

Site C Clean Energy Project Agriculture Monitoring and Follow-up Program 2018 Annual Report

*Prepared in accordance with the Agricultural Monitoring and Follow-up
Program (December 22, 2015)*

2018 Annual Report Submission Date: July 20, 2018

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1.0 Background

The Site C Clean Energy Project (the Project) is a hydroelectric dam and generating station under construction in northeast B.C. Construction started in July 2015 and will be in service in 2024. The Project will help meet future electricity needs by providing 1,100 megawatts of dependable capacity, and producing about 5,100 gigawatt hours of energy each year — enough to power the equivalent of 450,000 homes per year. Once built, the Project will be a source of clean, reliable and cost-effective electricity in B.C. for more than 100 years.

The key components of the Project are:

- Access roads and a temporary construction bridge across the river, at the dam site.
- Worker accommodation at the dam site.
- Upgrades to 240, 269, 271 and Old Fort roads.
- The realignment of six segments of Highway 29.
- Two temporary cofferdams across the river to allow for construction of the earthfill dam.
- Two new 500 kilovolt transmission lines connecting Site C to the Peace Canyon Substation, within an existing right-of-way.
- Shoreline protection at Hudson's Hope, including upgrades to DA Thomas Road.
- An 800-metre roller-compacted-concrete buttress to enhance seismic protection.
- An earthfill dam, approximately 1,050 metres long and 60 metres high above the riverbed.
- A generating station with six 183 MW generating units.
- An 83-kilometre-long reservoir that will be, on average, two to three times the width of the current river.

2.0 Environmental Assessment Certificate Conditions

Condition 31 of the Environmental Assessment Certificate requires the following:

“The Agriculture Monitoring and Follow-up Program must include at least the following:

Monitoring for Project-induced changes in wildlife habitat utilization, and evaluation of associated crop or feed storage damage for, agricultural operations within 5 km of the reservoir, to assess if there is an increase in wildlife-related crop depredation due to Project-related habitat losses. Monitoring must include pre- and post- reservoir filling field surveys, wildlife monitoring, farm operator interviews, and analysis of relevant records related to wildlife-related crop depredation.

Monitoring for Project-induced changes to humidity within 3 km of the reservoir, and evaluate associated effects on crop drying within this area. Monitoring must include collection and analysis of climate data, calculation of crop drying indices, and farm operator interviews.

Monitoring for Project-induced changes to groundwater elevations within 2 km of the reservoir (the area potentially influenced by groundwater elevation changes), and

evaluate associated effects on crop productivity. Monitoring must include field surveys and farm operator interviews.

Monitoring for climatic factors to estimate moisture deficits and to estimate irrigation water requirements in the vicinity of the reservoir to provide information for potential future irrigation projects. Data collection will be undertaken before reservoir filling, and in the 5 years after reservoir filling, and data will be reviewed as required for proposed irrigation projects.

The Agriculture Monitoring and Follow-up Program reports must be provided annually during the monitoring and follow-up period to affected agricultural land owners and tenure holders, and Ministry of Agriculture.

The results of the Agriculture Monitoring and Follow-up Program must inform the Farm Mitigation Plans.

Reporting must begin 180 days after the commencement of the monitoring and follow-up program that is to begin 180 days after commencement of construction.

The EAC Holder must provide this draft Agriculture Monitoring and Follow-up Program to the Ministry of Agriculture, Peace River Regional District and the District of Hudson's Hope for review within 90 days after the commencement of construction.

The EAC Holder must file the final Agriculture Monitoring and Follow-up Program with EAO, Ministry of Agriculture, Peace River Regional District and the District of Hudson's Hope within 150 days of commencement of construction.

The EAC Holder must develop, implement and adhere to the final Agriculture Monitoring and Follow-up Program, and any amendments, to the satisfaction of EAO."

3.0 Agriculture Monitoring and Follow-up Program Overview

BC Hydro described the approach required by the above condition in the Agriculture Monitoring and Follow-up Program ("AMAFP"), submitted as final on December 22, 2015. The program will now start a year later than originally planned due to the delay in reservoir filling by one year.

The project schedule was changed in Fall 2017 after the Annual Report for Year 2 was submitted. The updated project schedule can be found here:

<https://www.sitecproject.com/sites/default/files/project-construction-schedule-jan-2018.pdf>.

The AMAFP was developed and is being implemented in accordance with Condition 31 of Environmental Assessment Certificate #14-02, dated 14 October 2014 (the EAC), which was issued in respect of the Site C Clean Energy Project (the Project).

Monitoring plans within the AMAFP include:

- Wildlife Habitat Utilization Monitoring
- Monitoring Potential Effects on Crop Drying
- Monitoring Potential Groundwater Effects
- Monitoring to Estimate Irrigation Water Requirements

The Project’s Environmental Assessment assessed how the creation of the reservoir may result in site-specific changes that may affect agricultural operations on individual farm operations, and where Project effects on agricultural operations are not already addressed under agreements with BC Hydro. The agricultural monitoring and follow-up programs are included in the Site C EAC as Condition 31. The monitoring program results are to confirm if a Project change has occurred, and to evaluate the adverse effect on agricultural operations.

If adverse effects are identified in the results of the agricultural monitoring plans for Wildlife Habitat Utilization, Reservoir Induced Effects on Crop Drying, and Groundwater Effects, the data and analysis will be used to inform individual Farm Mitigation Plans. Results from the Monitoring to Estimate Irrigation Water Requirements Plan will be used to support future decisions regarding irrigation improvements, including support for potential projects that may be proposed under the agricultural compensation program.

The AMAFP stated that monitoring, analysis and reporting will be undertaken in accordance with the following schedule:

Phase Description	Timeline
Historical data review, Baseline ¹ data collection; New climate station siting and installation; Preparations for field survey, consultation and interviews.	<ul style="list-style-type: none"> January 2016 – December 2018
Data collection, field surveys, interviews, consultation, and data analysis.	<ul style="list-style-type: none"> Five Years Prior to Reservoir Filling (December 2018 - December 2023) Five Year Post Reservoir Filling (January 2024 - January 2029)
Annual and Final Reporting	<ul style="list-style-type: none"> July 2016 – July 2029

*Note: Dates updated in Fall 2017 after change in reservoir filling date

The AMAFP stated that annual reports on the implementation of the AMAFP will be submitted beginning on July 21, 2016 (360 days after commencement of construction). These reports will include a summary of monitoring plan implementation activities. The annual reports will be posted on BC Hydro’s website and notifications sent to affected agricultural land owners and tenure holders, and the Ministry of Agriculture.

4.0 Annual Report Time Period and Format

The July 20, 2018 AMAFP Annual Report for the four monitoring plans covers the time period from April 1, 2017 to March 31, 2018.

¹ Baseline data refers to the continued collection of data from existing climate stations and monitoring sites. As new stations and sites are added, and additional parameters are included at existing stations, this data will be incorporated into reporting as it becomes available.

The AMAFP Annual Report includes separate updates for each of the four plans including:

- Wildlife Habitat Utilization Monitoring Plan (Appendix A)
- Monitoring Potential Effects on Crop Drying Plan (Appendix B)
- Monitoring Potential Groundwater Effects Plan (Appendix C)
- Monitoring to Estimate Irrigation Water Requirements Plan (Appendix D)

Each of the four monitoring plan annual reports follows a similar format, which includes the following elements:

- Introduction
- Methods (Study Location and Activities)
- Results and Analysis
- Next Steps
- References

5.0 Summary of Results

As each of the monitoring programs is in the early phase of implementation there are not yet substantive results or analysis. A description of the status of planning for each program is provided below.

5.1 Wildlife Habitat Utilization Monitoring Plan

During the program establishment phase there are limited results or analysis required. In years one to three of the plan, annual reports provide a summary of activities including baseline data review, selection of monitoring sites for field surveys and preparation for farm operator interviews. In year 3, wildlife compensation program information from the Ministry of Agriculture was analyzed and farm operations were identified for potential inclusion in the program.

5.2 Monitoring Potential Effects on Crop Drying Plan

During the program establishment phase there are limited results or analysis required. In years one to three of the plan, annual reports provide a summary of activities including baseline data review, selection of monitoring sites for field surveys and preparation for farm operator interviews. In year 3, farm operations were identified for inclusion in the program. The climate stations are collecting information that will provide baseline information to support future analysis.

5.3 Monitoring Potential Groundwater Effects Plan

During the program establishment phase there are limited results or analysis required. In years one to three of the plan, annual reports provide a summary of activities including baseline data review, selection of monitoring sites for field surveys and preparation for farm operator interviews. In year 3, mapping analysis identified the 10 locations within the Project area that meet the geographical requirements (elevation, proximity) for inclusion in the program.

5.4 Monitoring to Estimate Irrigation Water Requirements Plan

During the program establishment phase there are limited results or analysis required. The climate stations are collecting information that will provide baseline information to support future analysis.

Appendix A. Wildlife Habitat Utilization Monitoring Plan

1. Introduction

The Site C Clean Energy Project's amended Environmental Impact Statement (BC Hydro. 2013) ("EIS") noted the potential for increased wildlife crop damage (Table 20.1) and identifies reservoir induced changes to wildlife presence in agricultural areas as a key indicator (Table 20.3).

EIS Section 20.7.2.1 (page 20-53, lines 12 to 14) states: "The loss of wildlife habitat in the reservoir may lead to an increase in wildlife in agricultural areas near the reservoir, which could lead to wildlife damage to crops and stored livestock feed for farm operations."

EAC Condition 31 states: "The Agriculture Monitoring and Follow-up Program must include monitoring for Project-induced changes in wildlife habitat utilization, and evaluation of associated crop or feed storage damage for, agricultural operations within 5 km of the reservoir, to assess if there is an increase in wildlife-related crop depredation due to Project-related habitat losses. Monitoring must include pre- and post-reservoir filling field surveys, wildlife monitoring, farm operator interviews, and analysis of relevant records related to wildlife-related crop depredation."

In accordance with EAC Condition 31, this monitoring plan is intended to determine if there are changes to the extent and severity of wildlife damage to crops and stored livestock feed after reservoir filling.

2. Methods

Study location: The monitoring study area includes agricultural lands within 5 km of the reservoir.

Activities: Activities included initial work on mapping, historical data collection, identification of farm operators for interviews and field survey locations, and consultation.

- Mapping: A map was created overlaying aerial orthophotography data and Agricultural Land Reserve (ALR) areas over the 5km study area boundary for the wildlife habitat utilization monitoring area. This map titled: "Wildlife Habitat Utilization Monitoring Area Identification Map" is included at the end of Appendix A.
- Historical data review: BC Hydro requested historical data on the extent and severity of wildlife damage to crops from the B.C. Ministry of Agriculture's Agriculture Wildlife Program relevant to the Peace River Region, and specifically within 5 km of the reservoir. The information received was reviewed. Additional more detailed and site specific information will be requested.

- Identification of farm operators for interview participation and field survey locations. The “Wildlife Habitat Utilization Monitoring Area Identification Map” identifies cultivated areas and farm yard areas, and agricultural land reserve areas within the 5km study area to assist in identifying and inviting farm operators to participate in annual interviews and field surveys. Selection of locations for field surveys and selection of operators to be interviewed may also be based in part on historical crop loss information and on reports of current crop loss or losses within feed storage areas.
- Consultation: Regional agricultural producers and associations were invited to participate in consultation regarding the Framework for the Agricultural Mitigation and Compensation Plan and the draft Agricultural Mitigation and Compensation Plan. Comments were reviewed to identify any wildlife impacts on agriculture. Information on wildlife impact was retained and applied to this monitoring plan as relevant.

3. Results and Analysis

During the program establishment phase there are limited results or analysis required. In years one to three of the plan, annual reports provide a summary of activities including baseline data review, selection of monitoring sites for field surveys and preparation for farm operator interviews. Wildlife compensation program information from the Ministry of Agriculture will be analyzed upon receipt.

4. Next Steps

Consultation, field surveys and interviews will be completed over 10 years, commencing in December 2018 (5 years prior to reservoir filling) and ending 5 years after reservoir filling in accordance with EAC Condition 31 requirements.

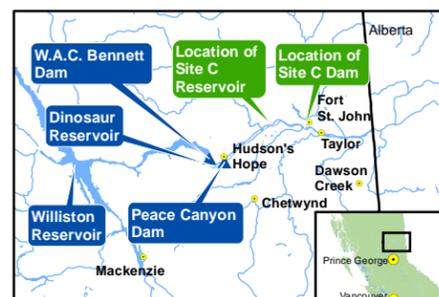
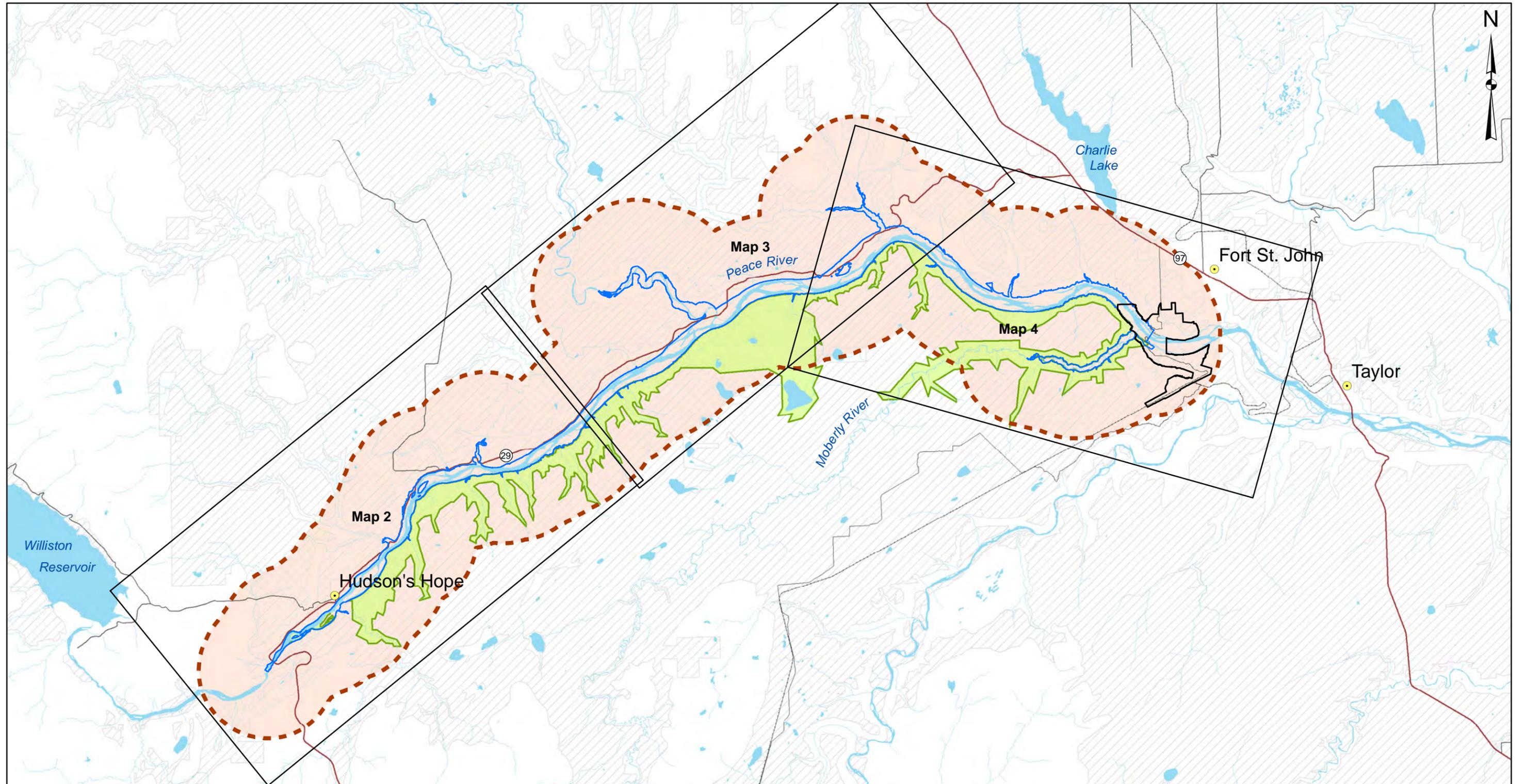
- Work will continue to obtain and review historical data from the B.C. Ministry of Agriculture’s Agriculture Wildlife Program.
- Identification of field survey locations will be completed with use of new maps developed and on site ground truthing, as required. Contacts will be identified, data collection sheets will be developed, and farm operators within 5 km of the reservoir will be invited to participate.
- Data Collection sheets will be finalized in order to record and analyze crop depredation events and will be distributed to participating farmers in 2019.
- BC Hydro is seeking to enter into a data sharing agreement with the Ministry of Agriculture for the purposes of the program.
- Efforts will be made to collaborate with associations, producer groups and government agencies that may have data or local knowledge related to this monitoring plan, including establishing an annual consultation with the Peace River Regional District Wildlife Committee, representatives of key provincial agencies, including the Ministry of

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Agriculture, Ministry of Environment, and Ministry of Forests, Lands and Natural Resource Operations, and interested producer groups to discuss the monitoring plan, findings, and possible modifications to the plan, as required.

5. References

- BC Hydro. 2013a, *Site C Clean Energy Project Environmental Impact Statement: Section 10 Effects Assessment Methodology*. Table 10.1 Spatial Boundary Descriptors.
- BC Hydro. 2013b, *Site C Clean Energy Project Environmental Impact Statement: Section 11.3 Land Status, Tenure and Project Requirements*.
- BC Hydro. 2013c. *Site C Clean Energy Project Environmental Impact Statement: Volume 3, Section 20 Agriculture*. Vancouver, BC.
- BC Hydro. 2013d. *Site C Clean Energy Project Environmental Impact Statement: Volume 3, Appendix D, Agricultural Assessment Supporting Documentation*. Vancouver, BC.
- BC Ministry of Agriculture: Crop Loss Damage Programs and Data Requests. 2015-2016. (Personal Communications)
- BC Ministry of Agriculture: Crop Loss Damage Due to Wildlife. Website (www2.gov.bc.ca/gov/content/industry/agriculture-seafood/programs/insurance-and-income-protection/crop-loss-damage-due-to-wildlife) Accessed February 2016.



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

Legend

- Area to be considered for wildlife habitat utilization monitoring
- Agricultural Land Reserve
- Proposed Reservoir
- Proposed Peace Boudreau Protected Area
- Dam Site Area
- Town
- Road
- Highway
- Railway

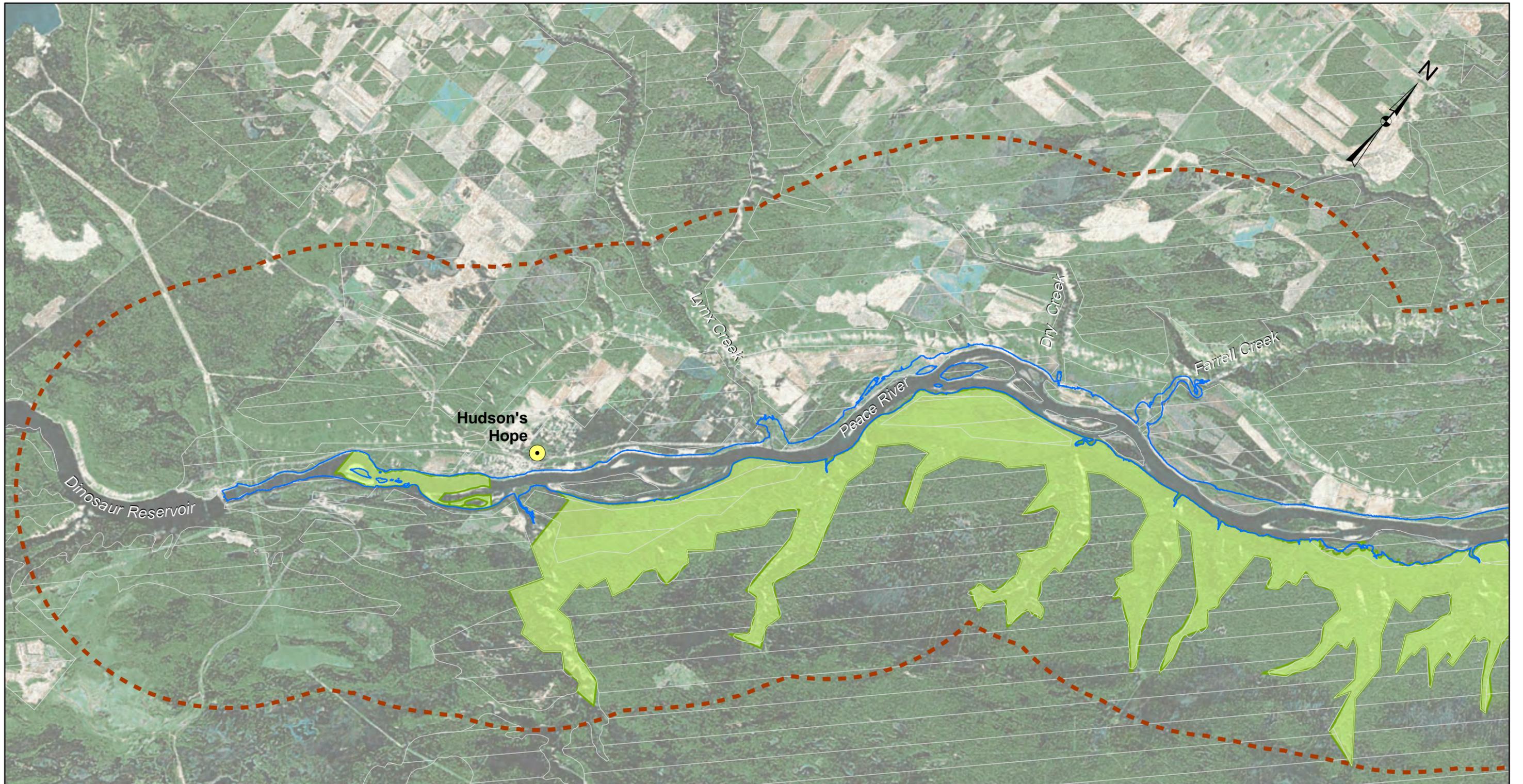
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Wildlife Habitat Utilization Monitoring Area Identification - Overview Map 1 of 4			
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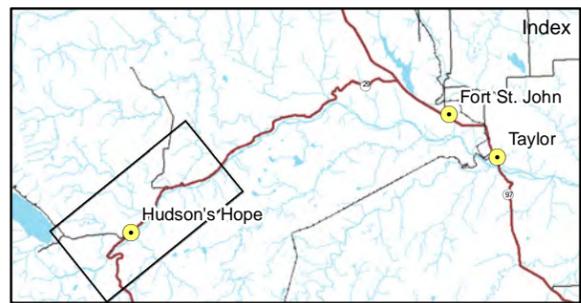
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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.



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Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos provided by ESRI
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

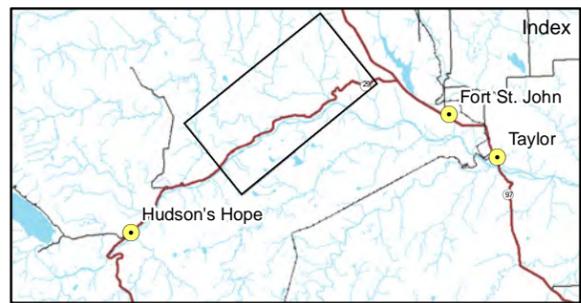
- Legend**
- - - Area to be considered for wildlife habitat utilization monitoring
 - Agricultural Land Reserve
 - Proposed Reservoir
 - Proposed Peace Boudreau Protected Area
 - Dam Site Area

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Wildlife Habitat Utilization Monitoring Area Identification - Map 2 of 4			
Date	July 14, 2016	DWG NO	1016-C14-07342-2 R 0



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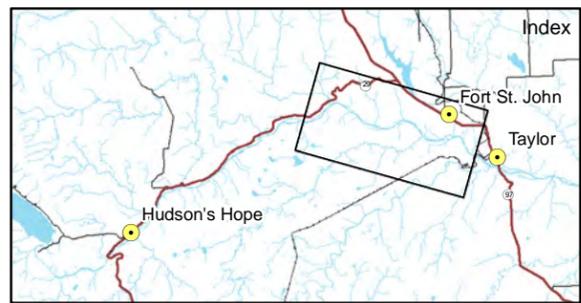
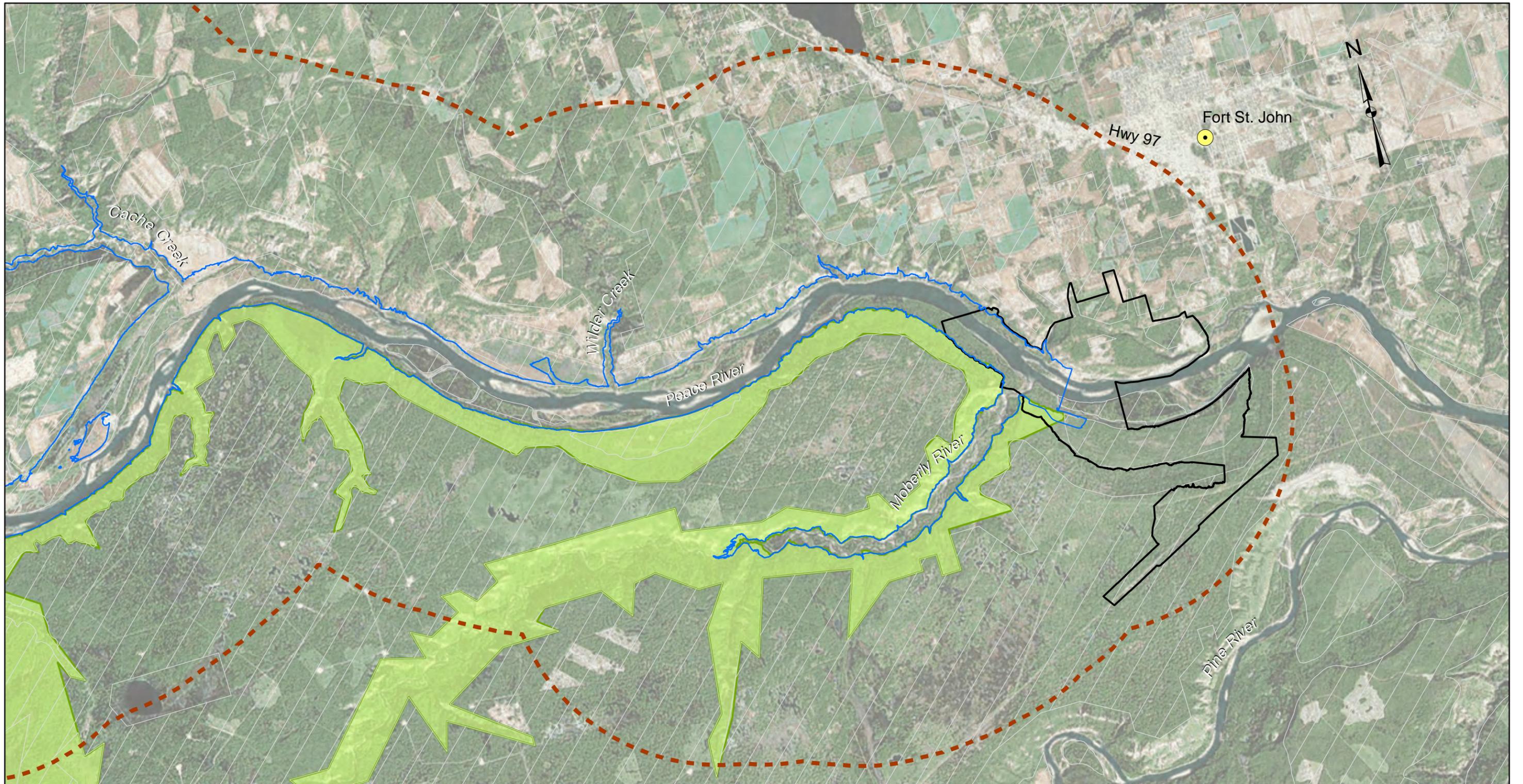
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 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos provided by ESRI
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

- Legend**
- - - Area to be considered for wildlife habitat utilization monitoring
 - Agricultural Land Reserve
 - Proposed Reservoir
 - Proposed Peace Boudreau Protected Area
 - Dam Site Area

1:90,000 0 2 km

**Wildlife Habitat Utilization
Monitoring Area Identification -
Map 3 of 4**

Date	July 14, 2016	DWG NO	1016-C14-07342-3	R 0
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Map Notes:
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 3. Base Data: Province of B.C.
 4. Orthophotos provided by ESRI
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

Legend

- Area to be considered for wildlife habitat utilization monitoring
- Agricultural Land Reserve
- Proposed Reservoir
- Proposed Peace Boudreau Protected Area
- Dam Site Area

1:90,000 0 2 km



Wildlife Habitat Utilization Monitoring Area Identification - Map 4 of 4			
Date	July 14, 2016	DWG NO	1016-C14-07342-4 R 0

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Appendix B. Monitoring Potential Effects on Crop Drying Plan

1. Introduction

The Site C Clean Energy Project's Environmental Impact Statement (BC Hydro. 2013) ("EIS") identifies reservoir induced changes to microclimate on adjacent agricultural operations as a key indicator (EIS Section 10, Table 20.3). Effect on crop drying is one reservoir induced change which may occur.

EIS Section 20.3.6 (page 20-50, lines 27 to 36) states: "Predicting the effect that the reservoir might have on crop drying is made difficult by the complexity of the effect of the reservoir on several climatic parameters that drive both drying and wetting effects. Generally, the RWDI model predicts increases in humidity up to 15% for stations located closely adjacent to the reservoir during the summer and fall months. The model predicts the effect on humidity during the summer and fall not to be statistically significant for locations not directly adjacent to the reservoir. The RWDI report predicts that effects on fog formation from the reservoir are in the order of 0.5% or less over the year. However, due to increased humidity, the reservoir could potentially have a small effect on crop drying during summer and early fall in the Peace River valley in areas adjacent to the reservoir."

EAC Condition 31 states: "The Agriculture Monitoring and Follow-up Program must include monitoring for Project-induced changes to humidity within 3 km of the reservoir, and evaluate associated effects on crop drying within this area. Monitoring must include collection and analysis of climate data, calculation of crop drying indices, and farm operator interviews."

In accordance with EAC Condition 31, this study is intended to determine if there are reservoir induced changes to the microclimate on adjacent farms which result in a negative effect on crop drying.

2. Methods

Study location: The plan includes the collection of climate data and information from interviews with operators of farms within 3 km of the reservoir to estimate the magnitude, if any, of adverse effects on crop drying.

Activities: Activities have included mapping, initial work on historical data review, baseline data collection, new climate station site planning, identification of farm operators for interviews and field survey locations, and consultation.

- Mapping: The following maps were created using aerial orthophotography data and Agricultural Land Reserve (ALR) data to support establishment of the monitoring plan:
 - 1) Climate Stations Map (See Appendix F - Climate Stations Map)
 - 2) Crop Drying Monitoring Area Identification (See Appendix B – Overview Maps 1 of 9)

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- Baseline Data Collection and Climate Station Management: Climate data was included in the EIS and baseline climate data continues to be collected using BC Hydro's Site C climate station network. Appendix E: Climate Station Information provides an overview of the climate stations relevant to the agriculture monitoring program. Complete details are available in the Site C Climate & Air Quality Monitoring Annual Reports for 2014, 2015 2016, and 2017 (RWDI).

For agriculture monitoring programs, there are currently 9 climate stations located at the sites below. (See Appendix F - Climate Stations Map)

- Attachie Flat Upper Terrace
- Attachie Plateau
- Bear Flat
- Farrell Creek
- Site C North Camp
- Old Fort
- 85th Avenue
- Tea Creek
- Taylor

These stations are maintained and monitored by RWDI and data collection is ongoing and summarized annually in tabular format, and by location. Agriculture monitoring plan parameters include:

- air temperature
 - humidity
 - precipitation
 - solar radiation
 - wind speed
 - wind direction
 - barometric pressure
 - net radiation
 - soil temperature
 - soil heat flux
 - soil water content
 - relative humidity
- Preparations for interviews and consultation: Planning for interviews with potentially affected farm operators will utilize the updated maps "Crop Drying Monitoring Area Identification – Overview (Map 1 of 9)" to identify appropriate operations for interviews.

3. Results and Analysis

During the program establishment phase there are limited results or analysis required. In years one to three of the plan, annual reports provide a summary of activities including baseline data review, selection of monitoring sites for field surveys and preparation for farm operator interviews. The climate stations are collecting information that will provide baseline information to support future analysis.

4. Next Steps

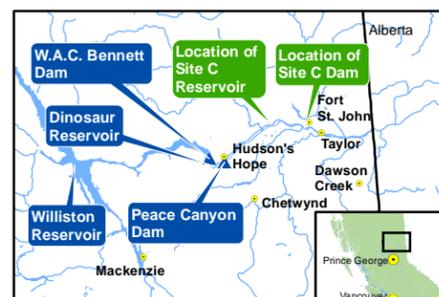
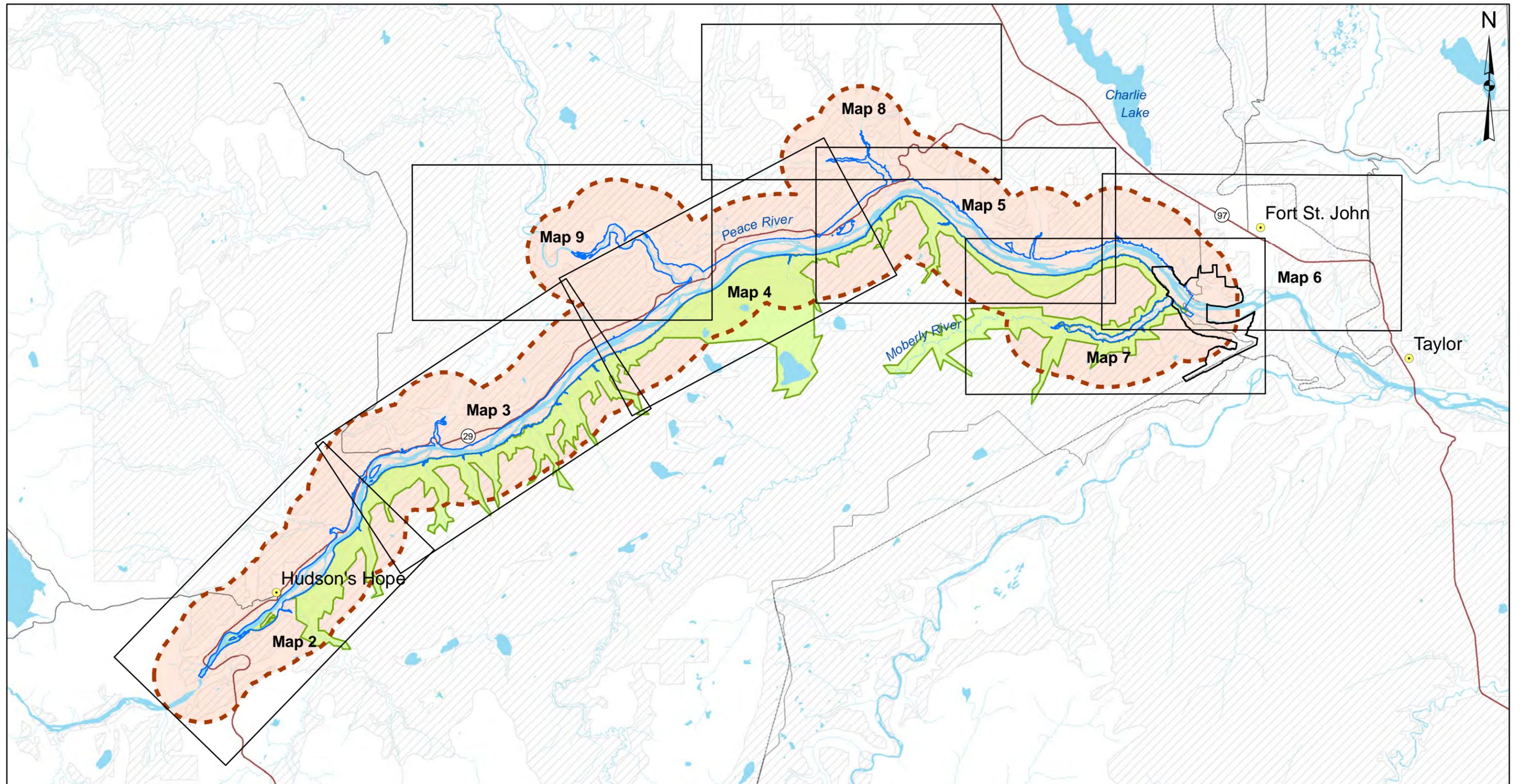
Historical climate data and baseline climate data continues to be reviewed. The existing climate station network was upgraded to meet monitoring plan requirements, and complete the climate station network, including new stations, which became operational in December 2017. The two new stations are located at Taylor, B.C., and on the plateau above Tea Creek. (See Appendix F - Climate Stations Map)

Preparation for interviews continues by identifying and inviting farm operators with farms within 3 km of the reservoir to participate in annual interviews. Efforts will be made to collaborate with associations, producer groups and government agencies that may have data or local knowledge related to this monitoring plan. BC Hydro is aware that there is an ongoing project, led by the BC Grain Producers' Association, titled "Peace – Agriculture Weather Monitoring and Decision Support Tools" that may be a helpful resource to this plan.

Full climate station data collection and interviews will begin after December 2018 in accordance with EAC Condition 31 requirements and the AMAFP implementation schedule. Full monitoring plan implementation will be undertaken over 10 years, commencing 5 years prior to reservoir filling and ending 5 years post reservoir filling.

5. References

- British Columbia Ministry of Environment. 1983. Climatic Capability for Agriculture, Mapsheets 94A/SW and 94A/SE. Victoria, B.C
- BC Grain Producers Association. 2015. "Peace- Agriculture Weather Monitoring and Decision Support Tools" Available at: http://www.bcgrain.com/Current_Projects.html. Accessed: December 2015.
- BC Hydro. 2013. Site C Clean Energy Project Environmental Impact Statement. Dated January 25, 2013; Amended August 2, 2013.
- BC Hydro. 2013. Site C Clean Energy Project Environmental Impact Statement. Dated January 25, 2013; Amended August 2, 2013.
- BC Hydro. 2013. Site C Clean Energy Project Environmental Impact Statement. Dated January 25, 2013; Amended August 2, 2013. Volume 3, Section 20 Agriculture. Subsection 20.3 Mitigation Measures (20.3.7.2.2)
- BC Hydro. 2013. Site C Clean Energy Project Environmental Impact Statement. Dated January 25, 2013; Amended August 2, 2013. Volume 3, Appendix D Agricultural Assessment Supporting Documentation. Appendix A. Climatic Moisture Deficit MD Calculations
- Dyer, J.A. and D.M. Brown (1977). A climatic simulator for field-drying hay. *Agricultural Meteorology*, 18:37-48
- RWDI Air Inc (2015), Site C Climate & Air Quality Monitoring Annual Report 2014, Final. August 26, 2015
- RWDI Air Inc (2016), Site C Climate & Air Quality Monitoring Annual Report 2015, Final. June 9, 2016.
- RWDI Inc. (2017), Site C Climate & Air Quality Monitoring Annual Report 2016, Rev. 1. June 14, 2017.
- RWDI Inc. (2018), Site C Climate & Air Quality Monitoring Annual Report 2017, Final. March 12, 2018.
- Schnorbus, M., K. Bennett, A. Werner and A. Berland. 2011. Hydrological Impacts of Climate Change in the Peace, Campbell and Columbia Watersheds, British Columbia, Canada. Pacific Climate Impacts Consortium, University of Victoria. Victoria, B.C.



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

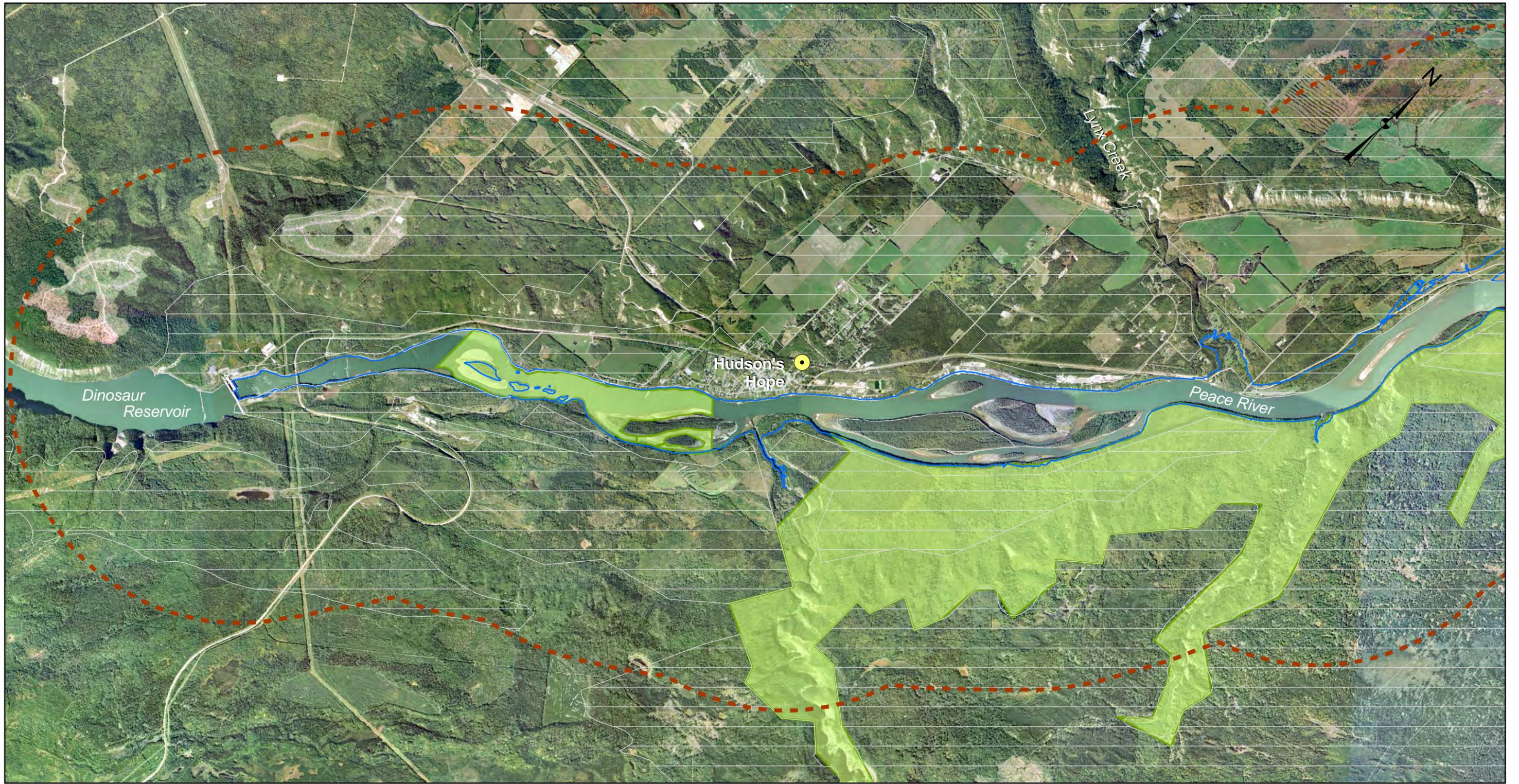
Legend

- Area to be considered for crop drying monitoring
- Agricultural Land Reserve
- Proposed Reservoir
- Proposed Peace Boudreau Protected Area
- Dam Site Area
- Town
- Road
- Highway
- Railway

1:250,000 0 5 km

Crop Drying Monitoring Area Identification - Overview Map 1 of 9			
Date	July 14, 2016	DWG NO	1016-C14-07342-1 R 0

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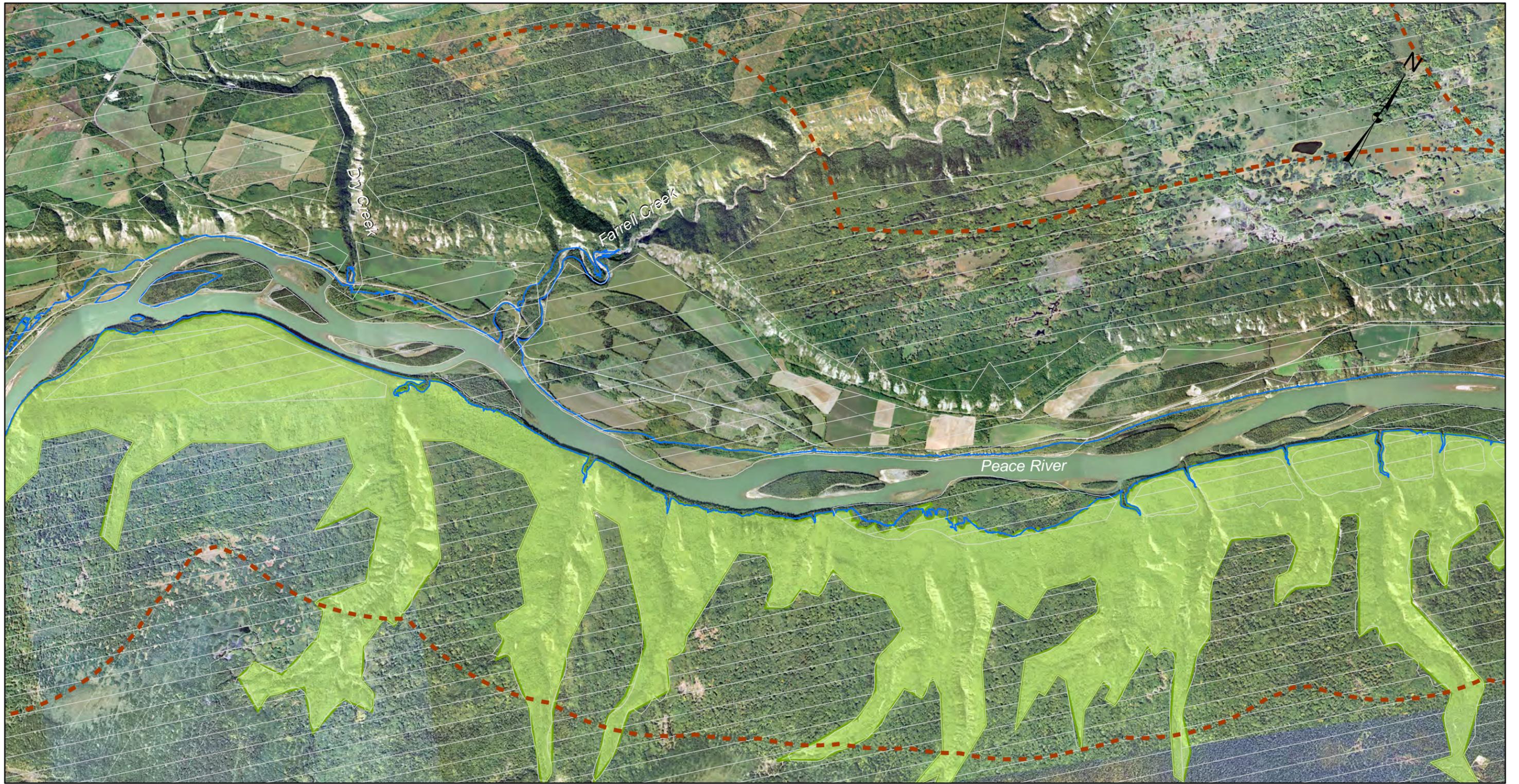
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 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.

Legend

- Area to be considered for crop drying monitoring
- Agricultural Land Reserve
- Proposed Reservoir
- Proposed Peace Boudreau Protected Area
- Dam Site Area

1:50,000 0 2 km

Crop Drying Monitoring - Area Identification			
Map 2 of 9			
Date	July 14, 2016	DWG NO	1016-C14-07342-2 R 0



Map Notes:
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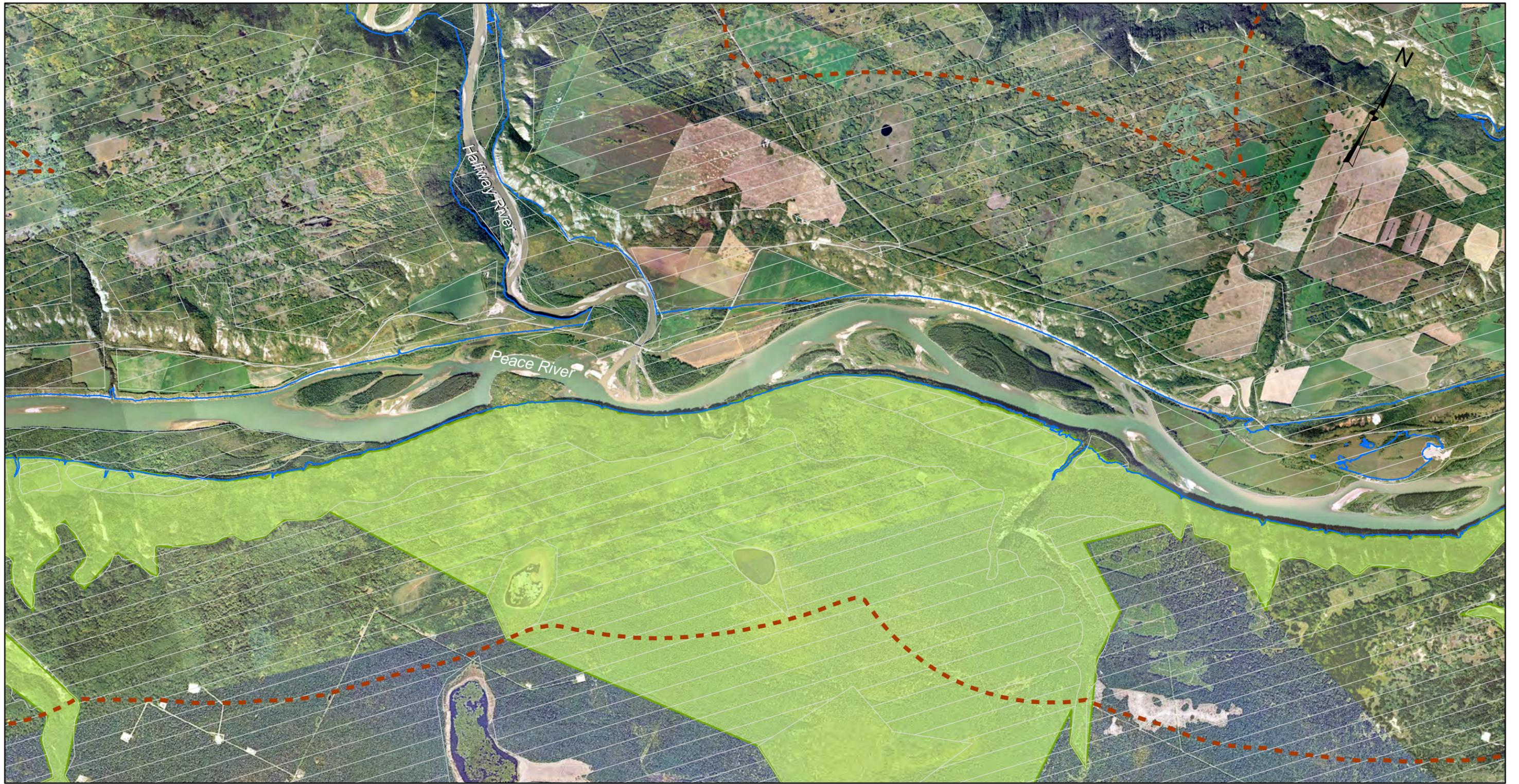
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- Area to be considered for crop drying monitoring
- Agricultural Land Reserve
- Proposed Reservoir
- Proposed Peace Boudreau Protected Area
- Dam Site Area

1:50,000 0 2 km

Crop Drying Monitoring - Area Identification			
Map 3 of 9			
Date	July 14, 2016	DWG NO	1016-C14-07342-3 R 0

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 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007, TRIM.
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.

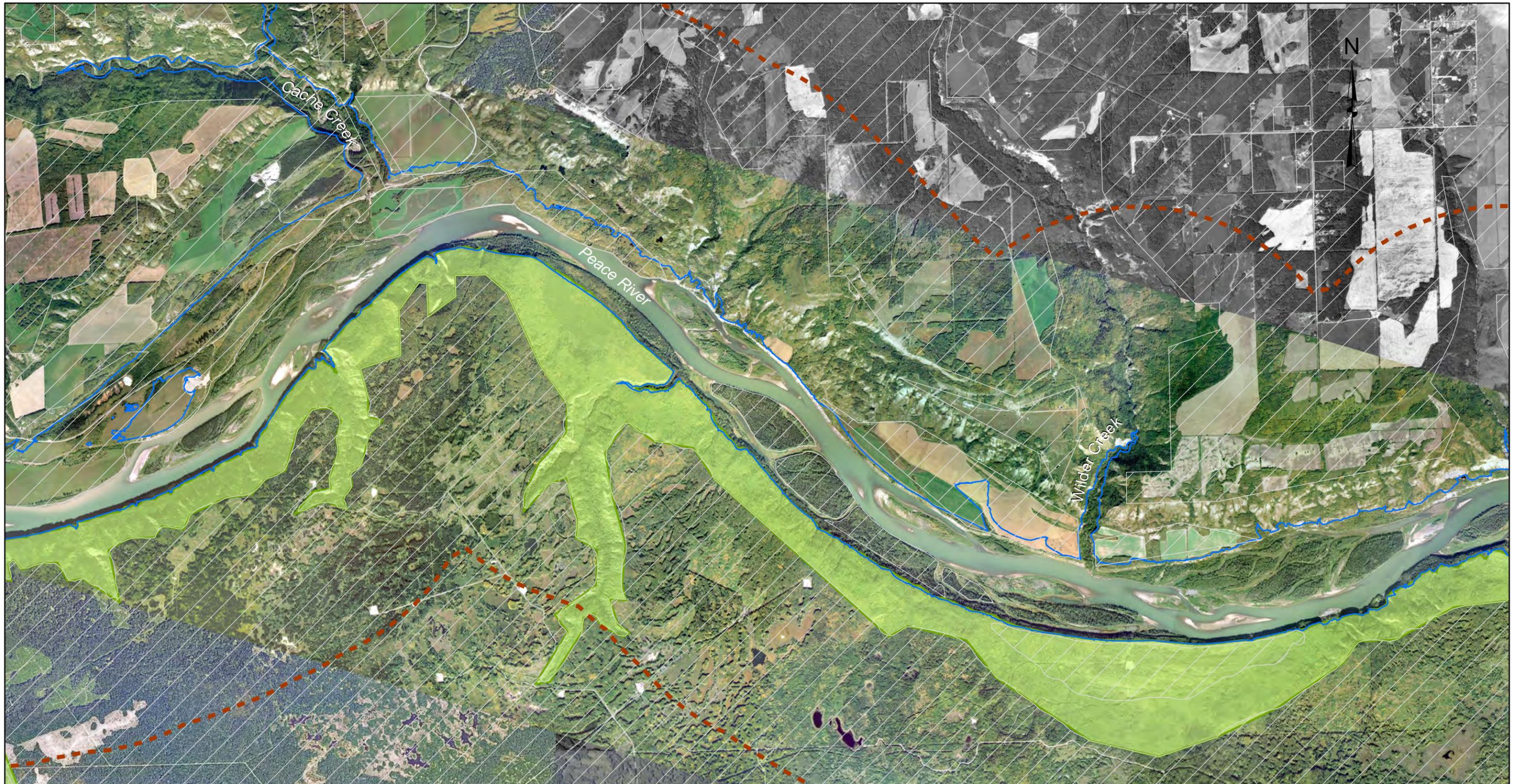
Legend

- Area to be considered for crop drying monitoring
- Agricultural Land Reserve
- Proposed Reservoir
- Proposed Peace Boudreau Protected Area
- Dam Site Area

1:50,000 0 2 km

Crop Drying Monitoring - Area Identification			
Map 4 of 9			
Date	July 14, 2016	DWG NO	1016-C14-07342-4 R 0

Path: X:\acGIS\Projects\Environment\Agriculture\Ag_3kmReservoirBoundary_1016_C14_07342-2-9.mxd



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007, TRIM.
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.

- Legend**
- - - Area to be considered for crop drying monitoring
 - Agricultural Land Reserve
 - Proposed Reservoir
 - Proposed Peace Boudreau Protected Area
 - Dam Site Area

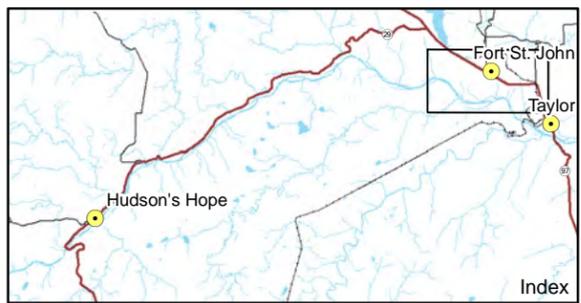
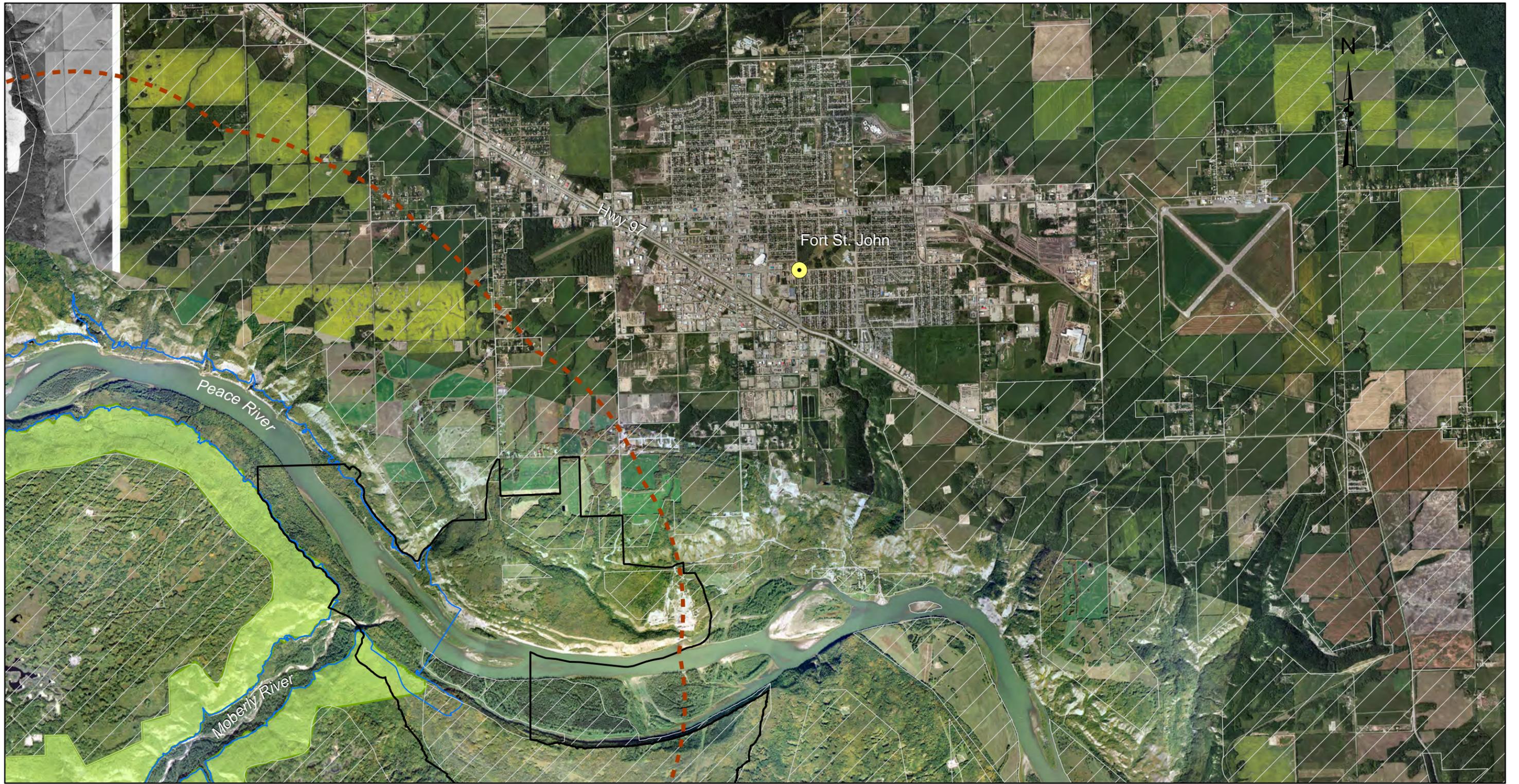
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BC Hydro

Crop Drying Monitoring - Area Identification
Map 5 of 9

Date	July 14, 2016	DWG NO	1016-C14-07342-5	R 0
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Path: X:\acGIS\Projects\Environment\Agriculture\Ag_3kmReservoirBoundary_1016_C14_07342-2-9.mxd



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007, TRIM.
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.

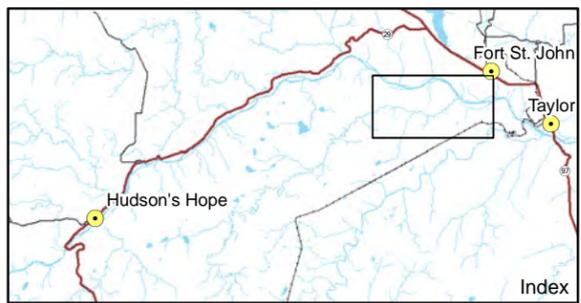
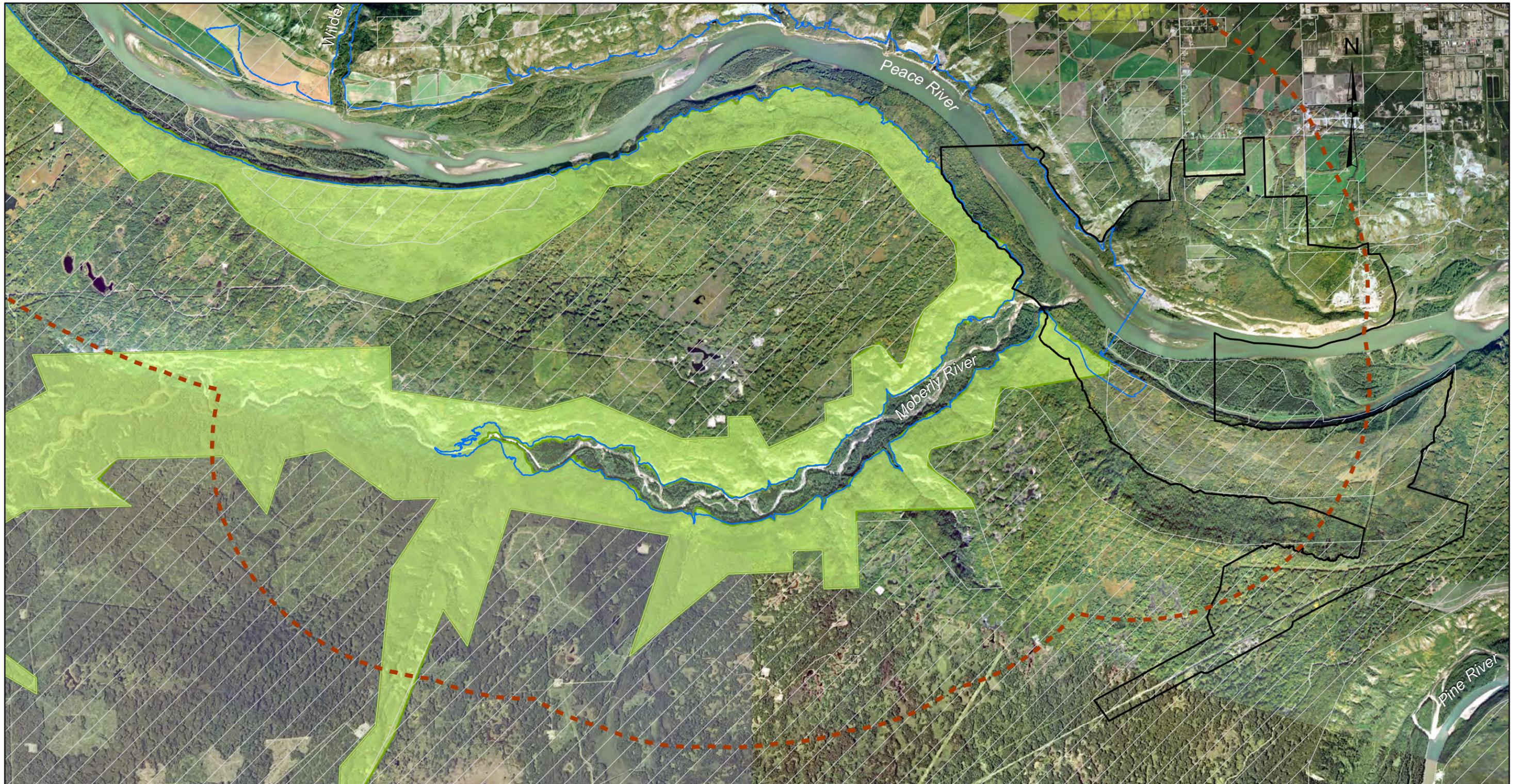
- Legend**
- Area to be considered for crop drying monitoring
 - Agricultural Land Reserve
 - Proposed Reservoir
 - Proposed Peace Boudreau Protected Area
 - Dam Site Area

1:50,000 0 2 km

**Crop Drying Monitoring -
Area Identification
Map 6 of 9**

Date	July 14, 2016	DWG NO	1016-C14-07342-6	R 0
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Path: X:\acg\Projects\Environment\Agriculture\Ag_3kmReservoirBoundary_1016_C14_07342-2-5.mxd



Map Notes:
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 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007, TRIM.
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.

Legend

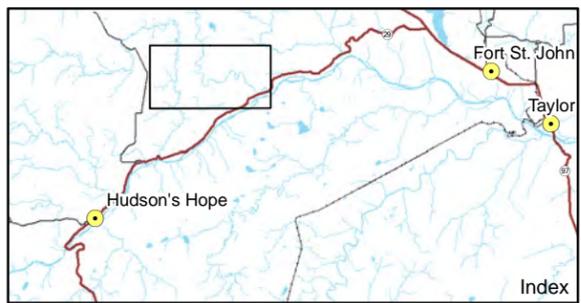
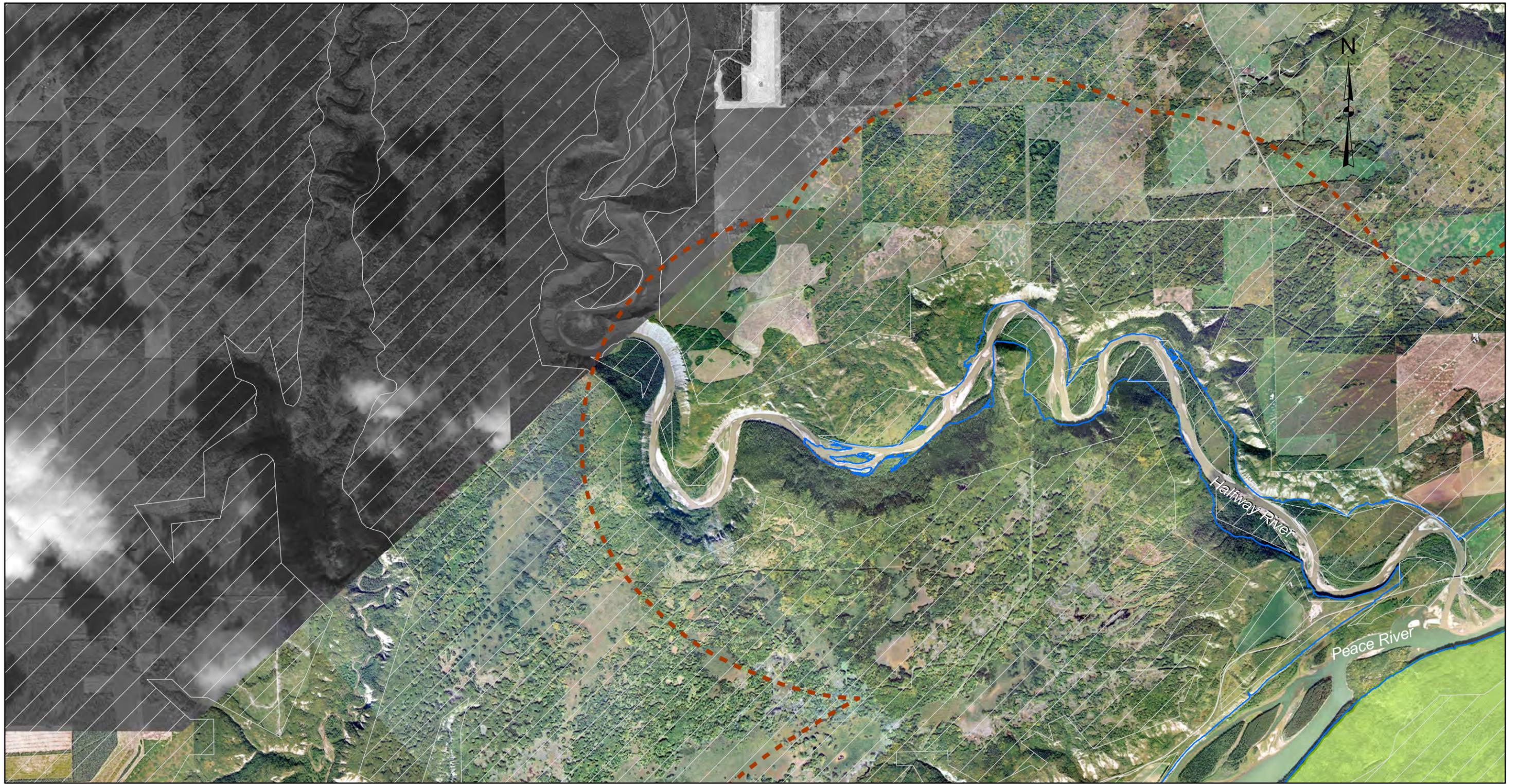
- Area to be considered for crop drying monitoring
- Agricultural Land Reserve
- Proposed Reservoir
- Proposed Peace Boudreau Protected Area
- Dam Site Area

1:50,000 0 2 km

**Crop Drying Monitoring -
Area Identification
Map 7 of 9**

Date	July 14, 2016	DWG NO	1016-C14-07342-7	R 0
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Map Notes:
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 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007, TRIM.
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

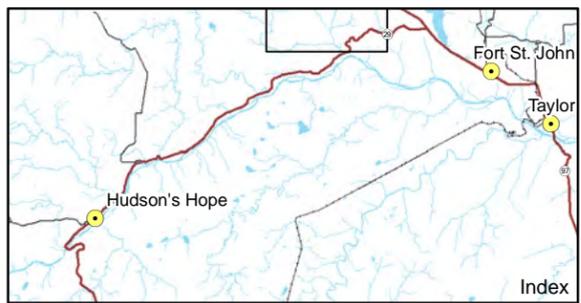
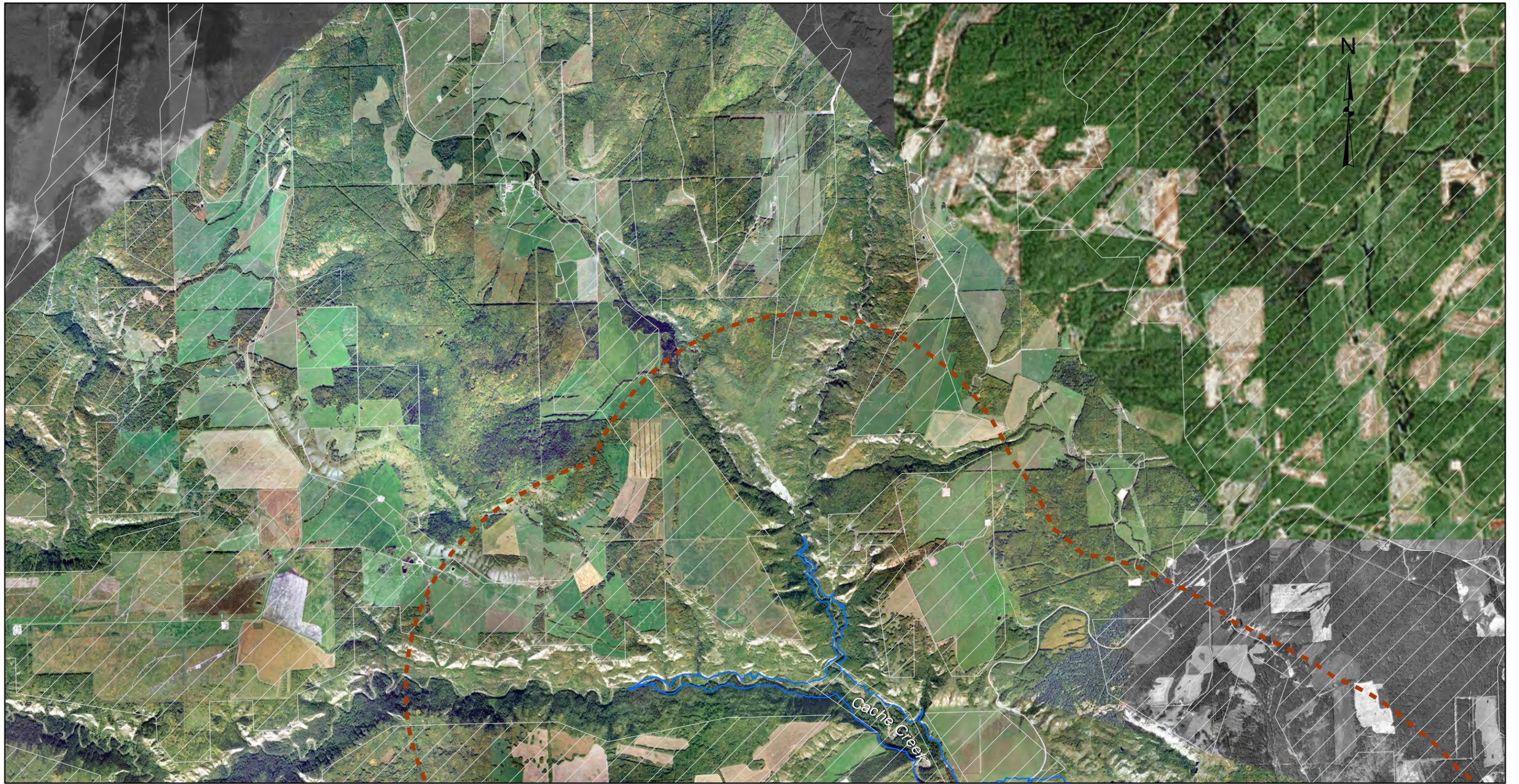
Legend

- Area to be considered for crop drying monitoring
- Agricultural Land Reserve
- Proposed Reservoir
- Proposed Peace Boudreau Protected Area
- Dam Site Area

1:50,000 0 2 km

Crop Drying Monitoring - Area Identification			
Map 8 of 9			
Date	July 14, 2016	DWG NO	1016-C14-07342-8 R 0

Path: X:\AcGIS\Projects\Environment\Agriculture\Ag_3kmReservoirBoundary_1016_C14_07342-2-9.mxd



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007, TRIM.
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.

Legend

- Area to be considered for crop drying monitoring
- Agricultural Land Reserve
- Proposed Reservoir
- Proposed Peace Boudreau Protected Area
- Dam Site Area

1:50,000 0 2 km

Crop Drying Monitoring - Area Identification			
Map 9 of 9			
Date	July 14, 2016	DWG NO	1016-C14-07342-9 R 0

Path: X:\AcGIS\Projects\Environment\Agriculture\Ag_3kmReservoirBoundary_1016_C14_07342-2-9.mxd

Appendix C. Monitoring Potential Groundwater Effects Plan

1. Introduction

The Site C Clean Energy Project's Environmental Impact Statement (BC Hydro. 2013) ("EIS") identifies changes to local hydrology and groundwater as a key indicator for agriculture (EIS Section 20, Table 20.3).

EIS Section 20.3.2.2 (page 20-34, lines 7 to 19) states: "The reservoir would result in rises in the groundwater elevation in areas near the reservoir and may affect agricultural land where the water table is anticipated to rise within 1 m of surface. Yields or the range of suitable crops may be affected on agricultural properties located on low terraces and banks near the proposed reservoir. However, since the majority of the cultivated lands within the local assessment area are located topographically above the proposed reservoir levels by greater than 1 meter and in most cases by greater than 10 m, only limited effects related to water table rise are anticipated."

EAC Condition 31 states: "The Agriculture Monitoring and Follow-up Program must include monitoring for Project-induced changes to groundwater elevations within 2 km of the reservoir (the area potentially influenced by groundwater elevation changes), and evaluate associated effects on crop productivity. Monitoring must include field surveys and farm operator interviews."

In accordance with EAC Condition 31, this study is intended to determine if there are reservoir induced changes to groundwater elevations on adjacent agricultural land which results in a negative effect on crop production.

Data will be collected and evaluated to determine if crop productivity, including yield and limitations on cropping selection, in areas within 2 km of the reservoir is potentially altered. The data to be collected will include:

- measured groundwater levels
- observations of crop growth
- measurements of soil moisture
- climate data
- information obtained from interviews with farm operators

2. Methods

Study Location: The plan includes monitoring of Project-induced changes to groundwater elevations in producing fields within 2 km of the reservoir. Cropped areas which are less than 2 metres above the reservoir full supply level have been identified and groundwater impacts in these areas will be monitored.

Activities: Activities have included mapping, initial work on historical data review, baseline data collection, preparation for field surveys and farm operator interviews, and consultation.

- Mapping: Groundwater monitoring area maps 1-5 include aerial orthophotography data and Agricultural Land Reserve (ALR) areas to support establishment of the monitoring plan (See Appendix C - Monitoring Potential Groundwater Effects Plan)
- Historical Data Review: Areas of potential groundwater effects have been identified.
- Baseline Data Collection and Climate Station Management: For the groundwater monitoring plan, precipitation and soil moisture are the key parameters. Baseline data collection and climate station management is consistent with activities included in Appendix B: Monitoring Potential Effects on Crop Drying Plan.
- Preparations for field surveys, and farm operator interviews, and consultation: Planning for interviews with potentially affected farm operators will utilize mapping to identify appropriate farm operators for field surveys and interviews.

3. Results and Analysis

During the program establishment phase there are limited results or analysis required. In years one to three of the plan, annual reports provide a summary of activities including baseline data review, selection of monitoring sites for field surveys and preparation for farm operator interviews.

4. Next Steps

The full monitoring plan implementation, including field work, interviews, and data interpretation will be completed over 10 years, commencing 5 years prior to reservoir filling and ending 5 years after reservoir filling.

- Baseline data continues to be reviewed, including observations of crop growth and soil moisture conditions in potentially affected areas. Selection of monitoring sites for field surveys may include ground truthing. A data collection sheet will be developed to gather the following information:
 - Drainage: perceptions on growing conditions and variability
 - Crop and soil type
 - Crop productivity (yield and variability)
- Farm operators in these areas and producer groups will be identified and invited to participate in annual interviews, and assist in the determination of field survey locations.
- Efforts will be made to collaborate with associations, producer groups and government agencies that may have data or local knowledge related to this monitoring plan.

5. References

BC Hydro. 2013. Site C Clean Energy Project Environmental Impact Statement. Dated January 25, 2013; Amended August 2, 2013.

BC Hydro. 2013. Site C Clean Energy Project Environmental Impact Statement. Dated January 25, 2013; Amended August 2, 2013. Volume 3, Section 20 Agriculture. Subsection 20.3 Mitigation Measures.

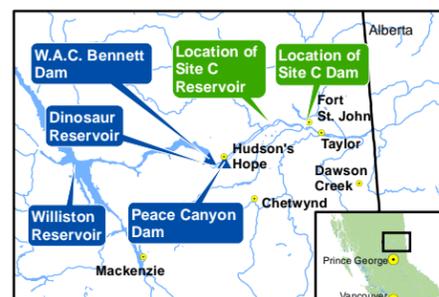
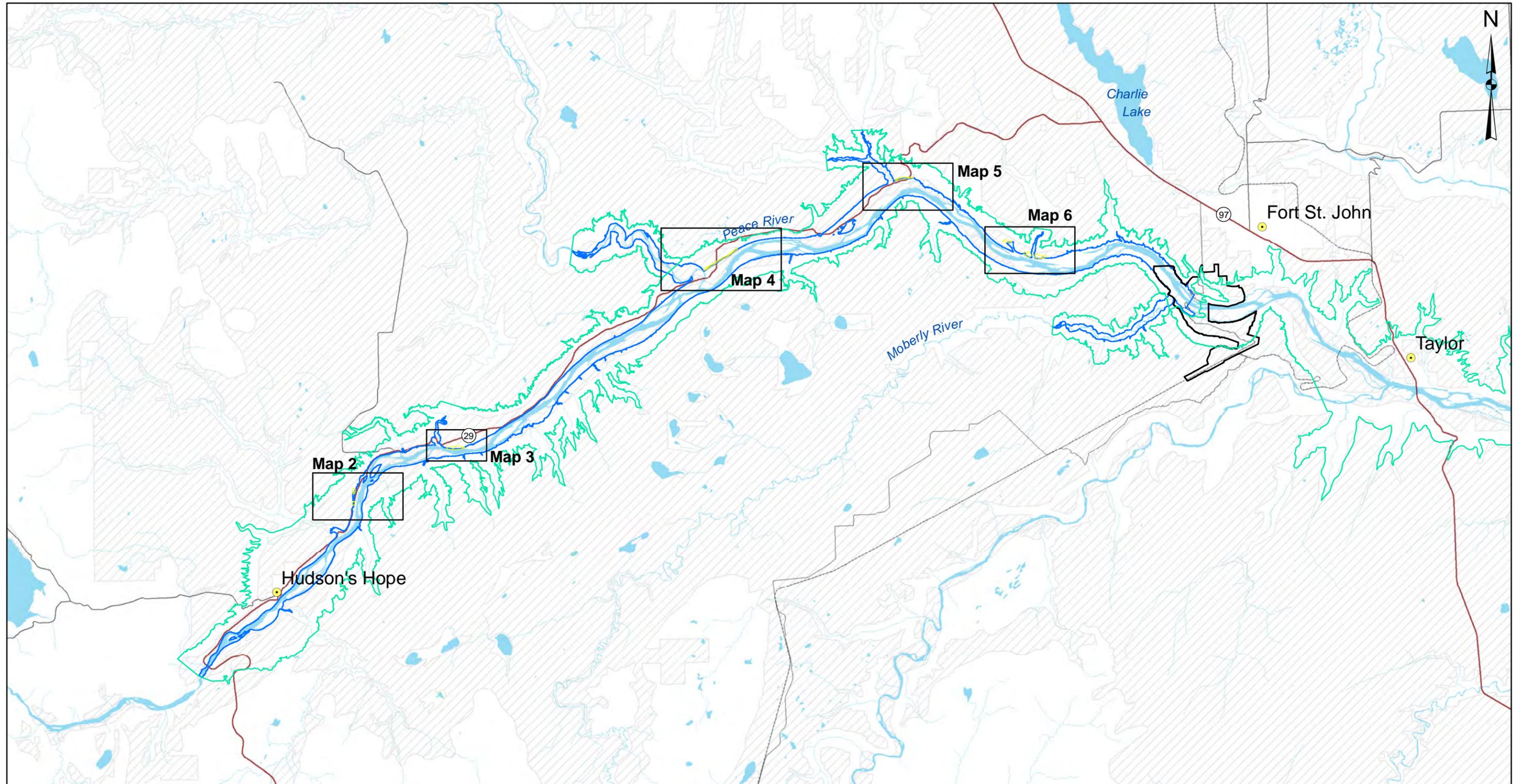
BC Hydro. 2013. Site C Clean Energy Project Environmental Impact Statement. Dated January 25, 2013; Amended August 2, 2013. Volume 3, Appendix D Agricultural Assessment Supporting Documentation.

RWDI Air Inc. 2015. Site C Climate & Air Quality Monitoring Annual Report 2014, Final. August 26, 2015

RWDI Air Inc. 2016. Site C Climate & Air Quality Monitoring Annual Report 2015, Final. June 9, 2016.

RWDI Inc. (2017), Site C Climate & Air Quality Monitoring Annual Report 2016, Rev. 1. June 14, 2017.

RWDI Inc. (2018), Site C Climate & Air Quality Monitoring Annual Report 2017, Final. March 12, 2018.



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

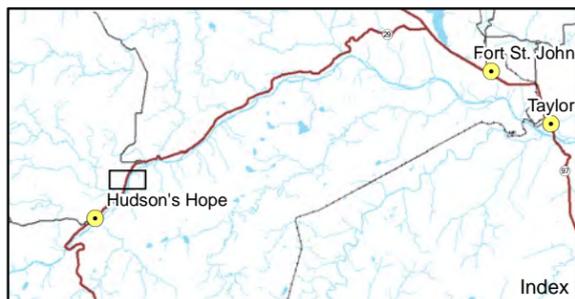
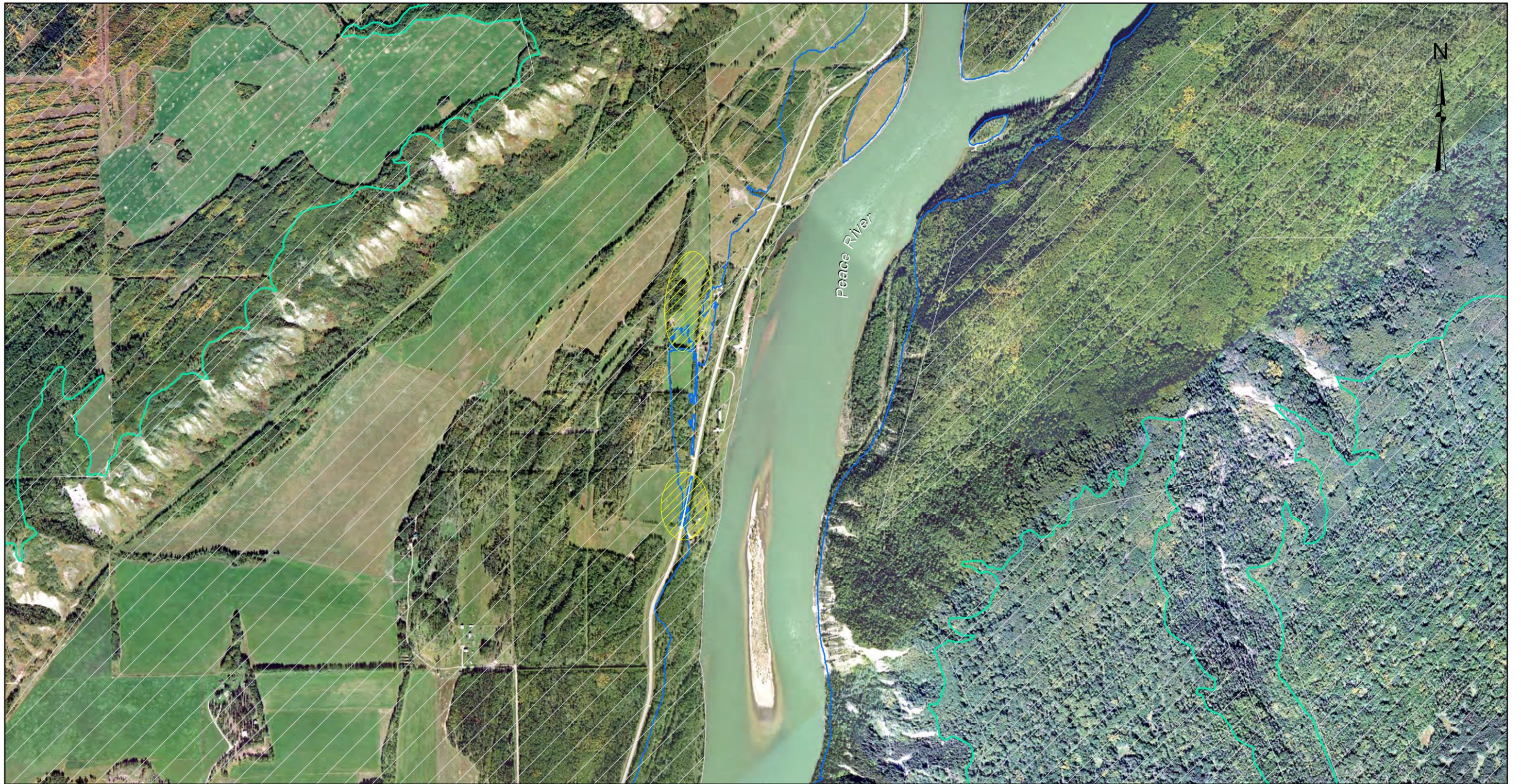
Legend

- Groundwater Monitoring Area
- Peace River and Tributary Valleys Definition
- Proposed Reservoir
- Dam Site Area
- Agricultural Land Reserve
- Town
- Road
- Highway
- Railway

1:250,000 0 5 km

Groundwater Monitoring Areas Overview			
Map 1 of 6			
Date	July 14, 2016	DWG NO	1016-C14-07345-1 R 0

Path: X:\AcGIS\Projects\Environment\Physical_Environment\Ground_Water\Groundwater_Monitoring_Overview_1016_C14_07345-1.mxd



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007, TRIM.
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.

Legend

- Groundwater Monitoring Area
- Peace River and Tributary
- Valleys Definition
- Proposed Reservoir
- Dam Site Area
- Agricultural Land Reserve

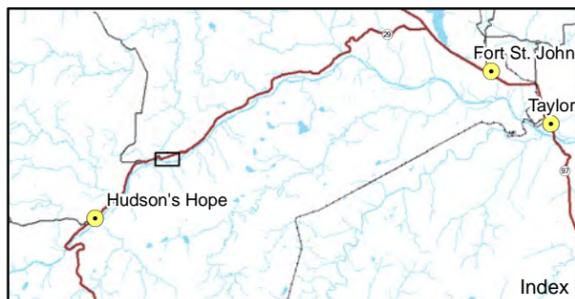
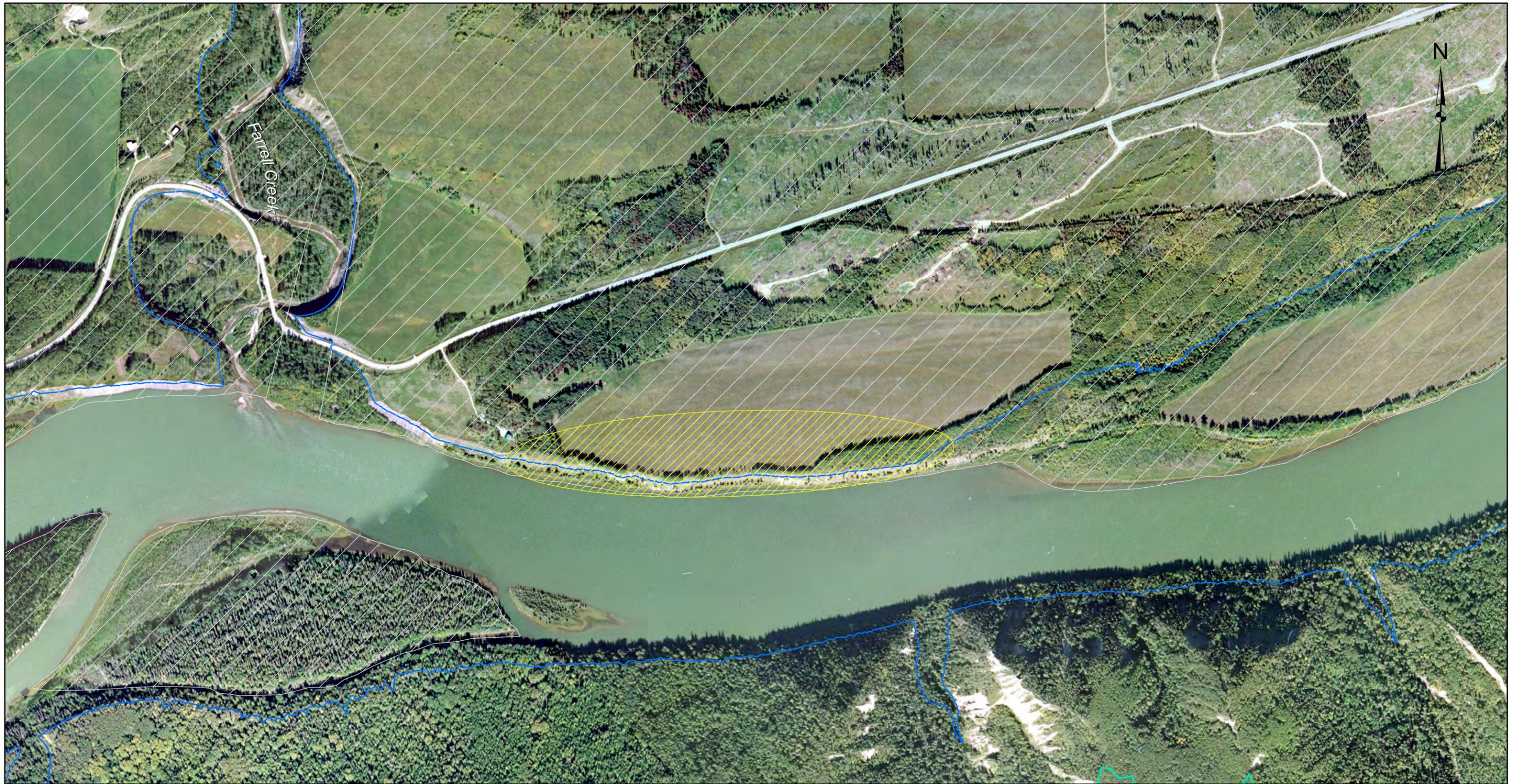
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Groundwater Monitoring Areas Map 2 of 6

Date	July 14, 2016	DWG NO	1016-C14-07345-2	R 0
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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007, TRIM.
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

Legend

- Groundwater Monitoring Area
- Peace River and Tributary
- Proposed Reservoir
- Dam Site Area
- Agricultural Land Reserve

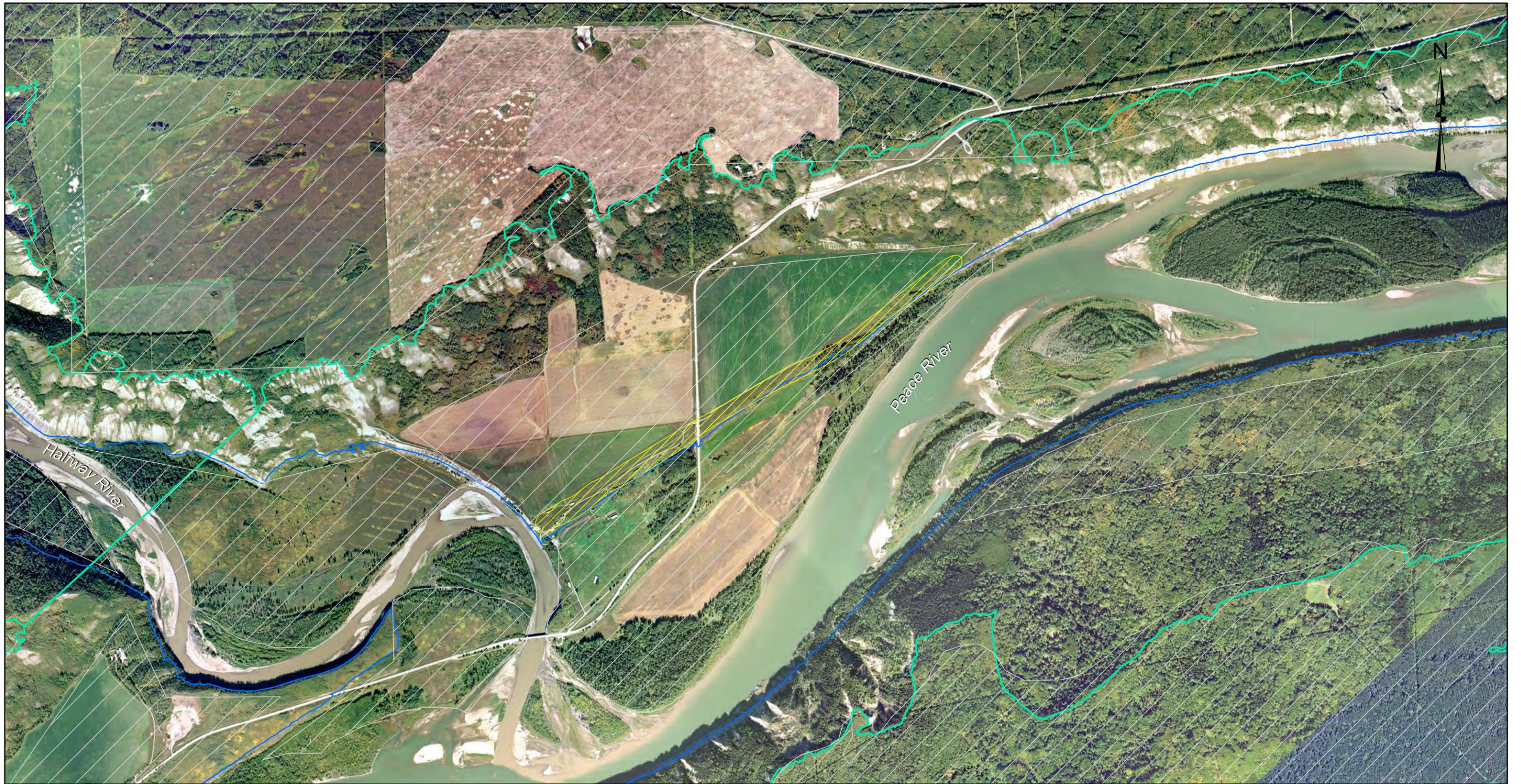
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Groundwater Monitoring Areas Map 3 of 6

Date	July 14, 2016	DWG NO	1016-C14-07345-3	R 0
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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007, TRIM.
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

- Legend**
- Groundwater Monitoring Area
 - Peace River and Tributary
 - Valleys Definition
 - Proposed Reservoir
 - Dam Site Area
 - Agricultural Land Reserve

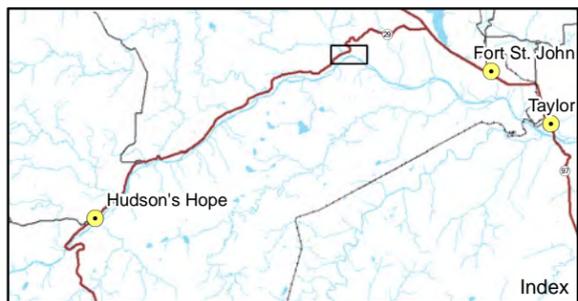
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**Groundwater Monitoring Areas
 Map 4 of 6**

Date	July 14, 2016	DWG NO	1016-C14-07345-4	R 0
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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.



Map Notes:
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 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007, TRIM.
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

- Legend**
- Groundwater Monitoring Area
 - Peace River and Tributary
 - Valleys Definition
 - Proposed Reservoir
 - Dam Site Area
 - Agricultural Land Reserve

1:15,000 0 0.5 km



**Groundwater Monitoring Areas
 Map 5 of 6**

Date	July 14, 2016	DWG NO	1016-C14-07345-5	R 0
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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.



Map Notes:
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 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007, TRIM.
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

Legend

- Groundwater Monitoring Area
- Peace River and Tributary
- Valleys Definition
- Proposed Reservoir
- Dam Site Area
- Agricultural Land Reserve

1:15,000 0 0.5 km



**Groundwater Monitoring Areas
Map 6 of 6**

Date	July 14, 2016	DWG NO	1016-C14-07345-6	R 0
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Appendix D. Monitoring to Estimate Irrigation Water Requirements Plan

1. Introduction

The Site C Clean Energy Project's Environmental Impact Statement (BC Hydro. 2013) ("EIS") Section 20.3.4.1.2 identifies irrigation improvements as a potential mitigation measure for the permanent loss of agricultural land. Lines 25 to 27, page 20-42, of this section state: "Irrigation research, demonstration projects, and funding assistance for irrigation water supply infrastructure will be considered within the proposed agricultural compensation fund."

EAC Condition 31 states: "The Agriculture Monitoring and Follow-up Program must include monitoring for climatic factors to estimate moisture deficits and to estimate irrigation water requirements in the vicinity of the reservoir to provide information for potential future irrigation projects. Data collection will be undertaken before reservoir filling, and in the 5 years after reservoir filling, and data will be reviewed as required for proposed irrigation projects."

In accordance with EAC Condition 31, this study will monitor climate data and estimate irrigation water requirements. The objective of this monitoring program is to collect and analyze climate data to generate estimates of irrigation water requirements.

2. Methods

Study Location: The study areas are agricultural operations within 3 km of the reservoir. The plan will rely on climate station installation, maintenance, and data collection tasks carried out in the Appendix B: Monitoring Potential Effects on Crop Drying Plan.

Activities: Activities have included coordination of data needs with Appendix B: Monitoring Potential Effects on Crop Drying Plan, mapping, baseline data collection and climate station siting, and consideration of consultation input.

- Mapping: Maps in support of this plan are included in Appendix B: Monitoring Potential Effects on Crop Drying Plan.
- Baseline Data Collection and Climate Station Management: Coordination with Appendix B: Monitoring Potential Effects on Crop Drying Plan to ensure all parameters required for this plan are included in climate station siting and network upgrades.
- Consultation: Irrigation was a topic of discussion and included in numerous submissions on the consultation with regional agricultural producers and associations on the Framework for the Agricultural Mitigation and Compensation Plan. Content relevant to irrigation was considered and will be retained for application to this plan.

3. Results and Analysis

During the program establishment phase there are limited results or analysis required. The climate stations are collecting information that will provide baseline information to support future analysis.

4. Next Steps

In the 5 years pre- and post-reservoir filling, complete summaries of the collected data from the new and existing BC Hydro climate stations will be analyzed annually to estimate irrigation water requirements.

- The existing climate station network was upgraded and expanded between January 2016 and December 2017. Climate data collected by the existing climate stations will provide baseline data, and will begin being reviewed in 2018.
- Efforts will be made to collaborate with associations, producer groups and government agencies that may have data or local knowledge related to this monitoring plan, such as the BC Grain Producers Association which has funded a study “Evaluation of Irrigation Potential in the BC Peace Region”.

5. References

BC Grain Producers Association (2015) “Peace – Evaluation of Irrigation Potential in the BC Peace Region” Available at: http://www.bcgrain.com/Current_Projects.html. Accessed: December 2015.

FAO. (1998). Crop Evapotranspiration – Guidelines for Computing Crop Water Requirements. Rome: Food and Agriculture Organization of the United Nations – Paper 56.

BC Hydro. 2013. Site C Clean Energy Project Environmental Impact Statement. Dated January 25, 2013; Amended August 2, 2013.

Appendix E. Climate Stations Information

Table 1: Periods of Operation - Climate Stations Supporting the AMAFP

Monitoring Station	Period of Operation
Attachie Flat Upper Terrace	2011 - Present
Attachie Flat Lower Terrace *	2010 - 2017
Attachie Plateau	2010 - Present
Bear Flat	2010 - Present
Farrell Creek	2009 - Present
Site C Dam **	2010 - 2016
Site C North Camp ***	2016 - Present
Old Fort	2011 - Present
85 th Avenue	2013 - Present
Tea Creek	2017 - Present
Taylor	2017 - Present
Fort St. John Airport ****	1942 - Present

* Attachie Flat Lower Terrace was closed in 2017 because the site will be inundated by the Site C reservoir

** Site C Dam Station was relocated in 2016 to an area adjacent to the camp and offices. It is now the Site C North Camp Station

*** Site C North Camp Climate Station has instruments in two areas located near the Site C offices

**** Fort St. John Airport is operated by Environment Canada

Table 2: Locations & Elevations of Current Climate Stations Supporting the AMAFP

Station	UTM NAD 83 (m)	Latitude, Longitude (decimal degrees)	Elevation (m)
Attachie Flat Upper Terrace	597983 E, 6232938 N	56.23N, -121.41W	479
Attachie Plateau	595065 E, 6233032 N	56.23N, -121.46W	645
Bear Flat	610669 E, 6238135 N	56.27N, -121.21W	474
Farrell Creek	580779 E, 6220238 N	56.12N, -121.70W	471
Site C North Camp*	630127 E, 6230625 N	56.20N, -120.90W	581
Old Fort	634,890 E, 6,230,532 N	56.20N, -120.83W	421
85 th Avenue	633,033 E, 6,233,949 N	56.23N, -120.85W	686
Tea Creek	626812 E, 6234340 N	56.24N, -120.95W	653
Taylor	639212 E, 6226929 N	56.17N, -120.76W	411
Fort St. John Airport	640053 E, 6234872 N	56.24N, -120.74W	695

*The "Site C Dam" meteorological station was decommissioned from its original location on April 13, 2016 due to excavation at that location. It was relocated to a new location, "Site C North Camp", on July 7, 2016.

Table 3: Climate Station Parameters Supporting the AMAFP

<ul style="list-style-type: none"> • air temperature • humidity • precipitation • solar radiation • wind speed • wind direction 	<ul style="list-style-type: none"> • barometric pressure • net radiation • soil temperature • soil heat flux • soil water content
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Full reports including tabular summaries of the agricultural monitoring parameters are included in the 2014, 2015, 2016, and 2017 Site Climate and Air Quality Monitoring Annual reports.

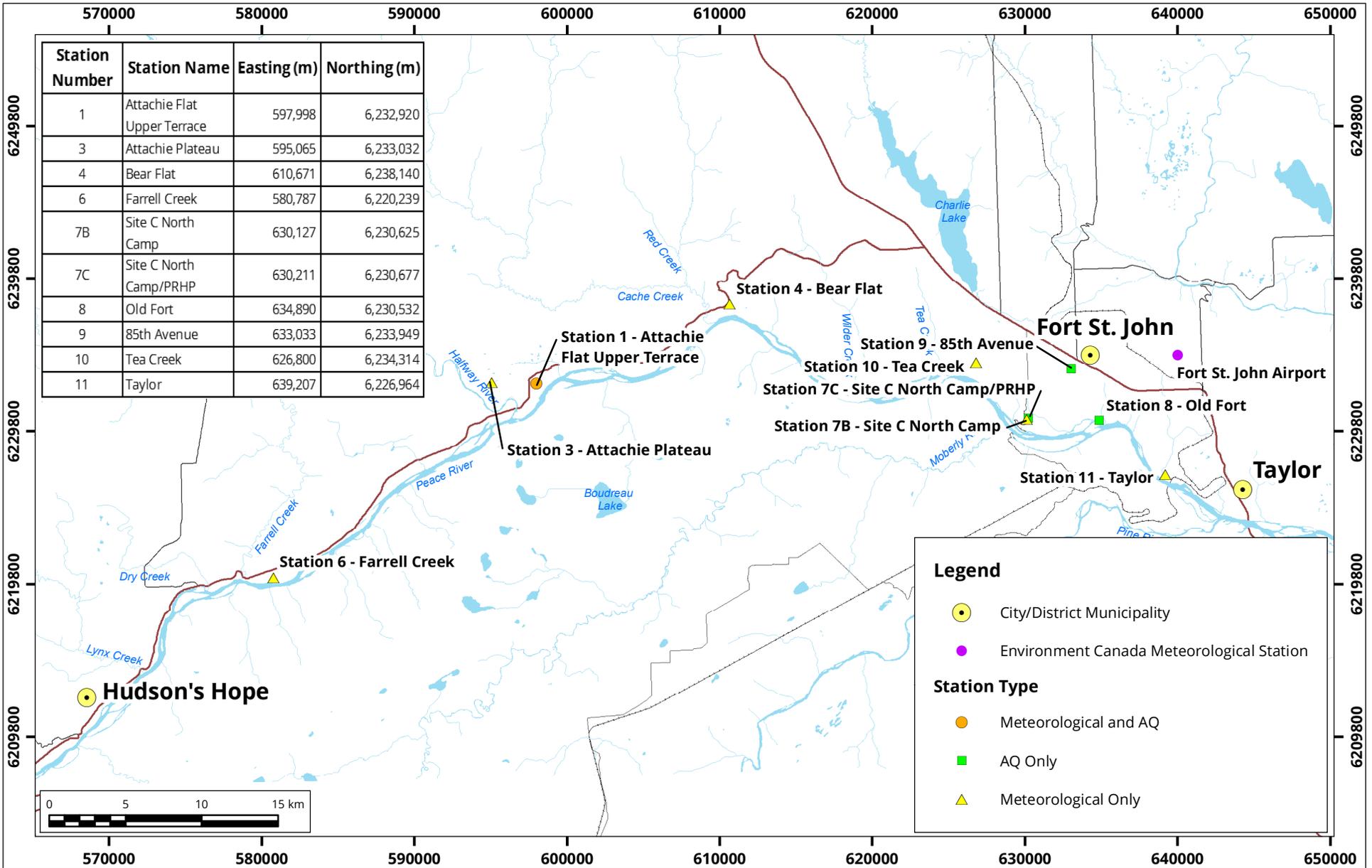
References:

RWDI Inc. (2015), Site C Climate & Air Quality Monitoring Annual Report 2014, Final. August 26, 2015.

RWDI Inc. (2016), Site C Climate & Air Quality Monitoring Annual Report 2015, Final. June 9, 2016.

RWDI Inc. (2017), Site C Climate & Air Quality Monitoring Annual Report 2016, Rev. 1. June 14, 2017.

RWDI Inc. (2018), Site C Climate & Air Quality Monitoring Annual Report 2017, Final. March 12, 2018.



APPENDIX F BC Hydro - Site C Meteorological and Air Quality Stations



Drawn by: DJH | Figure: 2-1

Approx. Scale: 1:350,000

Date Revised: Sep 18, 2017

Project #: 1601625

