Species and Site ID in 2023

Species	Site ID	Translocation Date	No. of Adults (1G Pots)
Sprengel's sedge	CARESPR-2021-C (Cohort 2)	9-Jun and 12-Jun	10
	CARESPR-2023-D	9-Jun	6
	CARESPR-2023-E	11-Jun	4
Total			**20**
Prairie buttercup	RANURHO-2023-D-1A	8-Jun	5
	RANURHO-2023-D-2A	8-Jun	5
	RANURHO-2023-E-1A	11-Jun	5
	RANURHO-2023-E-2A	11-Jun	5
Total			**20**
Torrey's sedge	CARETOR-2023-B-1A	8-Jun	5
	CARETOR-2023-B-2A	8-Jun	5
	CARETOR-2023-C-1A	11-Jun	5

Species	Site ID	Translocation Date	No. of Adults (1G Pots)
	CARETOR-2023-C-2A	11-Jun	5
Total			**20**
Canada mountain-ricegrass	PIPTCAN-2023-C	12-Jun	3
Total			**3**
Grand Total			**63**



Site C Project

Experimental Rare Plant Translocation
Recipient Site Locations
Figure 3.3-1

Date: 2023-12-12
Map Number: BCH-066a
Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Datum: North American 1983

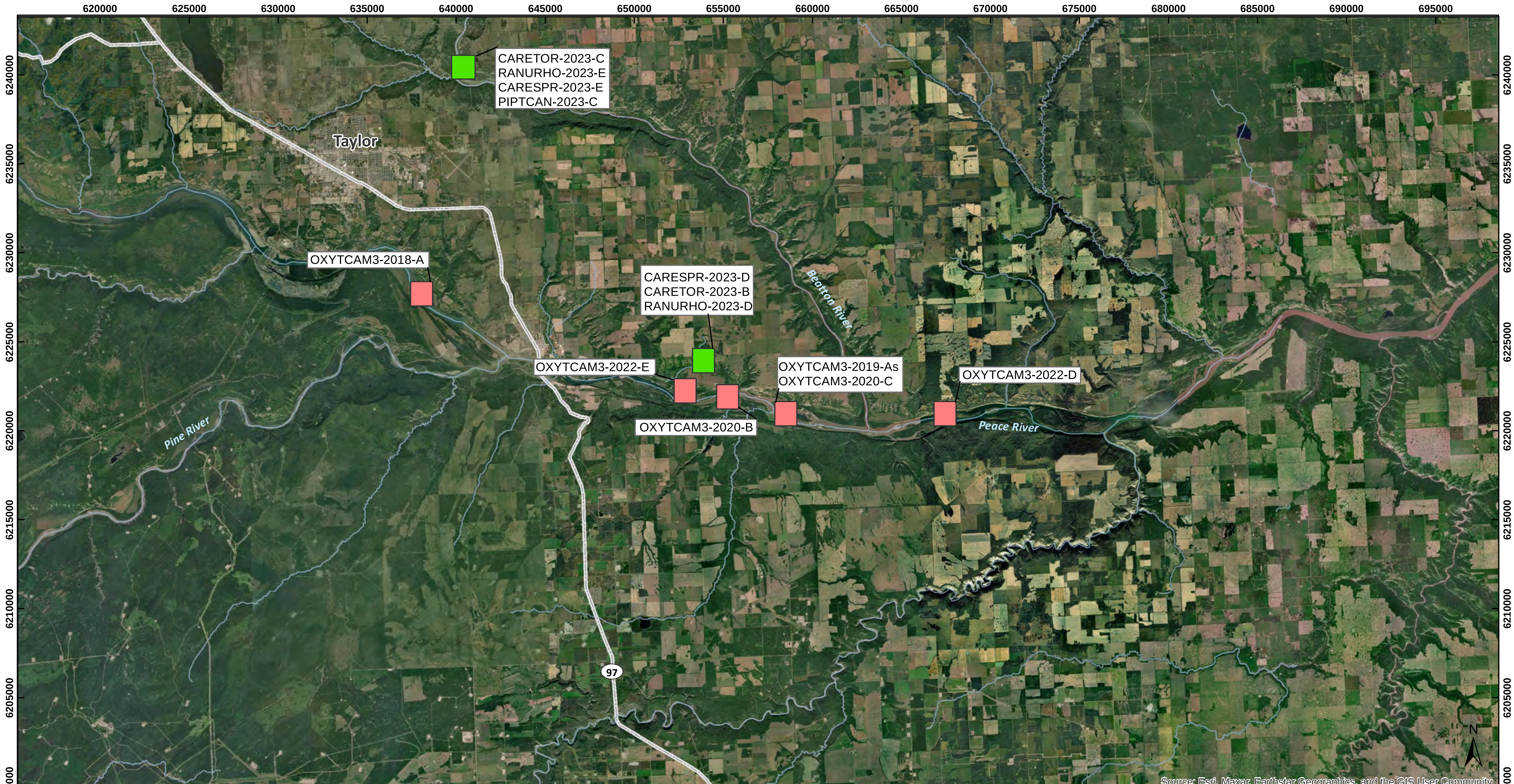
ECOLOGIC environmental consulting

Legend

- 2023 Recipient Sites[1]
- 2018-2022 Recipient Sites[1]
- Highway
- Streams

[1]Site names correspond to the following species:

CAREXER - Dryland sedge (*Carex xerantica*)
CARETOR - Torrey's sedge (*Carex torreyi*)
CARESPR - Sprengel's sedge (*Carex sprengelii*)
PENSGRA - Slender penstemon (*Penstemon gracilis*)
RANURHO - Prairie buttercup (*Ranunculus rhomboideus*)
SELARUP - Rock selaginella (*Selaginella rupestris*)
PIPTCAN - Canada mountain rice-grass (*Piptatheropsis canadensis*)



Site C Project

Experimental Rare Plant Translocation

Recipient Site Locations

Figure 3.3-2

Date: 2023-12-12

Map Number: BCH-066b

Coordinate System: NAD 1983 UTM Zone 10N

Projection: Transverse Mercator

Datum: North American 1983

ECOLOGIC environmental consulting

Legend

- 2023 Recipient Site [1]
- 2018-2022 Recipient Site[1]
- Highway
- Streams

0 2 4 6 km

1:200,000

[1]Site names correspond to the following species:

CAREXER - Dryland sedge (*Carex xerantica*)
CARETOR - Torrey's sedge (*Carex torreyi*)
CARESPR - Sprengel's sedge (*Carex sprengelii*)
PENSGRA - Slender penstemon (*Penstemon gracilis*)
RANURHO - Prairie buttercup (*Ranunculus rhomboideus*)
SELARUP - Rock selaginella (*Selaginella rupestris*)
PIPTCAN - Canada mountain rice-grass (*Piptatheropsis canadensis*)

3.3.1 Sprengel's Sedge (*Carex sprengelii*)

In June of 2023, 20 individual Sprengel's sedge (1 G pots) were planted at three locations: Leahy Pit Road (six individuals at CARESPR-2023-D on June 9, 2023), Beatton Valley Trails (four individuals at CARESPR-2023-E on June 11, 2023), and the bottom of Cache Creek Hill (ten individuals at CARESPR-2021-C [cohort 2] on June 9 and 12, 2023). The Leahy and Beatton Valley Trail locations are new translocation sites to the program, whereas the Cache Creek Hill site is an existing recipient site.

Leahy Pit Road Location

On June 9, 2023, six Sprengel's sedge were planted at the Leahy Pit Road location east of Taylor, BC (Figure 3.3-1). Two clusters of three individuals were planted in an aspen forest at the base of the grassland hill (Figure 3.3-3; Plate 3.3-1 to Plate 3.3-4). Aspen (*Populus tremuloides*), red-osier dogwood (*Cornus sericea*) and prickly rose (*Rosa acicularis*) were the dominant understory plant species. Game trails and signs of browse were prevalent throughout the area. Soils were clayey with a thick litter layer, and potting soil was mixed in with the native soil to backfill the holes excavated for planting. Each plant was fitted with zip tie collars held in place by an identifying tag and ground staple (Plate 3.3-5). The leaf litter was also replaced after planting and all plants were watered. All but one individual had seed heads present at the time of planting (Plate 3.3-6).

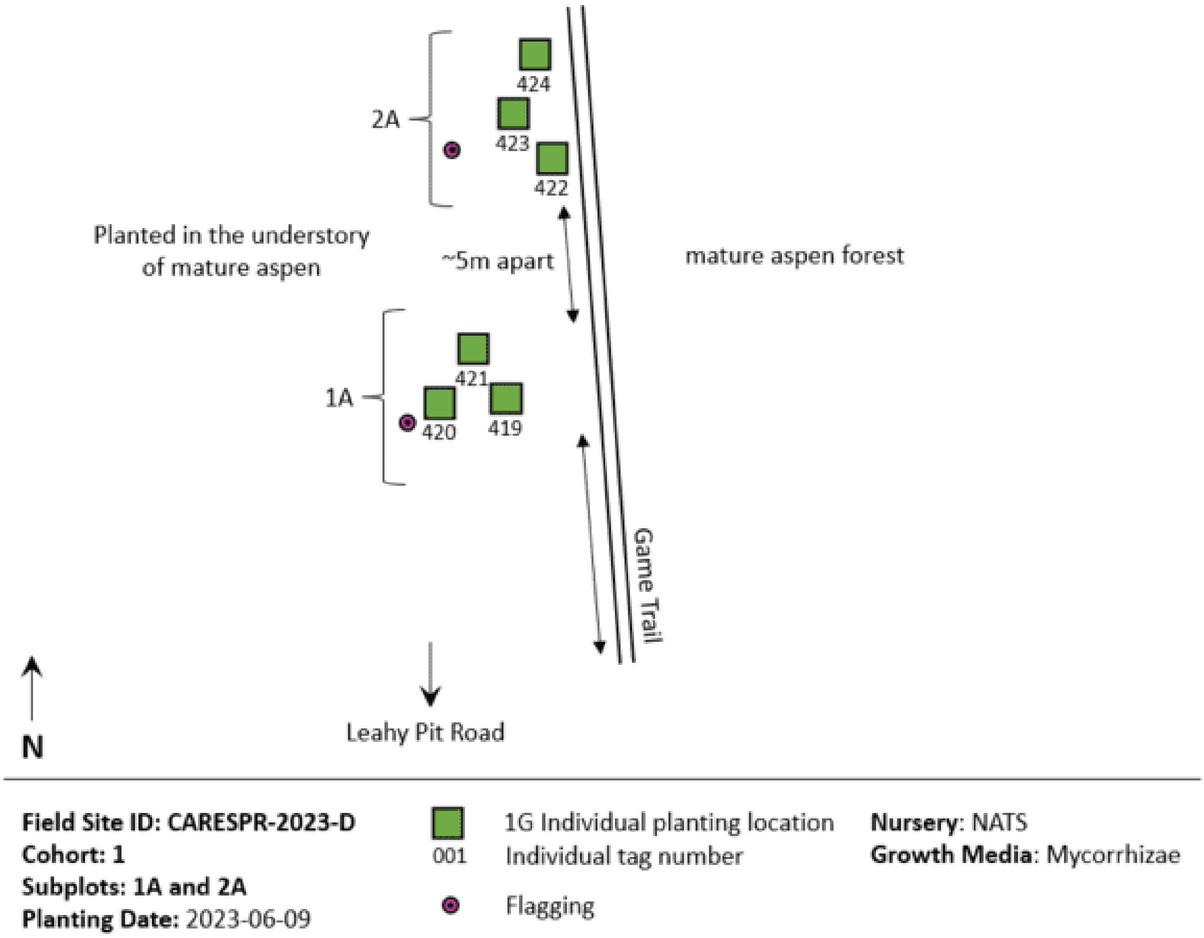


Figure 3.3-3. Sprengel's sedge planting diagram at the Leahy Pit Road site (CARESPR-2023-D)

Plate 3.3-1. Sprengel's sedge (CARESPR-2023-D-1A) planted in aspen forest at the Leahy Pit Road site

Plate 3.3-2. Sprengel's sedge (CARESPR-2023-D-2A) planted in aspen forest at the Leahy Pit Road site

Plate 3.3-3. Close up of Sprengel's sedge (CARESPR-2023-D-1A) planted in aspen forest at the Leahy Pit Road site

Plate 3.3-4. Close up of Sprengel's sedge (CARESPR-2023-D-2A) planted in aspen forest at the Leahy Pit Road site

Plate 3.3-5. Example of zip tie collar secured at the base of a Sprengel's sedge

Plate 3.3-6. Example of Sprengel's sedge inflorescence with seed heads

Beatton Valley Trails Location

On June 11, 2023, four Sprengel's sedge were planted at the Beatton Valley Trails recipient site (Figure 3.3-2; Figure 3.3-4). These individuals were planted off of a recreation trail down in a cool, level area under mature Bebb's willows (*Salix bebbiana*) (Figure 3.3-6 to Plate 3.3-9). Red-osier dogwood and prickly rose were the dominant understory plant species. The soil was rich with a thick litter layer and coarse material found at a depth of 15 cm. Potting soil was mixed in with the native soil to backfill the holes excavated for planting. Each plant was fitted with zip tie collars held in place by an identifying tag and ground staple. The leaf litter was also replaced after planting and all plants were watered. All but one individual had seed heads present at the time of planting.

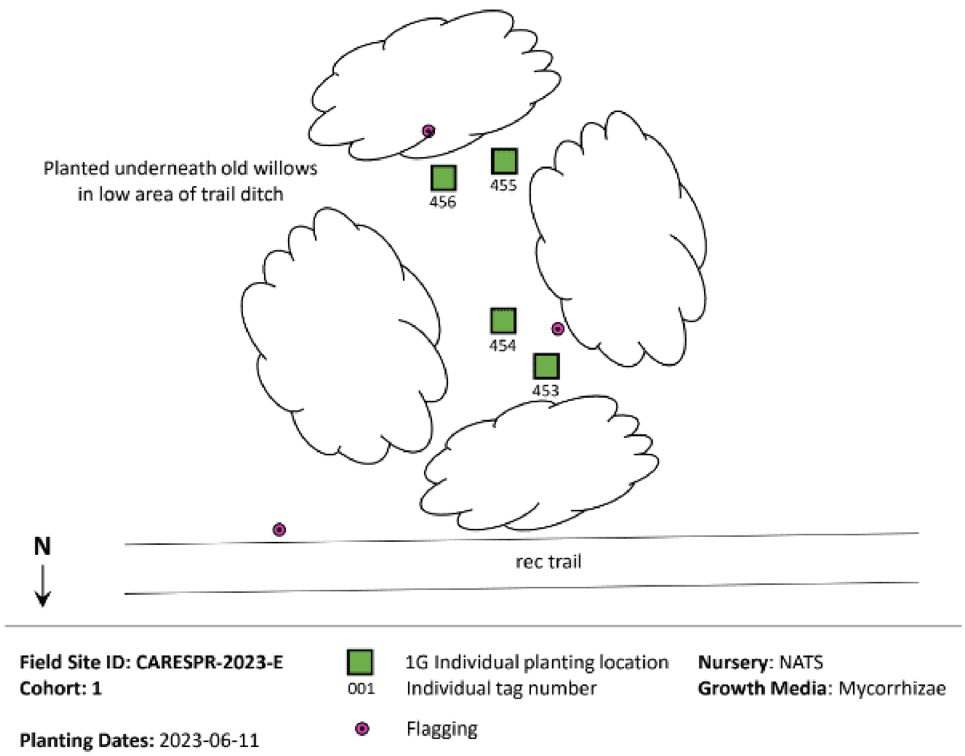


Figure 3.3-4. Sprengel's sedge planting diagram at the Beatton Valley Trails site (CARESPR-2023-E)

Plate 3.3-7. View of general planting area from a recreation trail at the Beatton Valley Trail location

Plate 3.3-8. Sprengel's sedge (CARESPR-2023-E; tag numbers 455 and 456) planted at the Beatton River recipient site

Plate 3.3-9. Sprengel's sedge (CARESPR-2023-E; tag numbers 453 and 454) planted at the Beatton River recipient site

Cache Creek Hill Location

On June 10, 2023, two clusters of three adults (six total) were planted at the Cache Creek Hill recipient site CARESPR-2021-C where one Sprengel's sedge had been planted in 2021 (Figure 3.3-1 and

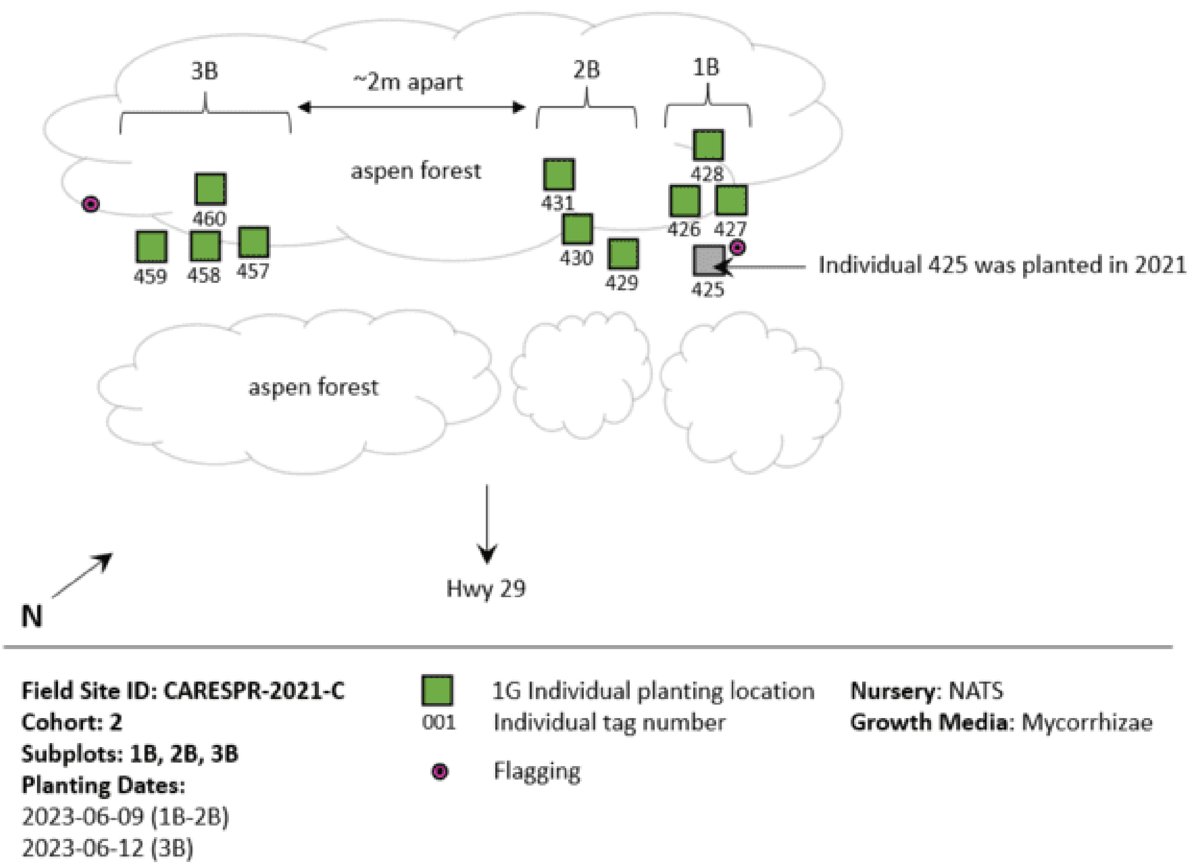
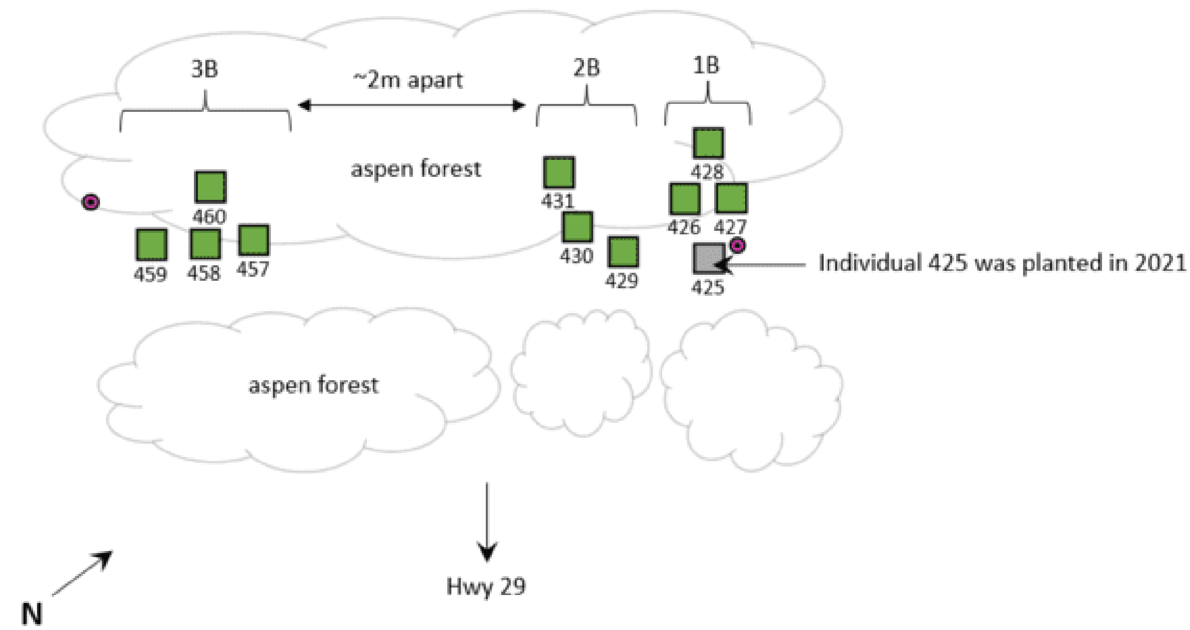


Figure 3.3-5; Plate 3.3-10 and Plate 3.3-11). On June 12, 2023, a cluster of four additional adults were planted within the same site.



Field Site ID: CARESPR-2021-C
Cohort: 2
Subplots: 1B, 2B, 3B
Planting Dates:
2023-06-09 (1B-2B)
2023-06-12 (3B)

1G Individual planting location
001 Individual tag number
Flagging

Nursery: NATS
Growth Media: Mycorrhizae

Figure 3.3-5. Sprengel's sedge planting diagram at the Cache Creek Hill site (CARESPR-2021-C)

Plate 3.3-10. Cache Creek Hill recipient site CARESPR-2021-C in June 2023

Plate 3.3-11. Example of Sprengel's sedge planted at site ID: CARESPR-2021-C

3.3.2 Torrey's Sedge (*Carex torreyi*)

In June of 2023, 20 individual Torrey's sedge (1-gallon pots) were planted between two locations (Figure 3.3-1): Leahy Pit Road (ten individuals at CARETOR-2023-B on June 8 and 9, 2023) and the Beatton Valley Trails (ten individuals at CARETOR-2023-C on June 11, 2023). The Leahy and Beatton Valley Trail locations are new recipient sites to the program.

Leahy Pit Road Location

Ten individuals were planted at the Leahy pit road recipient sites, where five were planted at subsite CARETOR-2023-B-1A on June 8, 2023, and five were planted at subsite CARETOR-2023-B-2A on June 9, 2023 (Figure 3.3-6 and Figure 3.3-7). Conditions were hot, dry, and smoky compared to the previous spring (see Plate 3.3-12 and Plate 3.3-13).

Individuals at subsite CARETOR-2023-B-1A (Plate 3.3-14) and 2A (Plate 3.3-15) were planted linearly on a gentle slope and along the eastern edge of a shrub border - interspersed among saskatoon (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana*), and spreading dogbane (*Apocynum androsaemifolium*) (Figure 3.3-6). Subsite 2A is located at the next crest uphill from subsite 1A.

Most of the newly planted Torrey's sedge were significantly rootbound (Plate 3.3-16), which was broken up with clippers before planting. Each plant was watered after planting and fitted with zip tie rings held in place by an identifying tag and small staple (Plate 3.3-17).

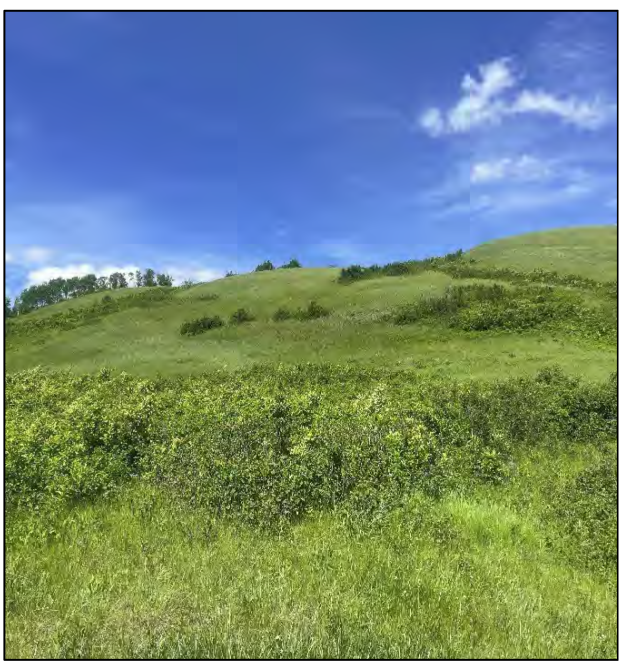


Plate 3.3-12. Leahy Pit Road site June 2022

Plate 3.3-13. Leahy Pit Road site June 2023

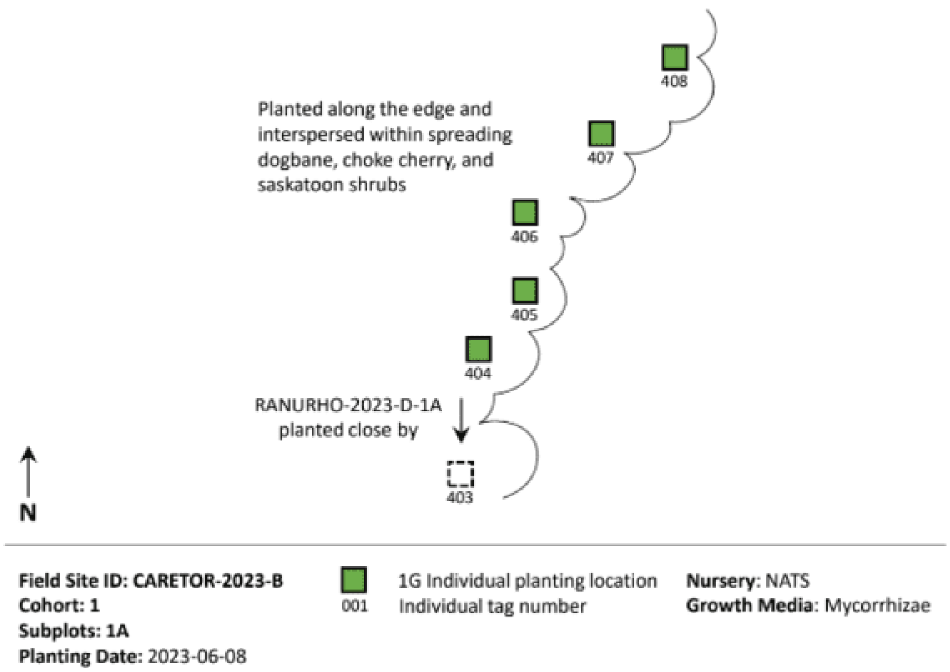


Figure 3.3-6. Torrey's sedge planting diagram at the Leahy Pit Road site (CARETOR-2023-B-1A)

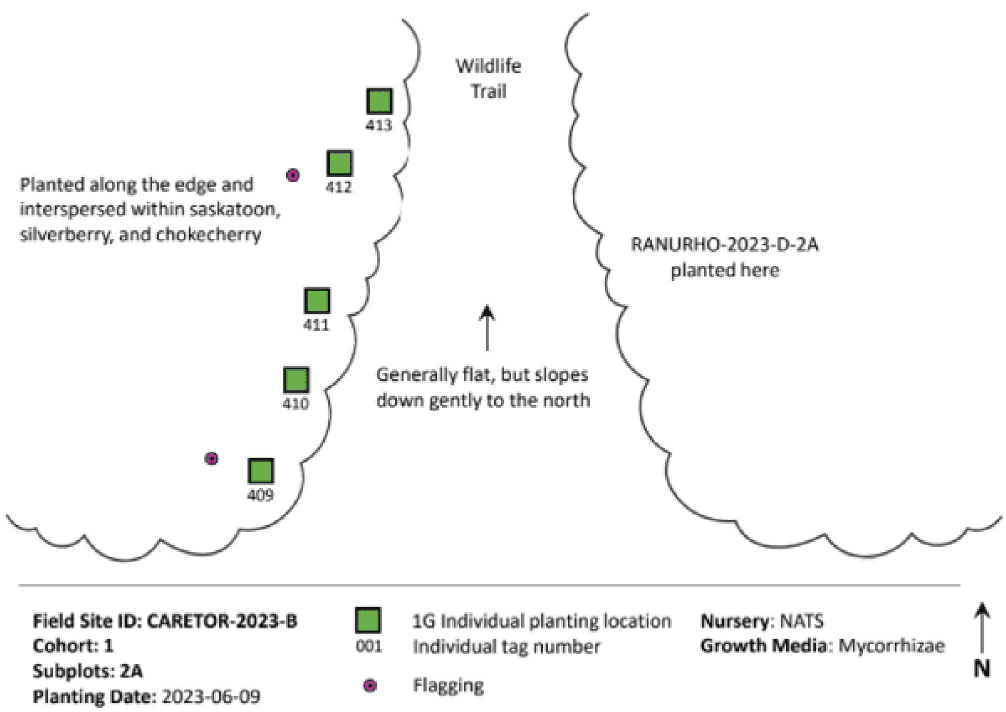


Figure 3.3-7. Torrey's sedge planting diagram at the Leahy Pit Road site (CARETOR-2023-B-2A)

Plate 3.3-14. Leahy Pit Road planting site: CARETOR-2023-1A (June 8, 2023)

Plate 3.3-15. Leahy Pit Road planting site: CARETOR-2023-1B (June 9, 2023)

Plate 3.3-16. Example of highly rootbound adult Torrey's sedge

Plate 3.3-17. Example of adult Torrey's sedge planted at site ID: CARETOR-2023-B

Beatton Valley Trails Location

The second planting location for Torrey's sedge was at the Beatton Valley Trails site: CARETOR-2023-C (Figure 3.3-2), where ten individuals were planted in total. Five individuals were planted at subsite CARETOR-2023-C-1A (Figure 3.3-8**)**, and another five individuals were planted at subsite CARETOR-2023-C-2A (Figure 3.3-9) situated east of subsite 2A. Both subsites have individuals planted within saskatoon, rose, and chokecherry shrubs. The soil substrate was observed to be more friable than the clayey soils observed at the Leahy Pit Road location.

Similar to the Torrey's sedge planted at the Leahy site, individuals were significantly rootbound and were loosened with clippers before planting. Each plant was watered after planting and fitted with zip tie rings held in place by an identifying tag and small staple (Plate 3.3-17).

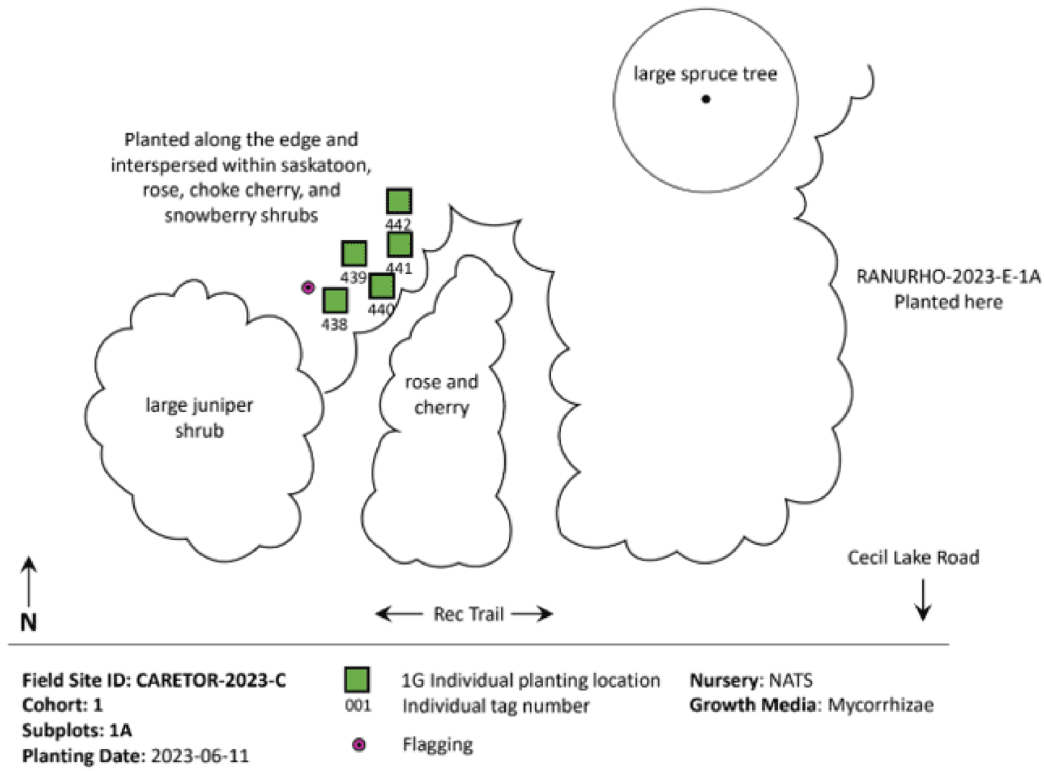


Figure 3.3-8. Torrey's sedge planting diagram at the Beatton Valley Trails site (CARETOR-2023-C-1A)

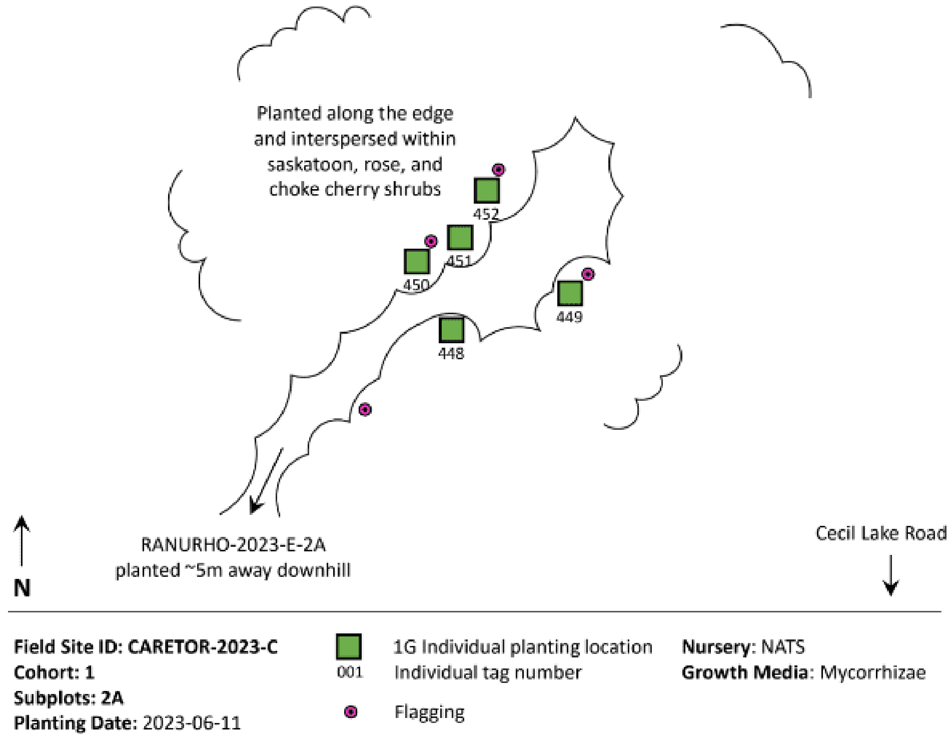


Figure 3.3-9. Torrey's sedge planting diagram at the Beatton Valley Trails site (CARETOR-2023-C-2A)

Plate 3.3-18. Planting site for Torrey's sedge – CARETOR-2023-C-1A

Plate 3.3-19. Planting site for Torrey's sedge – CARETOR-2023-C-2A

Plate 3.3-20. Example of adult Torrey's sedge planted at site ID: CARETOR-2023-C. Note seed heads of adjacent Torrey's sedge

3.3.3 Prairie buttercup *(Ranunculus rhomboideus)*

In June of 2023, 20 individual prairie buttercup (1-gallon pots) were planted between two locations (Figure 3.3-2): Leahy Pit Road (ten individuals at RANURHO-2023-D on June 8 and 9, 2023) and the Beatton Valley Trails (ten individuals at RANURHO-2023-E on June 11, 2023). The Leahy and Beatton Valley Trail locations are new recipient sites to the program.

Leahy Pit Road Location

Five individuals at subsite RANURHO-2023-D-1A (Figure 3.3-10; Plate 3.3-21) were planted linearly on a gentle slope and along the eastern edge of a shrub border - interspersed among saskatoon, chokecherry, and spreading dogbane. These individuals were planted directly south of Torrey's sedge (CARETOR-2023-B-1A). Another five individuals at subsite RANURHO-2023-D-2A were planted directly across from CARETOR-2023-B-2A (Figure 3.3-11; Plate 3.3-22) along the western edge of a shrub border comprised mostly of saskatoon.

All prairie buttercups were watered after planting and surrounded by plastic collars to deter herbivory (Plate 3.3-23). Each plant was given an identifying tag held in place with a ground staple.

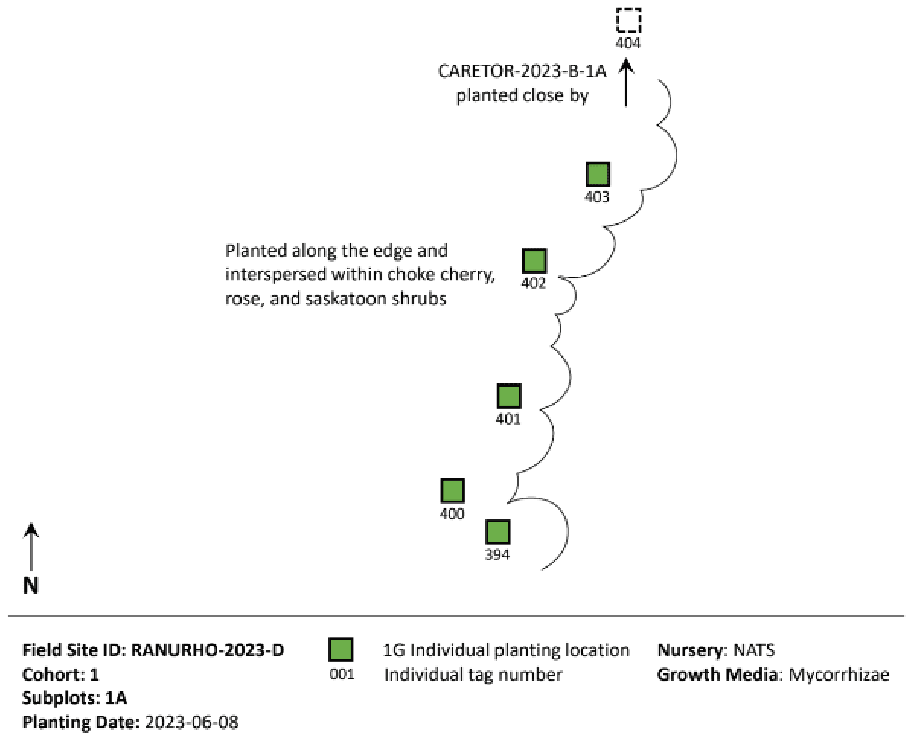


Figure 3.3-10. Prairie buttercup planting diagram at the Leahy Pit Road site (RANURHO-2023-D-1A)

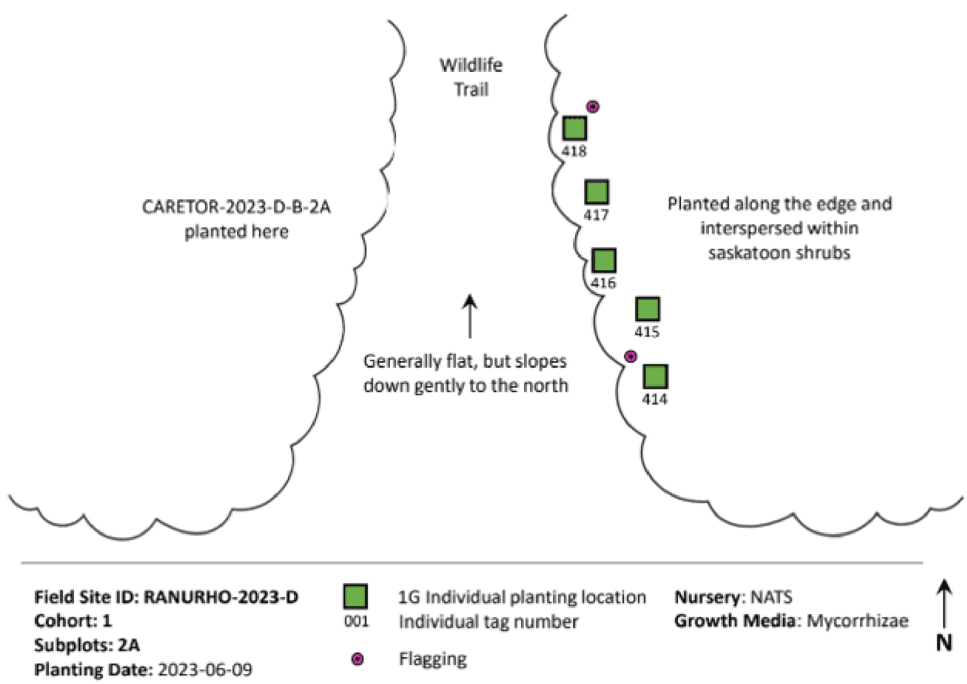


Figure 3.3-11. Prairie buttercup planting diagram at the Leahy Pit Road site (RANURHO-2023-D-2A)

Plate 3.3-21. Planting site for prairie buttercup – RANURHO-2023-D-1A

Plate 3.3-22. Planting site for prairie buttercup – RANURHO-2023-D-2A

Plate 3.3-23. Example of adult prairie buttercup in bloom and fitted with an anti-herbivory collar at site ID: RANURHO-2023-D

Beatton Valley Trails Location

The second planting location for prairie buttercup was at the Beatton Valley Trails site: RANURHO-2023-E, where ten individuals were planted in total. Five individuals were planted at subsite RANURHO-2023-E-1A (Figure 3.3-12; Plate 3.3-24; near CARETOR-2023-C-1A), and another five individuals were planted at subsite RANURHO-2023-E-2A situated east of subsite 2A (Figure 3.3-13; Plate 3.3-25; near CARETOR-2023-C-2A). Both subsites have individuals planted within saskatoon, rose, and chokecherry shrubs. The soil substrate was observed to be more friable than the clayey soils observed at the Leahy Pit Road location.

All prairie buttercups were watered after planting and surrounded by plastic collars to deter herbivory (Plate 3.3-26). Each plant was given an identifying tag held in place with a ground staple.

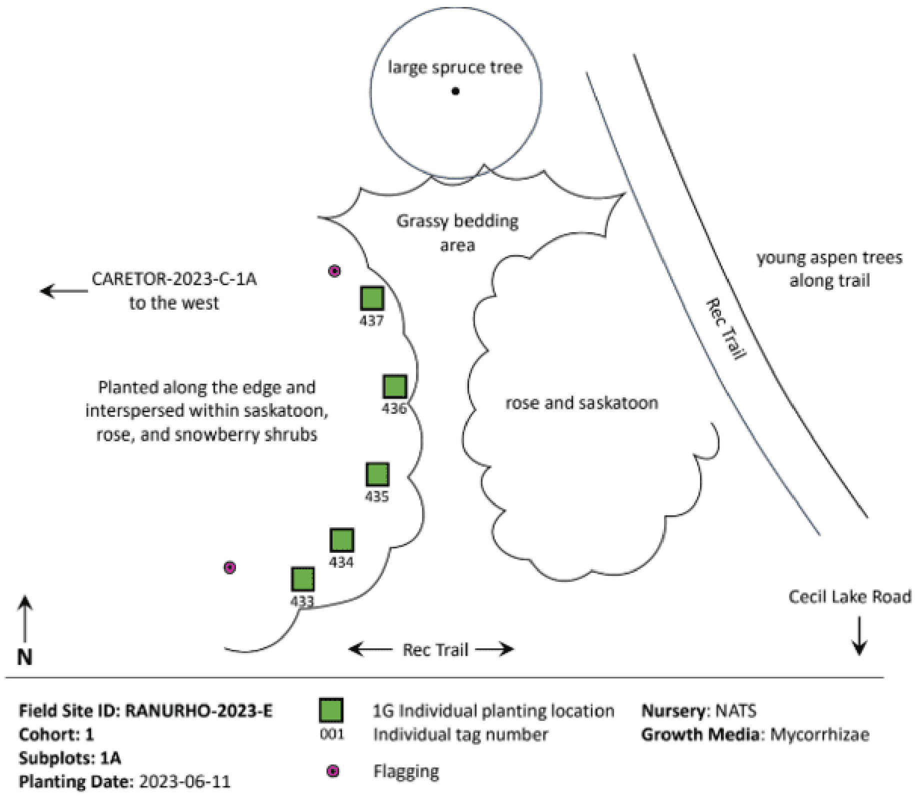


Figure 3.3-12. Prairie buttercup planting diagram at the Beatton Valley Trail site (RANURHO-2023-E-1A)

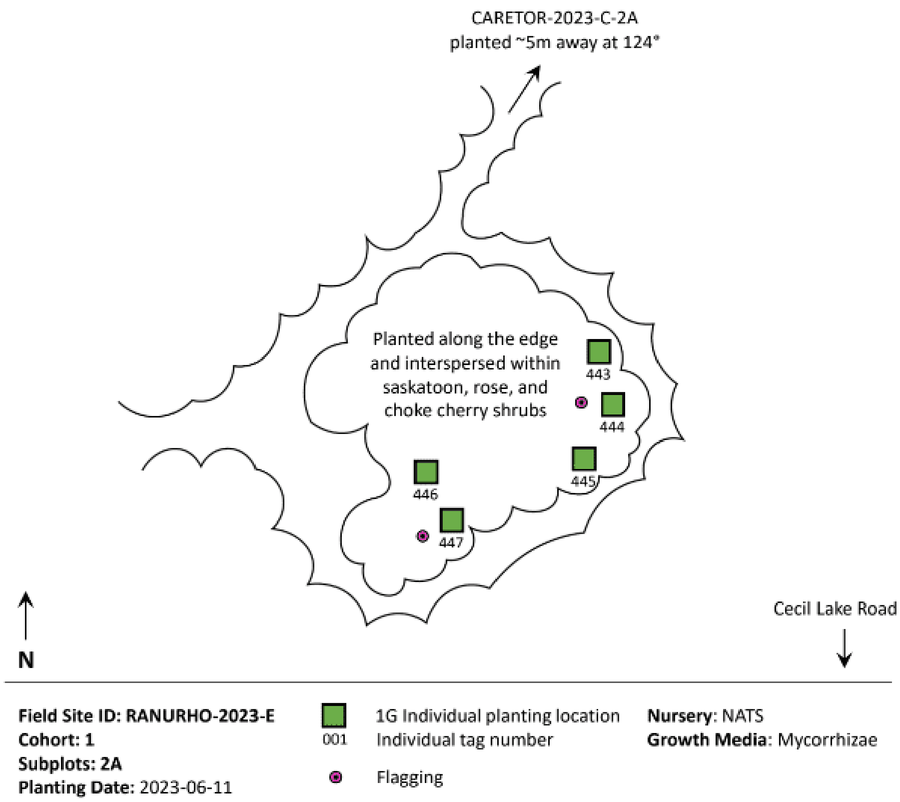


Figure 3.3-13. Prairie buttercup planting diagram at the Beatton Valley Trail site (RANURHO-2023-E-2A)

Plate 3.3-24. Planting site for prairie buttercup – RANURHO-2023-E-1A

Plate 3.3-25. Planting site for prairie buttercup – RANURHO-2023-E-2A

Plate 3.3-26. Example of adult prairie buttercup in bloom and fitted with an anti-herbivory collar at site ID: RANURHO-2023-E-2A

3.3.4 Canada mountain-ricegrass (*Piptatheropsis canadensis*)

On June 12, 2023, three Canada mountain-ricegrass (1-gallon pots) were planted by Eagle Cap at the Beatton Valley Trails location (PIPTCAN-2023-C; Figure 3.3-2; Plate 3.3-27 and Plate 3.3-28) near the RANURHO-2023-E-1A and CARETOR-2023-C-1A sites. They were planted in grassy openings among shrubs bordering young aspen.

Plate 3.3-27. Beatton Valley Trails planting site: PIPTCAN-2023-C (June 12, 2023)

Plate 3.3-28. Example of adult Canada mountain-ricegrass with seed heads planted at site ID: PIPTCAN-2023-C (June 12, 2023)

3.4 Phase 4. Monitoring

Monitoring of individuals occurred up to two times in 2023 to correspond with seasonal changes in the phenology of each species. Due to wildfire and the resulting extremely poor air quality conditions, monitoring occurred less frequently in 2023 than in previous years.

Interim monitoring and/or population monitoring occurred in early spring (June), mid -summer (August) and early fall (September) depending on the plant species and location. (Table 3.4-1). Refer to Figure 3.3-1 and Figure 3.3-2) for respective monitoring locations. A summary of follow up measures identified in 2023 during the interim monitoring and the 2023 status of the implementation of the follow up measures are summarized in Table 3.4-2.

Table 3.4-1. 2023 Species and Monitoring Sites

Species	Site ID	Interim Monitoring Date	Population Monitoring Date
Prairie buttercup	RANURHO-2021-A	September 6, 2023	June 10, 2023
	RANURHO-2021-B	September 6, 2023	June 9, 2023
	RANURHO-2022-C	-	June 7, 2023
	RANURHO-2023-D	August 11 and September 6, 2023	-
	RANURHO-2023-E	August 12 and September 6, 2023	-
Slender penstemon	PENSGRA-2020-A	-	August 9, 2023
	PENSGRA-2020-B	-	August 9, 2023
	PENSGRA-2021-C	September 5, 2023	June 12, 2023
Rock selaginella	SELARUP-2021-A	June 12, 2023	September 5, 2023
Canada mountain-ricegrass	PIPTCAN-2020-B	-	August 9, 2023
	PIPTCAN-2023-C	September 6, 2023	-
Dryland sedge	CAREXER-2020-D	-	August 9, 2023

Species	Site ID	Interim Monitoring Date	Population Monitoring Date
	CAREXER-2020-E	-	August 9, 2023
Torrey's sedge	CARETOR-2021-A	-	June 10, 2023
	CARETOR-2023-B	August 11 and September 6, 2023	-
	CARETOR-2023-C	August 12, , and September 6, 2023	-
Sprengel's sedge	CARESPR-2020-A	September 6, 2023	June 10, 2023
	CARESPR-2020-B	Unable to monitor September 6, 2023, due to moose activity in area	June 12, 2023
	CARESPR-2021-C	September 6, 2023	June 9, 2023
Davis' locoweed	OXYTCAM3-2020-B	-	September 4 and 5, 2023
	OXYTCAM3-2020-C	-	September 4 and 5, 2023
	OXYTCAM3-2022-D	-	September 4, 2023
	OXYTCAM3-2022-E	-	September 4, 2023

Table 3.4-2. Summary of Recipient Sites and Current Status

Species	Site Name	Status	Follow-up Measures (2022)	Follow-up Status (2023)
Dryland Sedge (*C. xerantica*)	CAREXER-2018-A	Inactive	na	na
	CAREXER-2018-B	Inactive	na	na
	CAREXER-2019-C	Active	Not visited	-
	CAREXER-2020-D	Active	Continue invasive plant removal and continue watering.	Site visited once for final monitoring. Not watered.
	CAREXER-2020-E	Active	Continue to restrict site visits to maximum two visits per year to minimize erosion of fine textured soils. Water if necessary.	Site visited once for population monitoring.
Canada mountain-ricegrass (*P. canadensis*)	PIPTCAN-2020-A	Active	Improve means of detection if necessary.	Potential for use of zip tie collar technique in the future. Site access has changed since the highway was completed and requires crossing a private field for monitoring.
	PIPTCAN-2020-B	Active	Improve means of detection if necessary.	Potential for use of zip tie collar technique in the future.
	PIPTCAN-2020-C	Active	Improve means of detection if necessary.	Potential for use of zip tie collar technique in the future.
Davis' locoweed (*O. campestris* var. *davisii*)	OXYTCAM3-2018-A	Inactive	Site contains an existing occurrence of *O. campestris* and may serve as a future reference site.	Not visited. No follow up measures proposed for 2024 due to rank change of this variety.

Species	Site Name	Status	Follow-up Measures (2022)	Follow-up Status (2023)
	OXYTCAM3-2018-As (i.e. C)	Active	Monitor a selection of seed trials in 2022.	Opportunistically evaluated while conducting population monitoring of translocated plants at the same location. No follow up measures proposed for 2024 due to rank change of this variety.
	OXYTCAM3-2020-B	Active	Install fencing if required to address herbivory.	Fencing not required. No follow up measures proposed for 2024 due to rank change of this variety.
	OXYTCAM3-2020-C	Active	Evaluate the efficacy of trial fencing to address herbivory. Consider re-establishing phenocamera to track herbivory.	Fencing continues to be effective. Phenocamera not installed. Clover removed from some monitored plots. No follow up measures proposed for 2024 due to rank change of this variety.
	OXYTCAM3-2022-D	Active	Evaluate the need for protection from herbivory	Not required. No follow up measures proposed for 2024 due to rank change of this variety.
	OXYTCAM-2022-E	Active	Evaluate the need for protection from herbivory	Not required. No follow up measures proposed for 2024 due to rank change of this variety.
Prairie buttercup (*R. rhomboideus*)	RANURHO-2021-A	Active	Consider removal of cages	Two of three cages readjusted. One flattened cage had inflorescence growing through the cage at time of monitoring, so the cage was left in place. Watered. Consider removal of cages (in the late fall or using wire cutters to avoid damage to plant structures)
	RANURHO-2021-B	Active	Readjust or replace collars if removed by wildlife and continue assessing the need for fencing	Reinstalled cages for two individuals. Watered. Readjust or replace collars if removed by wildlife and continue assessing the need for fencing.
	RANURHO-2022-C	Active	None identified	This crown parcel was observed to be fenced and stocked with cattle (after translocation). It is uncertain how long these disturbances will persist. Evaluate the need for protection from herbivory.
	RANURHO-2023-D	Active	None identified	Collars and plants had been found to be removed by wildlife during interim monitoring. Remaining individuals were watered. Evaluate the need for protection from herbivory or relocation.
	RANURHO-2023-E	Active	None identified	Plants were watered. Evaluate the need for protection from herbivory.

Species	Site Name	Status	Follow-up Measures (2022)	Follow-up Status (2023)
Rock selaginella (*Selaginella rupestris*)	SELARUP-2021-A	Active	Continue assessing the need for follow-up measures	Site is susceptible to erosion. Limit site visits and opportunistically sample different portions of the slope if more that one site visit is conducted.
	SELARUP-2021-B	Active	None identified	Not visited. Continue assessing the need for follow-up measures.
Slender penstemon *(P. gracilis*)	PENSGRA-2020-A	Active	Continued watering	Not watered in 2023.
	PENSGRA-2020-B	Active	Continued watering.	Not watered in 2023.
	PENSGRA-2021-C	Active	Initiate watering in drought conditions, if needed.	Watered (dry spring) and continue watering if deemed necessary.
Sprengel's sedge (*C. sprengelii*)	CARESPR-2020-1A	Active	Initiate watering in drought conditions, if needed.	Watered (dry spring) and continue watering if deemed necessary.
	CARESPR-2020-1B	Active	Determine if fencing is needed to prevent animals from laying on the plants.	No laydown observed. Plants watered (dry spring). Continue to assess if fencing is required. Continue watering if deemed necessary.
	CARESPR-2021-C	Active	Initiate watering in drought conditions, if needed.	Watered (dry spring) and continue watering if deemed necessary.
	CARESPR-2023-D		None identified	Watered (dry spring) and continue watering if deemed necessary.
	CARESPR-2023-E		None identified	Watered (dry spring) and continue watering if deemed necessary.
Torrey's sedge (*C. torreyi*)	CARETOR-2021-A		None identified	Watered (dry spring) and continue watering if deemed necessary.
	CARETOR-2023-B		None identified	Watered (dry spring) and continue watering if deemed necessary.
	CARETOR-2023-C		None identified	Watered (dry spring) and continue watering if deemed necessary.

3.4.1 Population Monitoring

Population monitoring involved an evaluation of survivorship, maturity, reproduction, and recruitment (Table 3.4-3). These metrics are being used to evaluate population viability at recipient sites and to track establishment of the translocated plants and resulting recruitment. The year-end monitoring is critical to ensure that issues with viability or establishment can be identified and addressed as they arise.

Table 3.4-3. Summary of Population Monitoring Results for 2023

Species	Site Name	Survivorship		Maturity		Reproduction		Recruitment
		Survival in Relation to Total	Percent Survival	Flowering in Relation to Total	Percent Flowering	Seed Production in Relation to Total	Percent Seeding	Number of recruits observed
Canada mountain-ricegrass	PIPTCAN-2020-B	1/5	20%	1/5	20%	1/5	20%	0
Davis' locoweed	OXTYCAM3-2020-B (all cohorts)	191/294	65%	116/294	39%	116/294	39%	22
	OXTYCAM3-2020-B-Cohort 1	42/92	46%	25/92	27%	25/92	27%	17
	OXTYCAM3-2020-B-Cohort 2	109/133	82%	70/133	53%	70/133	53%	5
	OXTYCAM3-2020-B-Cohort 2 (sandy subplot NN)	40/69	58%	21/69	30%	21/69	30%	0
	OXTYCAM3-2020-C	291/350	83%	161/350	46%	161/350	46%	15
	OXYTCAM3-2022-D	14/40	35%	9/40	22%	9/40	22%	2
	OXYTCAM3-2022-E	10/11	91%	6/11	54%	6/11	54%	1
Dryland sedge	CAREXER-2020-D	75/105	71%	26/105	25%	7/105	7%	0

Species	Site Name	Survivorship		Maturity		Reproduction		Recruitment
		Survival in Relation to Total	Percent Survival	Flowering in Relation to Total	Percent Flowering	Seed Production in Relation to Total	Percent Seeding	Number of recruits observed
	CAREXER-2020-E	48/50	96%	46/50	92%	36/50	72%	0
Prairie buttercup	RANURHO-2021-A	13/17	76%	3/17	3/17	3/17	3/17	0
	RANURHO-2021-B	2/3	67%	1/3	33%	1/3	33%	3
	RANURHO-2022-C	9/9*	100%	7/9	78%	5/9	56%	0
Slender penstemon	PENSGRA-2020-A	25/25	100%	16/25	64%	15/25	60%	0
	PENSGRA-2020-B	8/25	32%	1/25	4%	0/25	0%	0
	PENSGRA-2021-C	19/20	95%	15/20	75%	15/20	75%	1
Rock selaginella	SELARUP-2021-A-Cohort 1	36/36*	100%	36/36	100%	36/36**	100%**	-**
	SELARUP-2021-A-Cohort 2	2/2*	100%	2/2	100%	2/2**	100%**	-**
Torrey's sedge	CARETOR-2021-A	7/8	88%	6/8	75%	6/8	75%	-
Sprengel's sedge	CARESPR-2020-A	2/2	100%	0/2	0%	0/2	0%	-
	CARESPR-2020-B	5/5	100%	1/5	20%	1/5	20%	-
	CARESPR-2021-C	1/1	100%	1/1	100%	1/1	100%	-

*Clumps of individuals; **Quantifying reproduction and recruits for this species is difficult – refer to section 3.4.7 for details.

3.4.2 Canada mountain-ricegrass (*Piptatheropsis canadensis)*

In 2023, Canada mountain-ricegrass were monitored at two sites (site IDs: PIPTCAN-2020-B and PIPTCAN-2023-C). At site ID: PIPTCAN-2020-B, five clumps containing Canada mountain-ricegrass that had been salvaged and translocated in 2020 were monitored on August 9, 2023. Out of the five clumps, one appeared to have survived, exhibiting both inflorescences and seeds. On September 6, 2023, interim monitoring was conducted at the newly planted site: PIPTCAN-2023-C (Plate 3.4-1). All three 1G plants were found to be present, with most of their seed heads browsed.

Plate 3.4-1. Sample of Canada mountain-ricegrass that was monitored at site ID: PIPTCAN-2023-C (September 6, 2023)

3.4.3 Davis' locoweed (*Oxytropis campestris* var. *davisii*)

Four Davis' locoweed sites were monitored between September 4 and 6, 2023: OXYTCAM3-2020-B, OXYTCAM3-2020-C, OXYTCAM3-2022-D, and OXYTCAM3-2022-E (Figure 3.3-2). At the time of monitoring, all Davis' locoweed that had produced stalks were at the seeding stage with seed pods observed to be present or absent. Where in previous years, all seed pods had opened and dispersed seed, in 2023, some pods were closed and appeared "mushy" (Plate 3.4-2).

Plate 3.4-2. Example of Davis' locoweed with "mushy" and closed pods

3.4.3.1 Site OXYTCAM3-2020-B

On September 4 and 5, 2023, 306 Davis' locoweed (from 2020 and 2022 plantings) were monitored (Plate 3.4-3 to Plate 3.4-5). Out of 294 monitored individuals, 191 (65%) had survived and 116 out of the 294 individuals (39%) were observed to have this year's stalks. Three microsites were planted at this site: a high bench cobble site (cohort 1), understory edge (cohort 2), and a sandy-gravellier site (cohort 2; subplot NN). Monitoring results for each microsite are summarized below.

From the first cohort (planted in 2020), 42 out of 92 monitored individuals (46%) had survived and 25 out of the 92 (27%) individuals were observed to have this year's stalks. Seventeen recruits were observed in cohort 1. From the second cohort (planted in 2022), 109 out of 133 monitored individuals (82%) planted in the understory edge had survived and 70 out of 133 individuals (53%) were observed to have stalks. Five recruits were observed in this cohort group. From the second cohort (planted in 2022) and planted in a sandier and gravellier microsite (subplot NN), 40 out of 69 monitored individuals (58%) had survived and 21 out of 69 individuals (30%) were observed to have stalks. No recruits were observed in this cohort group.

As seen in previous years, evidence of herbivory was observed, and a small number of individuals (12) were identified as the species *Oxytropis splendens* (showy locoweed; Plate 3.4-5). Additionally, insect bore holes were observed in the pods of one plant which may indicate another threat to seed production and maturity (Plate 3.4-6).

Plate 3.4-3. Example of Davis' locoweed plot (OXYTCAM3-2020-B-1G-CO2-PLCC: planted June 16, 2022) monitored September 4, 2023

Plate 3.4-4. Example of Davis' locoweed recruits (in yellow circles) near individual 091 (OXYTCAM3-2020-B-1G-6-CO1-091)

Plate 3.4-5. Examples of *O. splendens* (OXYTCAM3-2020-B-T1)

Plate 3.4-6. Suspected insect bore holes in seed pods (OXYTCAM3-2020-B-T2-CO1-018)

3.4.3.2 Site OXYTCAM3-2020-C

On September 4 and 5, 2023, 350 individuals out of 713 Davis' locoweed translocated in 2020 and 2022 were monitored in 2023. Eleven individuals were identified as the species *Oxytropis splendens* and have been excluded from the total. Due to high numbers of translocated individuals and limited time constraints, only a sample of the population was monitored. Monitoring was focused on the same subplots monitored in 2022 (cohorts 1-3) and an additional sample of cohort 4 planted in 2022. Effort was placed on sampling an adequate coverage of the population through all cohorts. Out of the 350 monitored, 291 survived (83%; Plate 3.4-7) and 161 individuals (46%) were observed to have seed heads. Fifteen recruits were observed in total (Plate 3.4-8). Evidence of herbivory was observed, and several plots exhibited relatively dense mats of clover growing between the transplants. In most instances, clover was removed during monitoring activities.

Plate 3.4-7. Example of Davis' locoweed plot (OXYTCAM3-2020-C-1G-CO2-PL16: planted June 12, 2021) monitored September 4, 2023

Plate 3.4-8. Example of Davis' locoweed recruit (in yellow circle) in plot 33 near individual 286 (OXYTCAM3-2020-C-50P-CO3-PL33-286)

3.4.3.3 Site OXYTCAM3-2022-D

On September 4, 2023, monitoring of the 40 translocated individuals (June 14, 2022, planting) at site OXYTCAM3-2022-D were conducted. Three individuals were identified as the species *Oxytropis splendens* and have been excluded from the total (Plate 3.4-9). Of the 40 individuals monitored, 14 survived (35%) and nine individuals had seed heads (22%). All pods that were present appeared to have opened and may have dispersed seed. Two recruits were observed.

During interim monitoring in the previous fall, many of the individuals appeared desiccated. This site was generally more exposed than other translocation sites (Plate 3.4-10). Grasses were prevalent, adjacent to the planting areas.

Plate 3.4-9. Example of suspected showy locoweed in plot 7 and showing low survivability of other individuals (OXYTCAM3-2023-D-PL7)

Plate 3.4-10. OXYTCAM3-2023-D planting area – note exposure

3.4.4 Dryland sedge (*Carex xerantica*)

Dryland sedge at CAREXER-2020-D and CAREXER-2020-E were monitored on August 9, 2023. At site CAREXER-2020-D, 75 out of 105 (71%) individuals were observed to be present (Plate 3.4-11). Twenty-six of the individuals (25%) had green stalks (culms) with or without inflorescences and seven individuals (7%) had stalks producing viable achenes (fruit bearing seed). At site CAREXER-2020-E, 48 out of 50 (96%) individuals were present (Plate 3.4-12). Forty-six of the individuals (92%) had green stalks and 36 individuals (72%) had stalks producing viable achenes.

Plate 3.4-11. Example of dryland sedge monitored at site ID: CAREXER-2020-D (tag 68) – August 9, 2023

Plate 3.4-12. Example of dryland sedge monitored with seed heads at site ID: CAREXER-2020-E (tag 009) – August 9, 2023

3.4.5 Prairie buttercup (*Ranunculus rhomboideus*)

Three prairie buttercup sites were monitored: RANURHO-2021-A, RANURHO-2021-B on June 10, 2023, and RANURHO-2022-C, on June 7, 2023. Interim monitoring occurred on August 11-12 and September 6, 2023, at the two new prairie buttercup recipient sites at Leahy Pit Road and the Beatton Valley Trails. The plants at these locations were also watered on both occasions.

Monitoring was conducted at site RANURHO-2021-A June 10, 2023. Thirteen of the 17 individuals monitored survived. Three of the surviving individuals had inflorescences and seed heads. No recruits were observed during monitoring (three recruits had been observed in the previous year). Two wire cages that were flattened in previous years were fixed. However, one wire cage was not fixed because a prairie buttercup was growing through the flattened cage. To improve future monitoring efforts, the cage will be replaced or removed (carefully with wire cutters in the spring or in the late fall when the plants have died down).

Plate 3.4-13. Example of prairie buttercup foliage observed during monitoring June 10, 2023

Plate 3.4-14. Example of prairie buttercup seedhead observed during monitoring June 10, 2023

Plate 3.4-15. Crushed wire cage (the seed head pictured above was growing through the wire)

Monitoring occurred at site RANURHO-2021-B on June 10, 2023. The collars that had been installed previously around the plants had been torn out of the ground. The collars were re-installed with longer ground staples to keep the collars in place. Two of the three individuals monitored (67%) survived and were in good condition (Plate 3.4-16 and Plate 3.4-17). One individual showed an inflorescence (Plate 3.4-17). A total of three recruits were identified in the vicinity of the parent plant (Plate 3.4-18).

During a follow up visit on September 6, 2023, the collars had been torn out of the ground again and individuals were showing fall dieback (Plate 3.4-19).

Plate 3.4-16. Sample of prairie buttercup on June 10, 2023 (site ID: RANURHO-2021-B)

Plate 3.4-17. Sample of prairie buttercup with inflorescence on June 10, 2023 (site ID: RANURHO-2021-B)

Plate 3.4-18. Example of prairie buttercup recruit observed on June 10, 2023 (site ID: RANURHO-2021-B)

Plate 3.4-19. Sample of prairie buttercup on September 6, 2023, showing fall die back (site ID: RANURHO-2021-B)

At the new recipient site: RANURHO-2023-D (Leahy Pit Road location) on September 6, 2023, two out of five individuals survived at subsite 1A (Plate 3.4-20) and one out of five individuals survived at subsite 2A (Plate 3.4-21). On a follow up site visit on August 11, 2023, plants were watered. However, most of the collars had been chewed by an animal, likely a bear and all of the plants found absent in September had been torn out of the ground (Plate 3.4-22 and Plate 3.4-23). The installation of wire cages at this location may be more effective on surviving prairie buttercup as the wire cages could be more challenging for wildlife to remove.

Plate 3.4-20. Sample of surviving prairie buttercup on September 6, 2023 (site ID: RANURHO-2023-D-1A)

Plate 3.4-21. Sample of surviving prairie buttercup on September 6, 2023 (site ID: RANURHO-2023-D-2A)

Plate 3.4-22. Sample of planting hole where a prairie buttercup had been torn out – observed during interim monitoring August 11, 2023 (site ID: RANURHO-2023-D-2A)

Plate 3.4-23. Chewed plant collar (site ID: RANURHO-2023-D-2A)

At site RANURHO-2022-C, on June 6, 2023, there were natural and anthropogenic disturbances observed on the crown parcel since the last visit. An electric fence had been installed and cattle were found to be grazing in the area. Trees and shrubs in the vicinity had been felled by beavers and chain saw (Plate 3.4-24). Despite the disturbances, all nine of nine clumps of prairie buttercup that were salvaged and translocated in 2022 had surviving individuals. Seven of the clumps had inflorescences (78%) and five of the clumps (56%) had inflorescences with developing achenes (Plate 3.4-25). Many of the fruiting heads had been browsed, however. It is uncertain how long these disturbances will persist and how the translocated plants will be affected. The need for protection from herbivory will be evaluated in 2024.

Plate 3.4-24. Felled aspen within monitoring site: RANURHO-2022-C (June 6, 2023)

Plate 3.4-25. Developing achenes on a monitored adult prairie buttercup at site: RANURHO-2022-C (June 6, 2023)

3.4.6 Slender penstemon (*Penstemon gracilis*)

Slender penstemon at PENSGRA-2020-A and PENSGRA-2020-B were monitored on August 9, 2023, and the slender penstemon at PENSGRA-2021-C (near Hudsons' Hope) were monitored on June 12, 2023.

All 25 individuals planted at PENSGRA-2020-A in 2020 were assessed and had survived (100%; Plate 3.4-26). Sixteen of the individuals were observed to have inflorescences (64%) and 15 of the individuals (60%) had capsules producing viable seeds. Of the 25 individuals planted at PENSGRA-2020-B, eight survived (32%; Plate 3.4-27) and one of the survivors (4%) produced inflorescences.

Plate 3.4-26. Sample of slender penstemon (tags 037-040) with inflorescences and developing seed pods at site PENSGRA-2020-A (August 9, 2023)

Plate 3.4-27. Sample of slender penstemon floret monitored at site PENSGRA-2020-B (August 9, 2023)

At site PENSGRA-2021-C cohort 2 (individuals planted on the aeolian cap), 19 out of 20 plants (95%) were present on June 12, 2023, in which 15 out of 20 plants (75%) contained inflorescences (Plate 3.4-28). One recruit with inflorescences was observed near individual 054. Overall, individuals were doing well, however, some of the leaves looked wilted and desiccated due to the hot and dry conditions (Plate 3.4-29). Water was provided to each of the plants after monitoring was completed. Cohort 2 was nursery-grown and translocated in a shadier portion of the upper slope that contained stone-free aeolian soils, which may have helped retain moisture, thereby contributing to the survival of these plants.

While monitoring samples of the salvaged rock selaginella plantings, efforts were also made to detect survival of any salvaged penstemon that had been interplanted with the selaginella in 2021. There were no penstemon detected and the low survival rate was expected due to transplant stress and the 2021 heat dome that followed.

Plate 3.4-28. Example of an adult slender penstemon (cohort 2) with flower heads

Plate 3.4-29. Example of slender penstemon (cohort 2) showing desiccation in the leaves

3.4.7 Rock selaginella (*Selaginella rupestris*)

All of the monitored rock selaginella that had been interplanted with slender penstemon at site SELARUP-2021-A appeared to have survived translocation (Plate 3.4-30 to Plate 3.4-33). Out of 36 clumps of selaginella observed on June 12 and September 5, 2023, all 36 clumps were alive. All selaginella showed dormant foliage (yellowish green) in June (Plate 3.4-32), however, all selaginella had green foliage when observed in September (Plate 3.4-33).

Rock selaginella can reproduce vegetatively (via adventitious roots) as well as sexually (via spores). Quantifying reproductive success is difficult in this species due to challenges in identifying recruits and its more complex life cycle. Spores have been observed ripening and dispersing in early June, however, new sporophytes (recruits) may not be visible until further developed (M. Krichbaum, personal communication, May 31, 2021). Observing recruits formed from fragmented and dispersed individuals is possible, however, distinguishing a recruit from the parent individual over a large area of translocated selaginella would be very challenging. Because the visual condition of selaginella can vary widely within a season depending on environmental conditions, tracking growth over a short period of time would require a substantial investment.

Plate 3.4-30. Example of rock selaginella tag 096 (cohort 2) on June 12, 2023

Plate 3.4-31. Example of rock selaginella tag 096 (cohort 2) on September 6, 2023

Plate 3.4-32. Example of rock selaginella tag 016 (cohort 1) on June 12, 2023

Plate 3.4-33. Example of rock selaginella tag 371 (cohort 1) on September 6, 2023

3.4.8 Torrey's sedge (*Carex torreyii*)

Monitoring occurred at Site CARETOR-2021-A on June 10, 2023, and at CARETOR-2023-B and CARETOR-2023-C on August 11-12 and then on September 6, 2023.

At site CARETOR-2021-A, seven out of eight individuals (88%) survived, and six out of eight (75%) had inflorescences (Plate 3.3-22). Despite the dry site conditions, all individuals appeared to be in very good health (Plate 3.4-34 and Plate 3.4-35).

Plate 3.4-34. Example of adult Torrey's sedge (tag 084) at site CARETOR-2021-A on June 10, 2023

Plate 3.4-35. Example of adult Torrey's sedge inflorescences (tag 084) at site CARETOR-2021-A on June 10, 2023

At sites CARETOR-2023-B (Leahy Pit Road location) and CARETOR-2023-C, all twenty Torrey's sedge were present on September 6, 2023 (Plate 3.4-36 and Plate 3.4-37). Zip tie collars placed around newly translocated Sprengel's and Torrey's sedge appeared to be effective and may be applied to individuals in the future.

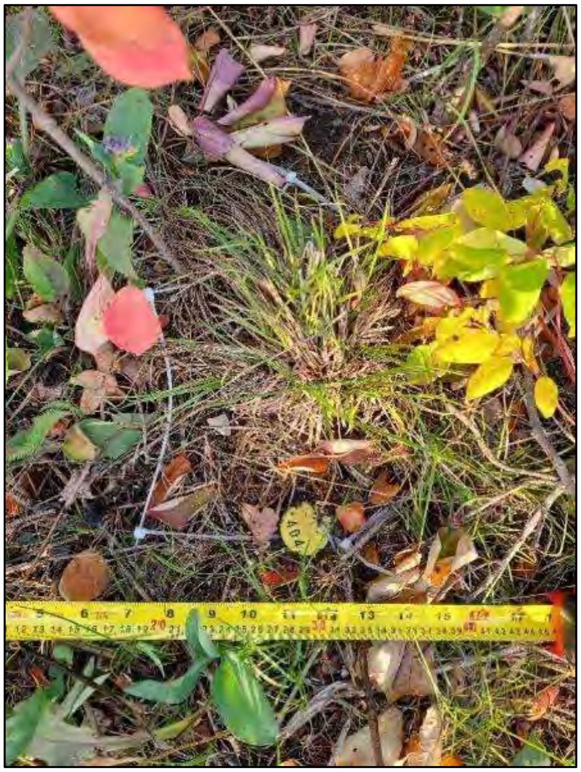


Plate 3.4-36. Example of adult Torrey's sedge inflorescences (tag 404) at site CARETOR-2023-B-1A on September 6, 2023

Plate 3.4-37. Example of adult Torrey's sedge inflorescences (tag 414) at site CARETOR-2023-C-2A on September 6, 2023

3.4.9 Sprengel's sedge (*Carex sprengelii*)

Population monitoring of Sprengel's sedge was conducted at three sites: CARESPR-2020-B-1A, CARESPR-2020-B-1B, and CARESPR-2021-C in June, followed by an interim check up on September 6, 2023. The newly planted Sprengel's sedge at sites CARESPR-2021-C (cohort 2), CARESPR-2023-D (Leahy Pit Road location), and CARESPR-2023-E (Beatton Valley Trails location) were watered and checked on August 11-12 and September 6, 2023.

On June 12, 2023, at site CARESPR-2020-B-1A, two out of two monitored individuals survived, with no inflorescences observed (Plate 3.4-38). On June 10, 2023, at site CARESPR-2020-B-1B, five out of five individuals monitored were present, with one individual having produced inflorescences (Plate 3.4-39). The one individual at site CARESPR-2021-C also contained inflorescences observed on June 9, 2023 (Plate 3.4-40). The interim monitoring results on September 6, 2023, remained similar except for lower plant condition scores and less inflorescences detected, which would be expected late in the season. CARESPR-2020-B-1A was not re-visited in the fall due to safety concerns associated with a moose frequenting the area.

Sprengel's sedges at all three sites (CARESPR-2021-C, CARESPR-2023-D, and CARESPR-2023-D) were observed to be present and in good condition during the September 6, 2023, interim monitoring (Plate

3.4-41 to Plate 3.4-43). Zip tie collars placed around newly translocated Sprengel's and Torrey's sedge appeared to be effective and may be applied to individuals in the future.

Plate 3.4-38. Example of adult Sprengel's sedge (tag 001) at site CARESPR-2020-B-1A on June 12, 2023

Plate 3.4-39. Example of adult Sprengel's sedge with inflorescences (tag 003) at site CARESPR-2020-B-1B on June 10, 2023

Plate 3.4-40. Example of adult Sprengel's sedge with inflorescences (tag 425) at site CARESPR-2021-C (cohort 1) on June 9, 2023

Plate 3.4-41. Example of adult Sprengel's sedge at site CARESPR-2023-D-1A on September 6, 2023

Plate 3.4-42. Example of adult Sprengel's sedge at site CARESPR-2023-E on September 6, 2023

Plate 3.4-43. Example of adult Sprengel's sedge at site CARESPR-2021-C (cohort 2) on September 6, 2023

3.5 PRELIMINARY ANALYSIS

Monitoring data collected from active sites since 2020 have been organized into a cumulative dataset in preparation for more detailed analysis in 2024. Data preparation involved a check for data completeness and consistency in numerical and categorical values between various years and data collectors. Data categories were organized further into discrete groups: site, species, cohort, and plant size. A major objective will be to compare annual data within and between sites to identify trends in survivability, maturity, reproduction, and recruitment between sites for each species.

3.6 YEAR IN REVIEW

This section summarizes what was achieved in 2023 from goals established at the end of year 2022. The goals and efforts taken for 2023 are summarized in Table 3.6-1.

Table 3.6-1. Summary of goals achieved in 2023

2022 Goals	Achievement Status	Details
Focus propagule collection efforts on Torrey's sedge, since both *in-situ* and *ex-situ* collection efforts were unsuccessful in 2022.	Ongoing	Torrey's sedge propagules were not collected in 2023; however, the goal of generating a target of 50 Torrey's sedge plants has been communicated with the native plant nursery in 2023.

2022 Goals	Achievement Status	Details
Generate new plants from the Canada mountain-ricegrass seeds at native plant nurseries.	In Progress	The goal of generating a target of 100 Canada mountain-ricegrass plants has been communicated with the native plant nursery in 2023.
Enhance further proliferation of rock selaginella cuttings in the nursery.	In Progress	Cuttings from existing trays were used to further propagate rock selaginella in 2023.
Generate a seed bank and new stock for species with lower germination rates (i.e., Torrey's sedge).	Ongoing	The goal of generating a target of 50 Torrey's sedge plants has been communicated with the native plant nursery in 2023.
Translocation efforts will continue to focus on distributing plants across a larger number of recipient sites to build resilience into the program and help alleviate the impacts of stochastic events (e.g., floods, fires, landslides) on the overall program objectives.	✓	Four species (Sprengel's sedge, Torrey's sedge, prairie buttercup, and Canada mountain-ricegrass) were planted across two new locations in 2023 (see Section 3.3: Translocation Implementation for further details).
Translocation will occur in the spring for those species that naturally occur in dryland habitats to facilitate establishment and survivability when moist conditions are more readily available.	✓	All translocation occurred in the spring; however, the spring season of 2023 was also unseasonably dry.
Understand facets of population dynamics of select target species through statistical analysis.	In Progress	The multi-year dataset has been quality checked and is ready for the analysis.
Improve the detectability of species using alternate markings that are more visible throughout the entire growing season.	✓	Zip tie collars were placed around all Sprengel's and Torrey's sedge translocated in 2023.
Identify opportunities for improvement within an adaptive management framework.	✓	Ongoing maintenance to previously installed cages and collars, weed removal, and watering are some of the opportunities identified in 2023. See section 3.7: Plan Forward for further details.

3.7 PLAN FORWARD

Knowledge gained from the program is being used to inform improvements to project methods and management to increase the likelihood of translocation success.

Propagation efforts will continue to focus on 1) generating new plants from the Canada mountain-ricegrass seeds at the native plant nursery; 2) enhancing further proliferation of rock selaginella cuttings in the nursery; and 3) generating a seed bank and new stock for Torrey's sedge.

Translocation efforts will continue to focus on distributing plants across a larger number of recipient sites, further building resilience into the program against the impacts of stochastic events. In addition, translocation will occur in the spring, when moist conditions are more readily available, for those species that naturally occur in dryland habitats to facilitate establishment and survivability.

Future efforts will continue to focus on improving detectability of species through measures such as coloured tags and flagging that is discernible throughout the various seasons. Re-flagging routes and plot numbers will be conducted as needed to improve monitoring efforts. Additional measures may include collars around individual plants with low detectability (i.e., Canada mountain-ricegrass and prairie buttercup).

Herbivory will be addressed thru continued use of rose collars, wire cages and other fencing alternatives, where needed.

The selection of the appropriate analytical and statistical paradigm to evaluate the key factors such as survival, maturity, and reproduction is in progress and will depend on a number of factors, including the number of sites deemed appropriate for translocation (and, therefore, the number of replicates) and the number of seeds/propagules/seedlings available for transplant and monitoring. As all phases of the program work concurrently, opportunities for improvement will be identified within an adaptive management framework throughout the remaining lifespan of the program.

The translocation of all species that specialize in drier habitats were prioritized in the spring or during a wetter season, if forecasted, to improve survivability and establishment. Although the spring of 2023 was unseasonably dry, efforts were made to water the translocation sites as much as feasible. Increased watering and improving means of water retention (e.g., use of mulch, prioritizing planting areas with more cover) may be required if drier conditions persist.

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APPENDIX A. SITE C EXPERIMENTAL TRANSLOCATION PROJECT: POTENTIAL RECIPIENT SITE SELECTION METHODS & RESULTS MEMO

MEMO

Date: November 9, 2023

To: Natasha Bush (EcoLogic)

From: Randy Krichbaum (Eagle Cap), Margaret Krichbaum (Eagle Cap)

Subject: Site C ERPT Program: Potential Recipient Site Selection Methods & Results

Introduction

An important component of the Site C Experimental Rare Plant Translocation (ERPT) program is the selection of suitable recipient sites for planting of propagules collected from the project activity zone. Program planning in the spring of 2023 identified a need for additional recipient sites to accommodate the propagules available for outplanting. This memo outlines the methods and results of the recipient site selection work performed in 2023.

The goal of this work was to locate and document suitable recipient sites for planting of rare plant propagules (seeds, achenes, spores, and started plants). The sites needed to meet a number of criteria regarding habitat (both biotic and abiotic components), accessibility, and geographic location.

Methods

Prefield Review

A prefield review was conducted to identify and delineate possible recipient areas for later verification in the field. The review followed a structured workflow designed to locate the optimal planting locations based on the desired site characteristics.

A team of two qualified botanists completed the majority of the prefield and field portions of this work, in consultation with the ERPT program manager. The botanists have performed extensive rare plant work in the BC Peace River area, and as such are familiar with both the habitat requirements of rare species and the logistics of working in the Peace Region.

Three of the nine taxa currently in the ERPT program were selected by the program manager as 2023 target species in need of additional recipient sites for translocation:

- *Carex sprengelii* (Sprengel's sedge)
- *Carex torreyi* (Torrey's sedge)
- *Ranunculus rhomboideus (prairie buttercup)*

In addition, a new species, *Drymocallis arguta* (tall wood beauty) was added to the ERPT program in 2023, after having been added to the Blue-list of provincial rare plant taxa by the BC Conservation Data Centre (BCCDC) in late July of 2022. Although future plans for the treatment of tall wood beauty within the ERPT program are still under discussion, it was decided that a limited number of potential recipient sites for the species should be identified to allow early season seed trials and possible salvage to occur in 2024 if desired.

The project botanical team met in March 2023 to review the target species list and define desired recipient site characteristics for each of the four taxa. Each desired site characteristic was also assigned a weighting to reflect its relative importance to successful propagule establishment. This allowed for the potential recipient sites to be ranked for suitability following the field visits.

The prefield review identified thirteen desirable characteristics of the potential recipient sites. While no potential recipient site can meet all of the listed criteria, the intent of the work was to locate the best possible sites given the limitations present. An ideal site would have the following characteristics:

- contain suitable high-quality habitat for the specific rare plant taxon
- be located in the Peace River region of BC
- be located on land owned by BC Hydro or on Crown land
- not be located on lands requiring access through a locked gate or other owner permission
- not be located in the Site C Project Activity Zone (PAZ)
- not be located below the reservoir preliminary Erosion Impact Line (EIL - a precautionary estimate of the amount of erosion that could occur over a 100 year period)
- be accessible by road or boat during the entire growing season
- have a low likelihood of future disturbance
- have a low percentage of non-native plants
- have good cell service
- be more than one kilometre from known occurrences of the same taxon
- not contain known occurrences of other rare plant taxa
- be close to a source of water

A literature review was conducted for each of the ten species in the 2023 ERPT program to evaluate any new information relevant to the translocation work. This included checks of recent BCCDC information to uncover any new element occurrences or changes to rare status, and a Google Scholar search for literature on the 10 species published since 2022. The review supplemented literature searches conducted in previous years for the translocation project. Queries were also run on the project rare plant database to uncover apparent habitat associations for the four 2023 target species based on updated field data.

The habitat needs for the four target taxa were then reviewed and grouped into three types, in order to aid in the visual evaluation of aerial imagery:

1. moist, shrubby or wooded, level to moderate slope, shading open to full, aspect variable, densely vegetated, may dry out later in season, relatively rich clay/silt soil

2. mesic to dry, open, south-facing hillcrest or gentle slope; relatively dense low-shrub grassland vegetation with a green-coloured appearance

3. moist to dry, shrubby to open, level to sloped, aspect variable, fair to good condition native low- to mid-height shrub grassland or edges of deciduous or mixed woodlands

Using the list of desired site characteristics, the three habitat grouping types, and other collected information, Geographic Information System (GIS) layers were visually examined and potential recipient sites were selected. Primary GIS layers used for this phase of the prefield review were:

- aerial imagery of the BC Peace River region;
- property ownership provided by BC Hydro;
- known element occurrences of the target taxa;
- potential recipient sites documented in previous years;
- the Site C Project Activity Zone; and
- the preliminary Erosion Impact Line.

Field Verification

Once recipient areas had been marked in the GIS, selected sites were inventoried in the field to determine suitability. Suitable Potential Recipient Sites (PRS) were evaluated and documented, with the data entered into a digital form for later analysis. Data elements collected included all those typically required by the BCCDC to document rare vascular plant element occurrences, as well as ratings for each of the thirteen desired site characteristics.

In addition to the vegetation composition and cover data recorded for the overall site, in certain cases three supplemental one-metre-square vegetation plots were placed in representative locations. Species codes, with their associated percent covers, were recorded on a paper form for later analysis.

Potential Recipient Sites were selected partially based on distance to other planting sites, with the aim of distributing them over a wide geographical extent. In some instances, a site was found to contain suitable habitat for several ERPT program species in close proximity, and multi-species PRS plots were completed. While this does provide the option to plant multiple species at the same site, with the consequent increased risk of a single disturbance event impacting multiple species, the limited number of suitable sites available for some of the program species necessitated using one site for several species in some cases. In addition, several of the program species occur together in wild populations.

Results

Prefield Review

The literature search uncovered three recent references containing information potentially relevant to the translocation of the ERPT program species.

- *Structure, Function and Drought Resilience of Northern Prairie Communities, 50 Years After Grazing Disturbance (Robertson 2023)*

- *Local Adaptation of Blue Penstemon: Molecular and Morphological Characterizations of a Potential Restoration Species for the Northern Basin and Range and Snake River Plain (Stettler 2022)*

- *The role of aftercare in plant translocation (Corli et al. 2023)*

The queries run on the Site C rare plant database to identify habitat associations for the four 2023 target species needing recipient sites returned two helpful correlations that may have not been otherwise noted. These refine the correlations uncovered during previous years' prefield reviews and are:

- For *Drymocallis arguta*: most occurrences where a specific aspect was recorded (17 of 22) were located on south-facing slopes (SW to SE); and most occurrences where slope was recorded (22 of 33) were on gentle slopes (5° or less).

- For *Carex torreyi*: most occurrences where a specific aspect was recorded (8 of 9) were located on south-facing slopes (SW to SE).

A total of eight planting areas that appeared to have a high likelihood of meeting the requirements for recipient sites were selected from the examination of the GIS layers. The most weight was given to the *appropriate habitat types* and *ease of legal access* criteria. Two planting areas appeared to contain habitat specific to only one rare taxon, but the remaining areas were thought to contain habitat for multiple rare taxa. Not all potential planting areas in the BC Peace Region were considered; rather the review focussed on areas that appeared to be easily accessible by road from Fort St. John. Therefore, if additional potential recipient sites are required in the future, the as-yet unreviewed portions of the BC Peace region remain for consideration.

A unique PRS point was then generated for each planting area microsite thought to have suitable habitat for translocation of one of the four 2023 target species. These points were intended to speed the field verification work by directing the surveyors' effort on the ground towards microsites of the best quality habitat. There was no expectation that every PRS point would be field checked, and the exact location for each actual PRS plot was to be decided in the field after a cursory area survey.

Nearly half of the PRS points used for the 2023 recipient site evaluation work had been generated previously, in the prefield reviews completed in 2019, 2020, 2021, and 2022 for the project. A number of new PRS points were required for the four 2023 target taxa: one new point was generated for Carex *sprengelii*, two new points each were generated for *Carex torreyi* and *Drymocallis arguta*, and three points were generated for *Ranunculus rhomboideus.*

Field Verification

The team of two botanists performed the field verification work between June 7 and 12, on August 9, and on September 8 and 12, 2023. In preparation, the eight selected planting areas were grouped according to the general access route to allow for efficient survey days. Of the eight planting areas delineated, seven received either complete or partial field checks in 2023 (Table 1). All areas were reached by road from Fort St. John, with the closest area located approximately seven kilometres away, and the farthest area approximately 85 km from the town.

The single planting area not field checked in 2023 had been field checked previously and has already had plots completed.

Table 1: ERPT Potential Planting Areas Considered in 2023

Planting Area ID	Field Checked 2023?	Field Check Date(s)	Details
15	yes	2019-06-02, 2022-06-10, 2023-06-07	Plots completed in 2022; Removed from Consideration in 2023
17	no	2019-08-10, 2020-07-30, 2022-06-09, 2022-07-28	Plots completed in 2019, 2022; Set Aside for Future Consideration
30	yes	2019-06-07, 2020-06-04, 2021-06-11, 2022-06-10, 2023-06-08	Plot completed in 2022; Set Aside for Future Consideration
34	yes	2020-06-05, 2021-06-11, 2022-06-12, 2023-08-09	Plots Completed in 2020, 2021, 2022, 2023
40	yes	2020-06-07, 2021-06-13, 2022-07-28, 2023-06-12	Plots Completed in 2020, 2022, 2023
58	yes	2022-06-11, 2022-07-28, 2023-06-10	Plots Completed in 2022, 2023
59	yes	2023-09-08	Plot Completed in 2023
60	yes	2023-09-12	Plot Completed in 2023

The seven field checks produced the following results:

- one planting area was removed from consideration (area has been fenced and grazing cattle were present);
- one planting area was set aside for future consideration; and
- five planting areas were considered to be worth investigating further.

A survey of each of the five "best choice" planting areas was performed, and a total of eight PRS plots were completed (Table 2). Supplemental planting locations were also marked in suitable habitat near the PRS plots, where appropriate, to provide options for the planting crew.

It should be noted that during the course of the field verification surveys, thirteen new rare plant sites were discovered: nine patches of *Drymocallis arguta*, two patches of *Ranunculus rhomboideus*, and one patch each of *Carex torreyi* and *Penstemon gracilis.*

Table 2: Potential Recipient Site Plots 2023

PRS Site ID	*Taxon*	Habitat	Survey Date	Area (sq m)
PRS-2023-001	*Carex torreyi, Ranunculus rhomboideus*	Shrub-grassland interface	2023-06-10	90,000
PRS-2023-002	*Carex sprengelii*	Moist woodland	2023-06-10	10,000
PRS-2023-003	*Carex torreyi, Ranunculus rhomboideus*	Shrub-grassland interface	2023-06-12	50
PRS-2023-004	*Carex torreyi, Ranunculus rhomboideus*	Shrub-grassland interface	2023-06-12	250
PRS-2023-005	*Carex sprengelii*	Moist wooded gully	2023-06-12	50
PRS-2023-006	*Carex sprengelii*	Moist woodland	2023-08-09	16
PRS-2023-007	*Drymocallis arguta*	Open shrub-pine woodland	2023-09-08	400
PRS-2023-008	*Drymocallis arguta*	Shrub-grassland interface	2023-09-12	300

Discussion

The goal of the work was to locate two suitable recipient sites for each of the current year's target taxa based on the 13 criteria listed in the Methods section above. During the course of the field verification, it became clear that the first 10 criteria were relatively easy to meet (that is, accessible planting areas outside of the Site C PAZ and EIL, on Crown or BC Hydro land near the Peace River, which contain appropriate rare plant habitat, low levels of both non-native plants and disturbance, and that have good cellular coverage).

However, the final three criteria proved much more challenging (planting areas greater than one kilometre from known sites of the same taxon, not already occupied by other rare plant species, and close to a source of water). While the prefield review specifically avoided known rare plant sites in choosing potential planting areas to evaluate, it was anticipated that new rare plant occurrences would be discovered since the goal was to target high-quality rare plant habitats. Thus, thirteen new rare plant sites were documented by the survey team during the field verification process in 2023. The surveyors attempted to avoid these new sites when placing PRS plots and marking supplemental planting locations, but this was not always possible: at three of the recommended planting sites, PRS plots had to be placed in the vicinity of other naturally-occurring rare plant populations. However, this compromise was accepted as reasonable considering that naturally-occurring multi-species rare plant sites are frequently found in the BC Peace region.

The final compromise for PRS plot placement, as anticipated, was that few of the sites could be said to have a source of water, since most PRS locations are on relatively dry shrub-grassland slopes generally found well above the Peace River and only rarely near year-round streams or springs. Of the eight plots completed in 2023, only three had a water source, as they were able to be placed within a 350 m drive of the Beatton River.

Therefore, given the above caveats, all eight locations where PRS plots were completed in 2023 do meet the majority of the requirements of an ideal recipient site. Three of the sites, all on Crown parcels near the Beatton River, contain habitat suitable for multiple species translocation, and multi-species plots were completed for *Carex torreyi* and *Ranunculus rhomboideus.*

The remaining five sites were specifically selected for single taxa; these plots were placed on either BC Hydro-owned land or Crown parcels from Lynx Creek to the Beatton River. Plots for *Carex sprengelii* and *Drymocallis arguta* were completed.

Closure

Reviewed and approved:

Randy Krichbaum M.Sc., R.P. Bio., P. Biol.
Senior Ecologist
Eagle Cap Consulting Ltd.

<Original signed and sealed November 9, 2023 at Calgary, Alberta>

References

Corli, A, G A Rocchetti, S Orsenigo, and J Possley. 2023. “The Role of Aftercare in Plant Translocation.” *Biodiversity and Conservation*, August. https://link.springer.com/article/10.1007/s10531-023-02703-x.

Robertson, Colleen. 2023. “Structure, Function and Drought Resilience of Northern Prairie Communities, 50 Years After Grazing Disturbance.” Master thesis, University of Winnipeg, Manitoba, Canada.

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APPENDIX B. DATA CAPTURE FORM – TRANSLOCATION

Experimental Rare Plant Translocation Program

ECOLOGIC	**TRANSECT / PLOT / INDIVIDUAL** **Data Capture Form**	SITE + T/P	[S-__________] +
		Data Sheet Tracking Number	

Data Recorder:		*Team:*	

TRANSECT / PLOT Level Information		**TRANSECT or PLOT**	*specify*	**ID:**	

Species Name	**Recipient Site Name**	**UTMZone**	**Easting**	**Northing**	**Elev. (m)**	**Plot Solocator Photos**
dd	dd					

Outplanting Conditions			**Nursery**	dd		
Date(yymmdd)	**Weather Cond**	**Ambient Temp (*C)**	**Date Removed**	**Plug Size (mm)**		**Growth Media**

TRANSECT or PLOT		**MAP**	Y/ N	**subPLOT Information**		
Dimensions (m x m)	**Shape & Orientation**	**Loc. of Map**		**subPlot ID**	**Dimensions (m x m)**	**subPL Photos**
		dd		dd		

General Comments

PLANT OBVS	*Example*
TAG NUMBER	94
Plant Presence	bsent
Plant Condition	dead
Inflorescences (#)	4
Seeds (#heads /pods)	1
Implem / Monitor	mon
Photos	meth
Height (cm)	3
Surf.Area cm2	200
%CV of Surf. Area	40
Soil Mositure	ories
Soil Temperature	deg C
Mulch Type	osses
Mulch Depth	2
MicroCatch Created	s / no
Damage1 Type	down
Damage1 Extent	down
Damage2 Type	down
Damage2 Extent	down
Damage3Type	down
Damage3 Extent	down
Planter (name)	Bush

Species	**Recip. Site**	**Nursery**	**Loc. of Map**	**subPlotID**	**Plant Presence**	**Plant Cond.**	**Inflorescences (#)**	**Seeds (#heads /pods)**
list	list	list	list	instructions	list	list	instructions	instructions

Experimental Rare Plant Translocation Program

Surf.Area cm2	%CV of Surf. Area	Mulch Type	Damage Type	Damage Extent
instructions	instructions	list	list	list

ECOLOGIC environmental consulting	MAP / SITE DIAGRAM	SITE + T/P	[S-__________] +
		Data Sheet Tracking Number	

Map Recorder:		*Team:*	

TRANSECT / PLOT Level Information		**TRANSECT or PLOT**	*specify T or P*	**ID:**	
Species Name	**Recipient Site Name**	**Slope (deg)**	**Aspect (T)**		
dd	dd			**Draw Slope Direct.**	**North Arrow**

General Comments

Draw site diagram here. Clearly illustrate locations of specific tag numbers.