26 NAVIGATION

26.1 Approach

Navigation, including water-based navigation (navigation) and air navigation (aviation), would be affected by Project-caused changes to navigability and navigation use of water bodies, to aviation routes or visibility, or to operation of the ferry and ice bridge crossings of the Peace River at Shaftesbury and Tompkins Landing in Alberta. The assessment considers these changes and the potential effects to water and air navigation.

26.1.1 Regulatory and Policy Setting

Navigation on waterways in Canada is governed by the *Navigable Waters Protection Act* (NWPA), amended March 12, 2009 to enable regulators to focus on waterways of navigation value and on "works" that may interfere substantially with navigation (Transport Canada 2012). Review under the NWPA is based on protecting the public right to navigate; although not specifically defined, this is a right that has developed over time through common law. If the waters are navigable, then the public has the right to navigate. In some cases, gaining approval to restrict the public's right to navigate requires an Act of Parliament.

The works that are subject to approval under the NWPA include:

- Any man-made structure, device, or thing – temporary or permanent
- Any dumping of fill in a navigable water
- Any excavation of materials from the bed of a navigable water

Works also include all types of other construction, permanent or temporary, related to the main project. Examples include any bridge, boom, dam, wharf, dock, pier, tunnel or pipe, telegraph, power cable, or wire (Transport Canada 2012).

The construction of the Project would interfere with navigation and is reviewable under subsection 5(1) (2) of the NWPA.

Aviation in Canada is regulated by both Nav Canada and Transport Canada. Nav Canada's mandate is to ensure the safe and efficient movement of aircraft within Canadian air space and the integrity of infrastructure, including communication, navigation, and surveillance equipment; published flight information; aviation weather services; airport control; and advisory services (Nav Canada 2012a). Transport Canada is responsible for regulatory requirements such as orders regarding the marking and lighting of hazards to aviation, aerodrome standards and recommended practices, and registered airport zoning.

This assessment considered Project effects on aviation specific to the North Peace Regional airport located 9 km east of the City of Fort St. John. The review was based on potential land use effects as outlined in the document Land Use in the Vicinity of Airports (Transport Canada 2005*)* and potential changes in the hours of poor visibility (fog) that could affect aviation.

26.1.2 Key Issues and Identification of Potential Effects

Issues, concerns, and interests identified during consultation with government, Aboriginal groups, and the public guided the scope of the navigation and aviation assessment (see Volume 1 Section 9 Information Distribution and Consultation). Determination of key issues related to navigation is based on consultations with regulators regarding technical requirements necessary to be compliant to regulations, regional governments, local governments, and local stakeholders, including the Peace Country River Rats. Aviation interviews and discussions included North Peace Regional airport and regulators, including Transport Canada and Nav Canada. More details are provided in Section 26.2.2 Interviews.

Navigation issues were identified, including defining the navigability of the Site C reservoir, future navigation use opportunities of the Site C reservoir, and ensuring project components are designed to address NWPA regulations and vessel clearance requirements. Construction issues such as diversion and channelization, debris management, Site C reservoir clearing, temporary bridges, and Site C reservoir filling were identified. Operational issues were related to the Site C reservoir stabilization and sedimentation, downstream flows, and river geomorphology. The effect of the Project on the Shaftesbury and Tompkins Landing ice bridges was raised as an issue. The need for navigation safety management was identified during the consultation.

Aviation issues included potential land use changes near North Peace Regional airport resulting from construction, a potential increase in hours of poor visibility (fog and heavy fog), and potential risks to aircraft caused by obstacles such as structures and overhead wires.

In Table 26.1, key issues have been organized according to the following key aspects of the project's potential effect on navigation and aviation:

- Change in navigability and navigational use
- Change or presence of navigational hazards in the waterway
- Changes that result in restrictions to navigation, their rationalization, and the approach to public and navigational safety use
- Changes associated with visibility of structures and overhead wiring on aviation
- Changes on microclimate on aviation
- Changes to Shaftesbury and Tomkins Landing ice bridges

The key issues and the approaches to addressing the issues are outlined in Table 26.1.

Table 26.1 Key Issues: Navigation and Aviation

Key Issues	Approach to Addressing Key Issues
Navigability and navigation use	
Navigability of the Site C reservoir and future use opportunities	▪ Issue resulted in a literature review to determine factors that support navigability and navigation use of reservoirs. ▪ A benchmark review of BC Hydro's reservoirs in relation to navigability and navigational use was undertaken. Results identified key criteria and key factors that support navigability of, and navigation use of, reservoirs. ▪ Criteria and factors were subsequently used to determine the navigability of the Site C reservoir and the identification of appropriate mitigation measures.
Vessel clearances to support navigation for Highway 29 bridges	▪ Issue resulted in the review and identification of the types of vessels and their design characteristics (e.g., height, beam, draft) that currently, or have the potential to, navigate the Site C reservoir. ▪ Vertical, horizontal, and draft requirements were identified, project components (e.g., bridges, transmission lines were identified, and retention of existing bridge segments within inundated areas) was evaluated as to whether the vertical, horizontal, and draft clearances for current and future vessels potentially using the Site C reservoir would be accommodated. ▪ NWPP regulations are referenced to ensure compliance to regulations.
Aboriginal group (Dene Tha') concern with potential effects on boat passage	▪ Section 26.4 Effects Assessment assesses issues associated with boat passage at the dam site.
Potential that the Site C reservoir would result in increased access and increased boat traffic on waterways (Treaty 8 Tribal Association, Saulteau First Nations)	▪ Changes to access and boat traffic are discussed in Section 26.3 and assessed in Section 26.4. ▪ The effect of changes to access and boat traffic on Aboriginal land and resource use is discussed in Volume 3 Section 19 Current Use of Lands and Resources for Traditional Purposes.
Potential decreased boating safety associated with making the Peace River Valley into a recreational reservoir and increasing powerboat traffic (Treaty 8 Tribal Association)	▪ Changes to access and boat traffic are discussed in Section 26.3 Navigation Baseline Description and assessed in Section 26.4 Navigation Effects Assessment (Volume 3 Section 26 Navigation). ▪ Transport Canada is responsible for oversight of boater safety regulations on navigable waters.
Potential that the Site C reservoir and boat launches would increase boating access to the upper reaches of the Halfway and Moberly Rivers (Treaty 8 Tribal Association)	▪ The effect of changes to access and boat traffic on Aboriginal land and resource use is discussed in Volume 3 Section 19 Current Use of Lands and Resources for Traditional Purposes. ▪ Changes to existing boat launch locations, inclusive of the closure of the existing Halfway River boat launch, are assessed in Section 26.4.
Hazards to and interferences with navigation	
Diversion and channelization	▪ Issues related to hazards to and interferences with navigation caused by diversion and channelization activities were assessed (Volume 2 Appendix D Surface Water Regime Technical Memos).

Key Issues	Approach to Addressing Key Issues
Debris management	▪ Floating debris and management (debris boom locations and debris traps) as outlined in the Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan were assessed in relation to hazards and interferences to navigation.
Site C reservoir clearing and temporary bridges	▪ Issues associated with Site C reservoir clearing and the temporary bridges required by clearing activities (Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan) were assessed in relation to hazards and interferences to navigate.
Site C reservoir filling	▪ Issues associated with navigation hazards and interferences created by Site C reservoir filling were assessed based on a review of Volume 1 Appendix B Reservoir Filling and Commissioning Plan.
Site C reservoir stabilization	▪ Issues associated with Site C reservoir stabilization were assessed in relation to potential hazards and interferences to navigation based on Volume 2 Appendix B Geology, Terrain Stability, and Soil Reports.
Site C reservoir sedimentation	▪ Issues associated with Site C reservoir sedimentation were reviewed in the context of potential creation of hazards to or interferences with navigation based on a review of Volume 2 Appendix I Fluvial Geomorphology and Sediment Transport Technical Data Report.
Downstream flows and river geomorphology	▪ Issues associated with the effect of downstream flows and river geomorphology on navigation and navigational use were identified and assessed based on Volume 2 Appendix D Surface Water Regime Technical Memos.
Navigation use restrictions	
Navigation safety management	▪ Issues associated with managing public safety throughout construction and early years of operations were assessed and the identification of a Public Safety Management Plan (Volume 5 Section 35 Summary of Proposed Environmental Management Plans) and establishment of boater communication protocols were identified.
Visibility of structures and overhead wires (aviation)	
Consideration of the potential land use implications of the Project on the North Peace Regional airport and potential obstructions associated with the construction and operation of the Project	▪ Transport Canada and Nav Canada regulations were identified associated with determining potential obstructions to aviation. ▪ Regarding proposed land uses in proximity to airports Transport Canada's document TP 1247 Land Use in the Vicinity of Airports was utilized. This document outlines the specific protection requirements to protect obstacle limitation surfaces used in airport operations. ▪ The Aeronautical Obstruction form has been identified and referenced in the assessment to deal with visibility and obstructions to aviation resulting from a construction project. ▪ To assess potential effects, an assessment was completed regarding the distance between the North Peace Regional airport and the crest of the Site C dam site, also noting the vertical elevation difference between the airport and the dam crest.
Microclimatic changes (aviation)	
Potential effects on microclimate specific to an increase in fog and heavy fog at the North Peace Regional airport	▪ Issues identified the need to study the microclimatic effects of the proposed Site C reservoir and potential increase in the annual hours of fog and heavy fog in relation to airport operations. ▪ Volume 2 Appendix K Microclimate Technical Data Report provides technical details on the results.

Key Issues	Approach to Addressing Key Issues
Shaftesbury and Tompkins Landing ice bridges	
Changes to ice bridges and ferry operations required for the transport of people, goods, and access to traditional hunting grounds (Duncan's First Nation, Beaver First Nation, Little Red River Cree First Nation, Paddle Prairie Métis Settlement Society)	▪ Issues associated with the timing of ice formation at the Shaftesbury and Tompkins Landing ferries were assessed based on the results of Volume 2 Appendix G Downstream Ice Regime Technical Data Report.

Potential project interactions with navigation and aviation are summarized in Table 2 in Volume 2 Appendix A Project Interactions Matrix. As defined in Volume 2 Section 10 Effects Assessment Methodology, a "2" ranking is assigned where an interaction may result in an adverse effect and mitigation measures are not well understood to be effective. These interactions were taken forward through the effects assessment. Project interactions with a ranking of "2" are summarized in Table 26.2 below.

Table 26.2 Interactions of the Project with Navigation and Aviation

Project Activities and Physical Works	Key Aspects					
	Changes to Naviga-bility and Navigation Use of defined Navigable Waters	Potential Navigation Hazards in Waterways	Navigation Use Restrictions	Micro-climate Changes on Aviation Use	Aviation Use and Visibility of Structures and Overhead Wires	Changes to Operation of Shaftesbury, Tompkins Landing Ferry and Ice Bridges
CONSTRUCTION						
Dam and Generating Station	✓	✓	✓			
Reservoir Preparation and Filling						
Upgrades to existing licensee roads, winter construction	✓	✓	✓			
Water Management during Confinement	✓	✓	✓			
Water Management during Diversion	✓	✓	✓			
Water management during Site C reservoir filling	✓	✓	✓			

Project Activities and Physical Works	Key Aspects					
	Changes to Naviga-bility and Navigation Use of defined Navigable Waters	Potential Navigation Hazards in Waterways	Navigation Use Restrictions	Micro-climate Changes on Aviation Use	Aviation Use and Visibility of Structures and Overhead Wires	Changes to Operation of Shaftesbury, Tompkins Landing Ferry and Ice Bridges
Water Management during Commissioning	✓	✓	✓			
OPERATIONS						
Site C Reservoir and Generating Station Operations	✓	✓	✓	✓		✓

NOTE:
Only project interactions ranked as "2" in Volume 2 Appendix A Project Interactions Matrix, Table 2 are carried forward to this table. A ✓ indicates that a project component or activity may interact with navigation or aviation.

In Table 26.2, interactions are considered at the component level for the dam and generating station construction, and for the Site C reservoir and generating station operations. Specific interactions are considered at a sub-component level within Site C reservoir preparation and filling.

Other interactions were considered, but were not carried forward because the activity was unlikely to contribute to an effect. The interactions were either given a ranking of "0" (indicating no interaction) or a ranking of "1". Further analysis and evaluation of interactions ranked "1" or "0" is not required in the environmental assessment as discussed in the following section.

26.1.3 Standard Mitigation Measures and Effects Addressed

The standard mitigation measures described in this section are the measures that reduced the interactions to a ranking of "1" in Table 1 in Volume 2 Appendix A Project Interactions Matrix. The ranking of "1" was given where an adverse effect may result from an interaction, but standard mitigation measures to avoid or minimize the potential effects are available and well understood to be effective, and any residual effect is negligible. These mitigation measures will be employed to ensure that effects to navigation and aviation will be fully avoided or mitigated.

For other construction activities, a "1" ranking was assigned to Hudson's Hope shoreline protection, transmission tower installation, and conductor stringing. For operational activities, Hudson's Hope shoreline protection maintenance was assigned a "1". All other project activities and works listed in Volume 2 Appendix A Project Interactions Matrix, Table 1 were ranked as "0" because the activities do not interact with navigation or aviation.

26.1.3.1 Standard Measures – Navigation

The proposed Highway 29 bridge crossings as detailed in Volume 1 Section 4 Project Description were designed in consideration of future navigation use of the reservoir,

including crossings at Lynx Creek (Figure 26.1), Farrell Creek (Figure 26.2), Halfway River (Figure 26.3), and Cache Creek (Figure 26.4). Preliminary specifications for vessel clearances for bridge design were identified (BC Hydro 2013 in Volume 3 Appendix C Land and Resource Use Assessment Supporting Documentation, Part 5 Outdoor Recreation and Tourism, and Navigation), and further research on a variety of vessel types likely to use the Site C reservoir confirmed that a navigation envelope that accommodates 1.5 m of draft, 25 m horizontal clearance, and 8 m vertical clearance would support future navigation use.

The replacement Highway 29 bridges would not cause an adverse effect on navigability or navigational use, nor create a hazard to or interference with navigation. Highway 29 bridge crossings are not considered further in the assessment.

A description of the Project transmission lines is included in Volume 1 Section 4 Project Description. The NWPA Aerial Cables (Power and Communications) regulations (TP 14596) provides specific standards and criteria under which Transport Canada considers aerial cables (power and communications) projects to be minor works that do not require an application under the NWPA (Transport Canada 2009). These criteria are based on the terms and conditions outlined in Section 5 of the Minor Works and Waters Order (Transport Canada 2009). Based on a review of the standards and criteria, the majority of creek crossings would not require an application under the NWPA, as they are considered minor works. Two crossings, the Peace Canyon crossing and the Moberly River crossing, are deemed navigable (due in part to the width of the crossings) and would likely require approval from Transport Canada's Navigable Waters Protection Program. Safe navigation clearances (defined as the vertical clearance under the conductor at maximum sag, less allowance for electrical flash and allowance for suspension marker spheres) have been determined for the Peace Canyon crossing (safe navigational clearance of 37 m) and the Moberly River (safe navigational clearance of 13 m).

The transmission line clearances would not cause an adverse effect on navigability or navigational use, nor create a hazard to or interference with navigation. Transmission line clearances are not considered further in the assessment.

26.1.3.2 Standard Measures – Aviation

Project interactions with aviation that are well understood are based on avoiding intrusion to obstacle limitation surfaces. Obstacle limitation surfaces are established to protect aviation by restricting land use developments in proximity to airports. The Project's distance from, and variation in elevation above sea level to, the North Peace Regional airport is considered.

Transport Canada's document entitled Land Use in the Vicinity of Airports (TP 1247) outlines specific protection requirements used in the assessment of potential land use development effects on airports. Development applications and projects planned near airports must consider implications on airport operations. Obstacle limitation surfaces that establish the limit to which objects may project into an airport's airspace and still ensure that aircraft operations would be conducted safely are established to provide a satisfactory level of safety. The outer obstacle limitation surface represents a common plane established at a constant elevation above the assigned elevation extending at least 4 km from the reference point. This requires protection by the enactment of zoning regulations or legal instruments. Such regulations or legal instruments prohibit the

erection of structures that would violate any of the defined plane surfaces (Nav Canada, Supervisor Land Use Office 2012, pers. comm.).

Throughout construction, the Project would not affect the North Peace Regional airport from a land use perspective, as construction activities and resultant operations are outside the airport boundary and the established obstacle limitation surface (Nav Canada 2012b). The use of cranes and blasting is not anticipated to adversely affect airport operations during Project construction. BC Hydro will be required to submit a Land Use Proposal Submission and Aeronautical Obstruction form to obtain an approval prior to construction. The land use interaction is well understood and controlled by regulation and legal instruments; therefore, this interaction is not ranked as a “2” and there is no need to carry it forward to the effects assessment. Figure 26.9 illustrates the general location of the North Peace Regional airport in relation to the Project.

26.1.4 Selection of Key Indicators

The key indicators for the navigation (water and air) VC are presented in Table 26.3.

Table 26.3 Key Indicators for Navigation and Aviation

Key Aspects	Key Indicator	Rationale for Selection of the Key Indicators
Changes to navigability and navigation use of defined navigable waters	Defined existing navigable waters using the methodology outlined in the River Classification System established for rivers in B.C. Current navigation use (e.g., vessel/boat traffic) of the defined navigable waters for transportation, recreation, and commercial purposes	Determination of navigability provides a baseline to evaluate potential effects to navigability and navigation use. Current navigation use necessary to evaluate potential effects to navigability and navigation use.
Potential navigation hazards in waterways	Identification of navigation hazards	Identification of navigation hazards supports evaluation of potential effects associated with navigation hazards in waterways.
Navigation use restrictions	Current navigation use (e.g., vessel/boat traffic) of the defined navigable waters for transportation, recreation, and commercial purposes	Current navigation use evaluated in relation to potential project effects associated with navigation use restrictions.
Microclimate changes on aviation use at the North Peace Regional airport	Air navigation routes and current aviation visibility	Air navigation routes and visibility at North Peace Regional airport provides a baseline to evaluate potential microclimate effects.
Aviation use and visibility of structures and overhead wiring	Air navigation routes	Air navigation routes evaluated in relation to potential effects to aviation (e.g. visibility of structures and overhead wiring).
Changes to operation of ice bridges	Operating information for ferries and ice bridges at Shaftesbury and Tompkins Landing	Ice bridge operating information provides a baseline to evaluate potential effects.

26.1.5 Spatial and Temporal Boundaries

26.1.5.1 Spatial Boundaries

The Local Assessment Area (LAA) and Regional Assessment Area (RAA) in the EIS Guidelines for the assessment of the VC of navigation is the Project activity zone and the Peace River downstream to Peace Island Park, and the locations of the Shaftesbury and Tompkins Landing ice bridges. The areas used for reporting in this assessment were updated from the originally proposed spatial boundaries in the EIS Guidelines based on assessment of navigation for water-based navigation (navigation) and air navigation (aviation).

A navigable water is defined in the NWPA as any water body, natural or man-made, capable of carrying a water-borne vessel. This includes waters capable of being used for commerce, transportation, or recreation, and there is no limit on the size of stream considered navigable (Transport Canada 2012).

Determination of spatial boundaries are based on areas within a navigable water up to the ordinary high-water mark, defined as the visible high-water mark of any lake, stream, or other body where the presence and action of the water are common and usual (DFO 2012).

The Project activity zone consists of all areas in which Project components affect navigable waters up to the ordinary high-water mark, and extends from the Peace Canyon Dam downstream to Peace Island Park.

The upstream extent of the LAA and RAA is the Peace Canyon Dam, and the downstream extent is the Peace Island Park.

The LAA and RAA are both equal to the Project activity zone, but they also contain the site-specific inclusion of the Shaftesbury and Tompkins Landing ice bridge crossings.

The aviation LAA represents the area in which potential adverse effects are assessed from a land use perspective, defined as the extent of the obstacle limitation surfaces of airports as defined by Transport Canada. The RAA includes the area from North Peace Regional airport to the crest of the proposed Site C dam at the construction site.

Spatial boundaries are specified below in Table 26.4 and illustrated in Figure 26.5.

Table 26.4 Spatial Assessment Area for Navigation and Aviation

Navigation Aspect	Local Assessment Area	Regional Assessment Area
Navigation	Project activity zone downstream to Peace Island Park, and the Shaftesbury and Tompkins Landing ice bridge crossings	Project activity zone downstream to Peace Island Park, and the Shaftesbury and Tompkins Landing ice bridge crossings
Aviation	North Peace Regional airport and the associated obstacle limitation surfaces	Area from North Peace Regional airport to the crest of the potential Project construction site

26.1.5.2 Temporal Boundaries

The temporal boundary for the assessment is the Project construction and operations phases. The timing of the construction and operations phases, including construction and operations components and specific component activities, is described in Volume 1 Section 4 Project Description. The detailed schedules for the project components are also included within Volume 1 Section 4 Project Description, which provides specific information pertaining to the Site C dam, generating station, and spillway construction schedule, including river channelization, diversion, and reservoir filling.

26.2 Information Sources and Methods

26.2.1 Literature Review

Background reports, published regulations related to navigation and airport operations, interviews with local stakeholders, and field investigations were reviewed in compiling the baseline information. Information was obtained from the following technical data reports (also identified in Table 26.1) in the preparation of this assessment:

- 2012 Peace River (Project dam site) vessel transit survey (Renegade Construction Inc. 2012)
- Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan
- Volume 2 Appendix D Surface Water Regime Technical Memos
- Volume 3 Appendix E Outdoor Recreation Mitigation Plan
- Volume 2 Appendix G Downstream Ice Regime Technical Data Report
- Volume 2 Appendix I Fluvial Geomorphology and Sediment Transport Technical Data Report
- Volume 2 Appendix K Microclimate Technical Data Report
- Land Use in the Vicinity of Airports Guidelines (Transport Canada 2005)

26.2.2 Interviews

Volume 3 Appendix C Land and Resource Use Assessment Supporting Documentation, Part 1 Land and Resource Use Assessment Interview Methodology outlines details on the interview method used as part of those interviews. Navigation interviews were held with representatives of the Navigable Waters Protection Program and with local government representatives from nearby communities, including the Peace River Regional District (PRRD), City of Fort St. John, District of Taylor, and District of Hudson's Hope.

Interviews were held with representatives of the Peace Country River Rats, who represent recreational boaters on the Peace River. The membership of the organization has over 300 boats, and it is estimated that between two to five people participate in activities in each boat. The total number of recreational enthusiasts represented by Peace Country River Rats is estimated to range from 600 to 1,500 persons.

Aviation interviews were held with Transport Canada, NAV Canada, and the North Peace Regional airport.

26.2.3 Field Investigations

Field investigations were undertaken April 16 to April 18, 2012 to view the entire length of the Peace River; to identify baseline conditions, including the location of existing boat launches and recreational access points; and to ascertain the extent of proposed inundation on the Peace River and tributaries such as the Moberly and Halfway rivers, and Lynx, Farrell, and Bear creeks.

During the summer months of 2012, for the period of June 21, 2012 to September 7, 2012, vessel transits of the construction site were tracked providing additional insight into the number of transits past the dam site (Renegade Construction Inc. 2012).

The Peace River Angling and Recreational-Use Creel Survey Study 2008–2009 Final Report (LGL 2010) was undertaken to develop a baseline of current recreational use on the Peace River. Field surveys were completed in 2008–2009 (LGL 2010) to develop an understanding of outdoor recreation sites, features, and amenities, as well as use levels and activities. The survey objectives also included completion of an angler and creel survey. This study identified current use of the Peace River for boating, including key launch locations and routes.

26.2.4 Mapping and Modelling

Recreation sites, boat launches, highway access points, Hudson's Hope shoreline protection construction, transmission line construction, and the extent of inundation were referenced and mapped to illustrate baseline conditions and to undertake the effects assessment. Navigational sites of interest and potential enhancement areas were identified, based on the expected normal Site C reservoir operating level.

Proposed changes in downstream flows were also mapped in relation to navigability and navigational use.

26.2.5 Aboriginal Community and Traditional Knowledge

Aboriginal community and traditional knowledge related to the navigation VC were gained through review of results of BC Hydro's consultation with Aboriginal groups and through review of First Nations community baseline studies prepared and submitted to BC Hydro by the following Aboriginal groups: Doig River First Nation, Halfway River First Nation, Prophet River First Nation, and West Moberly First Nations, through the Treaty 8 Tribal Association, as well as Duncan's First Nation. Information and concerns raised in those studies are identified in Table 26.1.

Blueberry First Nations, Saulteau First Nations, McLeod Lake Indian Band, and Horse Lake First Nation are undertaking community baseline studies. BC Hydro had not received community baseline information from them at the time of writing. Should information be received that pertains to the navigation VC, it will be incorporated during the EIS review period.

First Nations community baseline reports are provided in Volume 3 Appendix B First Nations Community Baseline Reports.

BC Hydro's approach to integrating community-based social and economic information is described in Volume 3 Appendix B First Nations Community Baseline Reports, Part 1 Approach to Gathering and Integrating Community Baseline Information.

26.3 Baseline Conditions

26.3.1 River Classification: Peace River

Smith (2005) provides a river classification for the whitewater rivers in the Canadian Rockies based in part on the internationally recognized American Whitewater Association river classification system. The river classification system is used to determine the level of difficulty associated with navigating waterways. The classification system is based on a difficulty scale, ranging from class one waterways (the least difficult) to class six waterways (the most difficult). Most rivers have varying degrees of difficulty based upon water levels. The classification system is not an exact science, and classifications of rivers and rapids may vary with fluctuating water levels. The Peace River downstream of the Dinosaur reservoir is classified as a class one waterway, with some specific locations classified as class two. The definitions are as follows:

- Class One (easy): Fast moving water with riffles and small waves. The river has few obstructions, which are all obvious and easily missed with a little training. The risk to swimmers is slight and self-rescue is easy.
- Class Two (novice): Straightforward rapids with wide, clear channels that are evident throughout scouting. Occasional manoeuvring may be required, but rocks and medium-sized waves are easily missed by trained paddlers. Swimmers are seldom injured and group assistance, while helpful, is seldom needed.

The classification of potentially inundated portions of the Peace River tributary rivers is described below:

- Halfway River: Predominantly a “class 1” waterway at the mouth of the Peace River. Further upstream (6 km past the confluence), certain reaches exhibit more difficult class 1 water, and may be considered class 2 due to reduced channel width.
- Moberly River: Predominantly a “class 1” waterway consisting of a relatively wide wetted channel with the presence of oxbow features. Significant waterborn debris is evident throughout the entire river, deposited during periods of high flows associated with freshet. The debris creates potential obstacles to navigation, limitating the potential use of the river for navigation.
- Creeks tributary to Peace River (e.g., Lynx, Farrell, and Cache Creeks): These creeks would be considered “class 1” waterways, although they do not exhibit qualities of a good navigable waterway due to the narrow channel width, shallow depth, and the presence of obstacles to navigation (stumps, log jams, etc).

26.3.2 Current Navigational Use for Transportation, Recreation, and Commercial Purposes

Current navigational use of the Peace River in the vicinity of the Project is predominantly used by the public for recreational use, and by Aboriginal people. There is no known ongoing non-recreational commercial navigation on the waterway.

Current navigational use of the Peace River at Shaftesbury and Tompkins Landing is for public ferry operations in the ice-free periods and for ice bridges during ice cover

periods. These crossings are operated by the Alberta Ministry of Transportation as part of the public highways system.

Aboriginal groups have identified the historic and current importance of the Peace River and its tributaries for traditional use activities and transport, and for its cultural significance (Volume 3 Appendix B First Nations Community Baseline Reports, Part 7 Community Baseline Report and EIS Integration Summary Table for Doig River First Nation, Halfway River First Nation, Prophet River First Nation, and West Moberly First Nations and Part 3 Community Baseline Report and EIS Integration Summary Table for Duncan's First Nation). Aboriginal historical and current navigational use of the Peace River is discussed further in Volume 3 Section 19 Current Use of Lands and Resources for Traditional Purposes.

The Peace River Angling and Recreational-Use Creel Survey Study 2008–2009 Final Report (LGL 2010) (the recreational survey) provided insight into current recreational use on the Peace River. The recreational survey identified navigation activities, such as jet boating, fishing (whether vessels were used is not defined), boating, kayaking, and canoeing (Figure 26.6). Jet boating occurred most frequently, particularly on the Pine River, a tributary to the Peace River located downstream of the proposed dam site. Jet

boating also occurred in the Peace River from immediately downstream of the dam site to Clayhurst, near the Alberta border and, to a lesser extent, upstream of the dam site to Hudson's Hope. Boating and canoeing were also identified as navigational activities throughout the local assessment area, although boating in this area comprises a small percentage of the overall boating activity. Kayaking occurs between Peace Canyon Dam and Hudson's Hope. Figure 26.7 provides a summary of key recreation activities by location.

Peace Island Park boat launch, which provides access to the Pine River and the Peace River below the dam site, was the most utilized point of access. The recreational survey also identified Hudson's Hope, Lynx Creek, Lynx Creek RV Park, and Halfway River Bridge boat launches as access sites located upstream of the dam site and accessible via Highway 29. Figure 26.8 provides a summary of recreational access points.

The Peace Country River Rats confirmed that a survey of membership was undertaken to ascertain whether members had concerns associated with the proposed Project (survey undertaken in 2010). The results indicated that approximately 80% of the members were "neutral" regarding the proposed Project. Key areas of current use were identified by Peace Country River Rats as the Pine River (a tributary of the Peace River), due to its proximity to Peace Island Park and warmer temperatures promoting swimming in the summer. Upstream, the predominant destination is the Halfway River (another tributary of the Peace River). Interest downstream of the Site C dam site was also noted. Peace Country River Rats also considered the creation of the Site C reservoir a benefit that had the potential to increase Peace River boating use fourfold.

Throughout the summer of 2012, water-based vessel transits past the Site C dam site (June 21, 2012 through September 7, 2012) were counted (Renegade Construction Inc. 2012). A vessel transit was a boat that travelled past the dam site in one direction. The period of the survey was chosen to represent peak periods of use, and all transits were assumed to have originated and concluded from Peace Island Park based on the findings of the recreational survey. A total of 212 transits were observed during the 79-day survey period. Of that total, 108 transits occurred on weekends and 104 transits occurred Monday through Friday. By definition, one vessel trip would include the transit upstream and the return downstream transit. The number of total vessel trips is half of the total transits (e.g., 212 transits equates to 106 vessel trips).Therefore, the total number of vessel trips that occurred throughout the 79-day survey was 106, or approximately 1.3 vessel trips per day averaged over the peak recreation season, or 0.3 per day if averaged over the year.

No commercial or transportation specific transits were observed during the survey period.

26.3.3 Shaftesbury and Tompkins Landing Ferries and Ice Bridges

The Shaftesbury and Tompkins Landing ferries and ice bridges are part of the Province of Alberta's transportation network. The Peace River can be crossed at these locations via ferry operations during the ice-free periods and via ice bridges during the ice cover periods. Ice bridges, similar to the ferries, are considered part of the transportation network when operational. Once the Alberta Ministry of Transportation determines that the ice has enough depth and stability to support vehicles, the ice bridges become operational. The Duncan's First Nation have indicated that community members use the Shaftesbury River crossing in winter and summer seasons to access hunting grounds

(Volume 3 Appendix B First Nations Community Baseline Reports). Other Aboriginal groups have also indicated to BC Hydro that they have concerns regarding use of these ice bridges for travel.

The Shaftesbury Ferry is located on Highway 744, upstream of the Town of Peace River in Alberta. The Shaftesbury Ferry crossing is 325 m in length. The tug propulsion ferry is 22.56 m in length, with a beam of 12.12 m, a draft of 1.22 m, and a load capacity of 38,000 kg supporting two crew members, 46 passengers, and eight mid-sized cars. The ferry operating season is generally between early April and late November. The ice bridge is established after freeze-up, which generally occurs between November 9 and January 5, with breakup occurring between March 21 and May 7 (Alberta Ministry of Transportation 2012a).

The Tompkins Landing Ferry crossing is located on Highway 697 upstream of La Crete, Alberta, and is 680 m in width. The ferry has a load capacity of 95,000 kg, a length of 33.4 m, a beam width of 32 m, and a hull depth of 1.52 m. Carrying capacity includes two crew members, 60 passengers, and 14 mid-sized cars. Freeze-up at the ferry crossing occurs from November 9 to December 19, with breakup occurring between April 20 and May 15 (Alberta Ministry of Transportation 2012b).

26.3.4 Air Navigation Routes and North Peace Regional Airport

The North Peace Regional airport, located near Fort St. John, is the major airport in the region, and the only airport near the Project activity zone. It has two runways within the airports' legal boundaries. Navigational aids at the airport include the recently upgraded Instrument Landing System by Nav Canada. The airport is about 12 km from the Site C dam site. The elevation of the airport is 218 m higher than the Site C dam site (Figure 26.9).

The hours of normal fog (visibility less than 1,000 m) and heavy fog (visibility less than 500 m) respectively for the airport are outlined in the Microclimate Report (Volume 2 Appendix K Microclimate Technical Data Report). Baseline data were collected at a series of climate stations installed by BC Hydro in the Peace River valley within the LAA, and climate data were obtained from the existing station at the airport.

The data show that the greatest number of hours of fog and heavy fog currently occur during the fall and winter months at all locations. The airport currently experiences approximately 1,575 hours of fog and 1,500 hours of heavy fog per year.

26.4 Effects Assessment

26.4.1 Effects Assessment – Changes to Navigability and Navigation Use – Construction

26.4.1.1 Site C Dam, Generating Station, and Spillways

At the start of construction of the Site C dam, generating station, and spillways (Volume 1 Section 4 Project Description) BC Hydro would seek a restricted navigation zone on the Peace River within an area extending from approximately 3 km upstream to 3 km downstream of the dam site (Figure 26.13). Site C dam site construction activities would occur within the restricted zone. Debris booms would be placed, to catch woody debris, within this restricted navigation zone on the Peace River above the dam site, at

the mouth of the Moberly River and, in construction Year 2, a boom above this zone at Wilder Creek. There would also be temporary bridges constructed across the Peace River and at the mouth of the Moberly River, within the restricted navigation zone (Figure 26.13).

After filling of the reservoir, the Site C dam site restricted navigation zone would be limited to a permanent upstream forebay safety boom and a 3 km downstream restricted navigation zone (Figure 26.14). After reservoir filling, temporary debris booms would be placed at the mouth of the Moberly River and across the reservoir 12 km upstream at Wilder Creek (Figure 26.14).

The construction and operation of the dam and the associated restricted access zones would be a permanent barrier to navigation.

As water-based navigation within the restricted navigation zones would no longer be permissible, there would be an adverse effect on navigability and navigational use at this location.

26.4.1.2 Water Management During Confinement and Diversion

Section 11.4 Surface Water Regime in Volume 2 Section 11 Environmental Background provides details on the effect of confinement and diversion works on both upstream and downstream flows throughout construction. Upstream headponding would occur during river channelization and diversion due to reduced flow capacity at the Site C dam site, the extent of which will exceed beyond the upstream 3 km Site C dam site closure zone during the river diversion phase, noted above. Fluctuations in water levels upstream of the dam site would occur due to headpond level fluctuation. There would be limited difference in water level fluctuation downstream compared to baseline.

Overall, fluctuations in water levels during confinement and diversion are not expected to have an adverse effect on navigability and navigation use.

26.4.1.3 Site C Reservoir Filling

The Site C reservoir would be filled over a period of approximately three months (Volume 1 Appendix B Reservoir Filling). A minimum downstream flow of 390 m^3/s would be maintained, which would be sufficient to support river navigation downstream of the dam site. On the reservoir there would be rising water levels, and mobilization of shoreline woody debris, which could have an adverse effect on navigability and navigation use.

While filling is expected to occur in the fall, which would avoid the peak navigational use periods, the actual filling schedule will be affected by the construction schedule. Depending upon the timing of filling during the year, there may be a temporary adverse effect on navigability and navigation use upstream during Site C reservoir filling.

Site C reservoir filling will not affect navigation downstream; temporary upstream adverse effects on navigation would be expected depending on when during the year the filling occurs.

26.4.1.4 Access to Water-Based Navigation

There are a number of reservoir preparation activities, including clearing, Highway 29 realignment, and Hudson's Hope shoreline protection construction. Boat launches

located at Lynx Creek, Halfway River, and Hudson's Hope, as well as other unmanaged and recreational access points, would remain operational until such time as construction activities restrict access.

Access to the boat launch at Hudson's Hope ferry landing would be unavailable once the Hudson's Hope shoreline protection construction starts in Year 5. Access to the Lynx Creek and Halfway River boat launches may be affected by Highway 29 construction and clearing activities; however, BC Hydro and its contractors will seek to minimize these temporary disruptions to boating access points, and to maintain access points to, and navigable use of, the Peace River during construction.

After reservoir filling is completed near the end of construction Year 7, all existing boat launches within the Site C reservoir area, including Halfway River, Lynx Creek, Hudson's Hope ferry landing, would become permanently unavailable. Until the new boat launches are opened for use on the reservoir, there would be an adverse effect on access to water-based navigation.

Figures 26.12 and 26.13 illustrate expected areas and periods of restricted navigation during construction.

Downstream of the Site C dam site, the ability to navigate and the provision of access will be unaffected by the Project during construction. Adverse effects on water-based access to navigation would result during construction.

26.4.2 Effects Assessment – Changes to Navigability and Navigation Use – Operations

26.4.2.1 Site C Reservoir Sedimentation

Navigability of waterways can be affected by sedimentation. For example, in summer 2011, a very high inflow event changed river morphology in the Halfway and Moberly rivers, which changed the locations of natural river bars and depths, and therefore changed navigation conditions. Sedimentation as a result of the Project is considered in the context of ongoing natural changes that would be expected to occur regardless of the Project.

The Site C reservoir sedimentation study (Volume 2 Appendix I Fluvial Geomorphology and Sediment Transport Technical Data Report) evaluated the morphological changes due to sedimentation in the Site C reservoir over 10-year and 50-year periods. The Site C reservoir sediment modelling confirmed that sedimentation would occur in all of the tributaries, especially the Halfway River.

Over the 50-year period evaluated in the study, a navigational channel with adequate depth clearance would be retained, enabling vessels to transit the reach of the Halfway River influenced by the Site C reservoir.

Overall, sedimentation of the Site C reservoir and tributaries are not expected to affect navigability and navigation use.

Water Management, Depth, and Channelization during Operations

Peace River flows are regulated by the existing upstream hydroelectric facilities at the G.M. Shrum and Peace Canyon generating stations, which came into operation in the early 1960s and 1980s, respectively. Today there are flow variations downstream of the Peace Canyon Dam, which are not dampened by tributary inflows until the Halfway

River. The Peace River in this reach is currently navigable. A third hydroelectric facility on the same river would shift the point of flow regulation from Peace Canyon Dam to the Site C dam site.

At Taylor, approximately 20 km downstream of the Site C dam site, high flows would occur more frequently and there would be an increase in the variability of water levels given its proximity to the point of regulation, similar to what is currently experienced in the vicinity of Hudson's Hope. Considering that the operation of Site C would be passing flows from Peace Canyon, and considering that there is a higher absolute minimum flow from Site C of 390 m^3/s, it would be expected that navigation conditions would be similar to those experienced in the vicinity of Hudson's Hope today. Inflow from the Pine River, upstream of Taylor and Peace Island Park, would dampen the flows from Site C. Further downstream on the Peace River, the addition of flows from tributaries continues to reduce flow variability, until at the Town of Peace River, Alberta, which is approximately 300 km downstream of the Site C dam site, where the influence of the Project on flows and water levels is expected to be minimal. See Section 11.4 Surface Water Regime in Volume 2 Section 11 Environmental Background for further discussion on water management during operations.

Overall, water management during operations is not expected to affect navigability and navigation use.

Figures 26.10 and 26.11 illustrate water depths and river channelization in the Peace River downstream of the Site C dam site to Taylor at the proposed minimum flow from Site C of 390 m^3/s.

Based on the 390 m^3/s minimum flows modelled downstream of the Site C dam site, there would be adequate water depth and a continuous channel to accommodate navigation (Volume 2 Appendix D Surface Water Regime Technical Memos). Changes in river flows due to the Project are not expected to influence the downstream erosion and deposition patterns; therefore, no incremental changes to the dynamic baseline patterns are predicted (Section 11.8 Fluvial Geomorphology and Sediment Transport in Volume 2 Section 11 Environmental Background).

Overall, from the point of regulation downstream to Taylor, no effects to navigability and navigation use are anticipated.

26.4.3 Mitigation Measures – Changes to Navigability and Navigation Use

The construction and operation of the dam, and the associated restricted navigation zones, would be permanent. Several key mitigation measures that support navigability and navigation use will be implemented during the Project construction and operations phases on the new reservoir.

The construction and operations Public Safety Management Plans represent the key tools that will be used to communicate with the boating public about changes to navigability and navigation use, and about hazards and navigation restrictions. The Public Safety Management Plans and supporting boater communication protocols will be based on established marine communication plans developed for other major infrastructure projects throughout B.C. which included input from the Navigable Waters Protection Program, local user groups and Aboriginal groups' involvement.

During construction, water-based navigation within the restricted navigation zones at the Site C dam site would no longer be permissible. The construction Public Safety Management Plan will inform users of access changes to water-based navigation and will identify alternative access points and areas where navigation is permitted. Signage for public safety around dams will be developed in accordance with the Guidelines for Public Safety Around Dams (CDA 2011) adopted by BC Hydro.

Areas upstream and downstream of this affected reach, including the Halfway River, the Peace River, Peace Island Park, and the Pine River (a key destination of users downstream of the Site C dam site), would be unaffected by the Project and would provide alternative boating recreation areas.

During the Project operations phase, the Site C reservoir would offer new recreation opportunities and a changed navigation environment. BC Hydro will fund the development of a Navigation and Recreation Opportunities Plan. This plan will enable the local communities, including Hudson's Hope, Fort St. John, and Taylor, and Aboriginal groups to plan for recreation opportunities created by the Site C reservoir. BC Hydro proposes that the planning process commence in the initial years of Site C reservoir operations, to provide an opportunity for the communities and Aboriginal groups to experience and develop a vision for recreation and boating over the long term.

Volume 3 Appendix E Outdoor Recreation Mitigation Plan provides further detail on the Site C Outdoor Recreation mitigation plans, which are largely relevant to navigation during operations. Mitigative measures relevant to navigability and navigation use include:

- Development of three boat launches along the Site C reservoir to replace the Halfway River and Lynx Creek boat launches and the Hudson's Hope ferry landing boat launch. The new boat launches, complete with upgraded amenities, will be located at Hudson's Hope, Lynx Creek, and Bear Flat (Figure 26.14).
- BC Hydro will provide a Community Recreation Site Fund to support development of new shoreline recreation within the Peace River and tributaries through to the Alberta border as well as the Site C reservoir
- BC Hydro will provide technical support to outdoor recreation providers that require access to the Site C reservoir (such as RV parks, campgrounds, and marinas operated by the private sector, as well as local, regional, or provincial governments) to assist with their development along, or adaptation to, new shoreline conditions

Replacement and use of Lynx Creek, Bear Flat, and Hudson's Hope boat launches will occur during the first or second year after Site C reservoir filling, based on evaluation of reservoir conditions and public safety.

26.4.4 Effects Assessment – Potential Navigation Hazards in Waterways – Construction

26.4.4.1 Debris Management

Floating debris can be a boating safety concern. The Project clearing plan proposes a debris management plan that will be initiated during the construction phase to collect floating debris from the Peace River upstream of the dam site. The Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan provides further

information on proposed debris management and on the use of temporary bridges for clearing access.

During Year 1, a debris boom would be deployed above the Site C dam site and at the mouth of the Moberly River, both of which are within the dam site restricted navigation zone. During Years 2 to 7 of construction, the upstream extent of the restricted navigation zone would be extended with a debris boom and trap deployed near Wilder Creek. The Peace River upstream of the Wilder Creek debris boom would remain open to navigation throughout Years 2 to 7. Refer to Figure 26.12 for the location of the debris booms.

Overall, debris management during construction will be managed, and adverse effects are not anticipated.

26.4.5 Effects Assessment – Potential Navigation Hazards in Waterways – Operations

26.4.5.1 Submerged Vegetation and Debris Management

Based on the normal operating level of the Site C reservoir of between 460 m and 461.8 m, trees that have an elevation exceeding 455 m would be topped or removed (Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan). Removal of vegetation above 455 m would eliminate submerged boating hazards.

The proposed advance clearing of vegetation within areas predicted to erode within five to 10 years would remove vegetation that would otherwise fall into the Site C reservoir and become floating debris. This management measure will reduce the recruitment of floating debris on the reservoir, and therefore will reduce the navigational hazards during early Site C reservoir operations. Clearing of this shoreline area will also facilitate shoreline use, including boat access.

BC Hydro will implement an ongoing debris management program during operations immediately following reservoir filling that will include various measures, including the potential use of debris booms at strategic locations throughout the Site C reservoir. The debris boom placements are proposed at Wilder Creek and the confluence of the Moberly River embayment, with deployment for several years during freshet (approximately June through August), depending on the amount of debris accumulations and the duration of reservoir clearing. A permanent debris and dam safety boom will be placed directly upstream of the Site C dam site. Refer to Figure 26.14 for the location of the debris booms.

Refer to Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan for further information on the reservoir clearing and debris management strategy.

Removal of the submerged forest canopy to the 455 m elevation, advanced removal of shoreline vegetation, and debris management would be beneficial to water-based navigation on the reservoir over the long term.

26.4.6 Mitigation Measures – Potential Navigation Hazards in Waterways – Operations

26.4.6.1 Public Safety Management Plan

The operations phase Public Safety Management Plans and supporting boater communication protocols would communicate navigational hazards to boaters (see Volume 5 Section 35 Summary of Environmental Management Plans). Signage as required will be provided in accordance with the Guidelines for Public Safety Around Dams (CDA 2011).

26.4.7 Effects Assessment – Navigation Use Restrictions – Construction

26.4.7.1 Vegetation Clearing and Temporary Bridges

Site C reservoir clearing activities are expected to take place over a four-year period. The majority of the clearing would be done during the winter months; however, scheduling issues may require clearing activities to occur during other periods. Navigation use restrictions would be implemented around active clearing areas as necessary to ensure boater safety. Refer to Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan for a further discussion on the Site C reservoir clearing schedule and clearing access.

To undertake clearing, the Site C reservoir would be accessed using temporary roads and bridges and using helicopters. Crossings may include the installation of temporary bridges or snow crossings. Depending on the length of span, abutment bridges or piling bridges may be used. Snow-crossing construction involves placing a box culvert over a drainage, whereupon it is covered by snow, ice, or gravel. Crossings would typically be sited in areas not commonly used for navigation, such as side channels.

Construction phase navigation use restriction areas and proposed temporary bridge crossings are illustrated on Figures 26.12 and 26.13.

Adverse effects on water-based navigation would result from vegetation clearing.

26.4.8 Effects Assessment – Navigation Use Restrictions – Operations

26.4.8.1 Site C Reservoir Stabilization and Debris Management

Potential erosion areas, potential slope stability areas of concern (preliminary stability impact line), and the potential for landslide-generated waves resulting from such slope stability concerns (preliminary wave impact line) represent potential areas in which public safety and navigational use could be affected (Volume 2 Appendix B Geology, Terrain Stability, and Soil Reports). Specific areas include:

- The mouth of Lynx Creek
- The mouth of Farrell Creek
- The mouth of Halfway River opposite the historical Attachie Slide area

Figure 26.14 illustrates these areas and a recommended one-year post-filling Site C reservoir navigational restriction due to anticipated shoreline erosion and landslide potential. Site C reservoir navigation access is anticipated after the second year, based

on monitoring of reservoir conditions related to slope stability and debris management. Site C reservoir areas downstream of Wilder Creek and the Moberly River embayment could be restricted for a slightly longer period due to anticipated ongoing debris management activities.

The restricted access to the new reservoir would adversely affect water-based navigation during the early years of the Site C reservoir. The Peace River and areas downstream of the Site C dam site, including the Pine River and the Peace Island boat launch, would remain unaffected by the Project.

26.4.9 Mitigation – Navigation Use Restrictions

The Public Safety Management Plans and supporting boater communication protocols represent the key communication tools utilized to address adverse effects throughout construction and the early years of operations. In addition to addressing navigational restrictions outlined, the plan will also address identified hazards and interferences to navigation as well as changes to navigability and navigation use.

The Public Safety Management Plans and supporting boater communication protocols will be based on current BC Hydro safety practices and on input from Transport Canada, based on their experience with other navigation restrictions. Refer to Volume 5 Section 35 Summary of Proposed Environmental Management Plans for further discussion of the Public Safety Plans to be developed for Project construction and operations.

26.4.10 Effects Assessment – Changes in Microclimate on Aviation – Operations

The potential for increases in fog frequency and density were assessed in relation to microclimate changes, due to changes in downstream water temperature, for the North Peace Regional airport. The microclimate study evaluated how the Project might influence the local climate (Volume 2 Appendix K Microclimate Technical Data Report), with a focus on changes in fog as it relates to aviation visibility. The technical report calculated resultant changes in poor visibility hours (fog) based on the Weather Research and Forecasting Numerical Model.

Visibility, as classed into various ranges from less than 500 m to greater than 20 km, was examined to determine the potential for change at the North Peace Regional airport as a result of the Site C reservoir (Table 26.5). The combined total number of clear hours with visibility greater than 20 km, and hours with visibility 10 km to 20 km was predicted to be reduced by 15 hours over the year. The number of hours with visibility in the range of 1 km to 10 km was predicted to increase by eight hours over the year.

The number of hours of poor visibility (heavy fog, less than 500 m) was predicted to increase by six hours per year with the Project, with the greatest seasonal increase occurring in fall, with 16 hours of fog and 14 hours of heavy fog predicted.

The results reflected a small percentage change from the baseline, and the base quantities of temperature and moisture (upon which fog is determined) do not show statistically significant changes beyond 1 km of the reservoir. The North Peace Regional airport is approximately 12 km from the reservoir.

Table 26.5 Predicted Changes in Visibility at North Peace Regional Airport

Seasons	Visibility					
	Clear		Moderate		Poor	
	> 20 km	10–20 km	5–10 km	1–5 km	0.5–1 km	< 0.5 km
Spring						
Baseline Case	1,914	9	16	37	20	188
Future Case with the Project	1,919 (+5)	9 (0)	9 (-7)	45 (8)	18 (-2)	184 (-4)
Summer						
Baseline Case	1,980	8	10	33	22	155
Future Case with the Project	1,977 (-3)	5 (-3)	14 (4)	31 (-2)	25 (3)	156 (1)
Fall						
Baseline Case	1,689	9	7	19	16	468
Future Case with the Project	1,674 (-5)	7 (-2)	6 (-1)	21 (2)	18 (2)	482 (14)
Winter						
Baseline Case	1,441	2	8	17	14	684
Future Case with the Project	1,444 (3)	2 (0)	7 (-1)	22 (5)	12 (-2)	679 (-5)
Year						
Baseline Case	7,024	28	41	106	72	1,495
Future Case with the Project	7,014 (-10)	23 (-5)	36 (-5)	119 (13)	73 (1)	1,501 (6)

NOTE:
Shown are hours per year within each visibility class. The change is given in brackets.

The Project is not expected to have an adverse effect on aviation visibility due to changes in fog conditions at the North Peace Regional airport.

26.4.11 Visibility of Structures and Overhead Wiring, and Proposed Temporary Aviation Restrictions – Construction

Aviation Project interactions associated with visibility of structures and overhead wiring are based on adhering to Transport Canada's document entitled Land use in the Vicinity of Airports (TP 1247) (Nav Canada 2012a). The Project's distance from, and variation in elevation above sea level to, the North Peace Regional airport is considered.

Development applications and projects planned near airports must consider implications on airport operations. Obstacle limitation surfaces that establish the limit to which objects may project into an airport's airspace and still ensure that aircraft operations would be conducted safely are established to provide a satisfactory level of safety. The outer obstacle limitation surface represents a common plane established at a constant elevation above the assigned elevation extending at least 4 km from the reference point. This requires protection by the enactment of zoning regulations or legal instruments. Such regulations or legal instruments prohibit the erection of structures which would violate any of the defined plane surfaces (Transport Canada 2005).

Throughout construction, the Project would not affect the North Peace Regional airport from a land use perspective, as construction activities and resultant operations would be

outside the airport boundary and the standard obstacle limitation surface (Transport Canada 2005). The use of cranes and blasting is not anticipated to adversely affect airport operations during Project construction, based on a review of the Aeronautical Obstruction form requirements (Nav Canada 2012b) and on the vertical difference between the Site C dam crest and the airport.

This interaction is well understood and regulated, and can be avoided through the application of standard procedures. This topic is addressed in Section 26.1.3, Standard Mitigation Measures and Effects Addressed, and was not considered further in the effects assessment.

26.4.12 Effects Assessment – Shaftesbury and Tompkins Landing Ice Bridges and Ferries – Operations

At Shaftesbury crossing, the analysis of changes to ice formation downstream of the Project has identified a potential for a shift in the relative operating periods of the Shaftesbury Ferry versus the ice bridge. On average, the ferry operations may extend four days longer into the fall, with a maximum extension of two weeks in some years (Volume 2 Appendix G Downstream Ice Regime Technical Data Report).

This would result in a delay in the installation of the Shaftesbury ice bridge by about five days on average relative to existing conditions, with a range of year-to-year delays of 0 to 14 days. With the Project, the average duration of operations of the Shaftesbury ice bridge would be reduced to 71 days, compared to 75 days under existing conditions. The Project would not affect total number of crossing days considering both ferry and ice bridge operations.

The Project would not affect ice bridge or ferry operations at Tompkins Landing. Modelling results showed no Project-related change in the timing of freeze-up and breakup at km 694, the location of the Tompkins Landing Ferry.

As the total number of crossing days at the Shaftesbury and Tompkins Landing are not expected to change, there would be no adverse effect on navigation at these locations.

26.5 Effects Assessment and Mitigation Measures

This assessment evaluated six potential effects to the navigation VC:

- Changes to navigability and navigation use of defined navigable waters
- Potential navigation hazards in waterways
- Navigation use restrictions
- Microclimate changes on aviation use at North Peace Regional airport
- Aviation use and visibility of structures and overhead wiring
- Changes to operation of ice bridges

26.5.1 Effects and Mitigation Measures

The communication of navigational restrictions, per the Public Safety Management Plan and supporting boater communications, will mitigate potential effects associated with hazards to navigation and restrictions to navigation at the Site C dam site. Effective

boater communications will provide useful information that will help boaters to plan their trip; will clearly articulate any restrictions, interferences, or public safety issues to boaters and the public; and will provide information about alternative boating areas or launches, when restrictions are in place.

Navigational use of the Peace River upstream of the Site C dam site will continue during construction, and the Lynx Creek and Halfway River boat launches will remain open to public use, provided they do not pose a conflict to construction activities. Throughout construction, the Peace River downstream of the Site C dam site will remain accessible and navigable at all times.

During Project operations, BC Hydro will monitor the reservoir shoreline conditions, will undertake debris management, and will open the boat launches and reservoir to public use as soon as conditions safely allow.

Also during Project operations, to facilitate the anticipated increase in use and accommodate new boating and navigational opportunities, BC Hydro will fund a Navigation and Recreation Opportunities Plan for the Site C reservoir. The plan will facilitate local and regional governments' involvement to plan for and optimize the benefits anticipated to be created as a result of the Site C reservoir.

With mitigation, the Project will have a residual adverse effect on navigability and navigational use at the Site C dam site, due to the permanent restriction of navigation at the dam site.

Potential effects and mitigation measures for the navigation VC are summarized in Table 26.6.

Table 26.6 Project Effects and Mitigation Measures on Navigation

Valued Component	Project Phase	Potential Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Navigation	Construction	Changes to navigability, navigational use, and access	A boater communications plan, as part of the Public Safety Management Plan, will provide recreational boaters with information about restricted navigation zones at the dam site, and any temporary navigation or boat launch access closures associated with active work areas for reservoir clearing, Highway 29 relocation, and Hudson's Hope shoreline protection construction. This will support boater trip planning and safety during the Project construction period. Develop three boat launches along the Site C reservoir accessible via Highway 29 to support navigability and navigational use. BC Hydro proposes to fund community groups to support re-establishment of recreational sites on the Site C reservoir and downstream, and to re-establish and create new use patterns and access. BC Hydro will provide technical support to outdoor recreational providers to facilitate further public and private sector investment opportunities associated with the use of the Site C reservoir and downstream. BC Hydro will fund the development of a Navigation and Recreation Opportunities Plan intended to enable the local communities to plan for boating and recreation opportunities created by the Site C reservoir.	Boaters will be able to plan effectively with the information provided in a boater communications plan. Mitigation supports future use opportunities, and expansion of activities and areas in which one can navigate. Access to the Site C reservoir is improved, and amenities are enhanced. The development and implementation of the Navigation and Recreation Opportunities Plan represents a significant Project enhancement and an innovative approach to optimizing opportunities. The Site C dam and the associated permanent restriction to navigation represent an adverse residual effect that remains after mitigation measures are in place.	BC Hydro and its contractors
		Potential navigation hazards in waterways	None required		
		Navigation use restrictions	BC Hydro's Public Safety Management Plan and supporting boater communication protocols, inclusive of adhering to the Canadian Dam Association Guidelines for Public Safety Around Dams, will address navigability and navigational use, and the identification of potential hazards and interferences in waterways. Areas that remain open to navigation and are accessible during construction (inclusive of boat launches and other public access) will be communicated to users and the public at large.	The implementation of the BC Hydro Public Safety Management Plan and supporting boater communication protocols will mitigate potential navigational restrictions throughout construction and in the early years of the Site C reservoir operations. No residual adverse effects are anticipated	BC Hydro and its contractors

Valued Component	Project Phase	Potential Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Navigation	Operations	Changes to navigability, navigational use, and access	A boater communications plan, as part of the Public Safety Management Plan, will provide recreational boaters with information about any temporary navigation restrictions or public safety concerns during the early years of Site C reservoir operations. See also mitigation implemented in the construction phase.	Continuation of communication of navigational risks, per the Public Safety Management Pan and boater communication protocols, throughout the early years of the Site C reservoir operations fully mitigates the effect. No adverse residual effects are anticipated.	BC Hydro
		Potential navigational hazards in waterways	The operations phase Public Safety Management Plans and supporting boater communication protocols will communicate navigational hazards to boaters. Signage, as required, will be provided in accordance with the Guidelines for Public Safety Around Dams.	Continuation of communication of navigational risks, per the Public Safety Management Pan and boater communication protocols, throughout the early years of the Site C reservoir operations fully mitigates the effect. No adverse residual effects are anticipated.	BC Hydro
		Navigation use restrictions	BC Hydro's Public Safety Management Plan and supporting Boater Communication Protocols will continue throughout the early years of the Site C reservoir operations	Continuation of communication of navigational restrictions, per the Public Safety Management Plan and boater communication protocols, fully mitigates the effect. No adverse residual effects are anticipated	BC Hydro
Navigation	Operations	Changes to microclimate	None required		
Navigation	Construction	Changes to visibility of Structures and Overhead Wiring	None required		
Navigation	Operations	Changes to Shaftesbury and Tompkins Landing ferry and ice bridge operations	None required		

26.5.2 Other Mitigation Options Considered

The option for a new boat launch closer to Fort St. John was considered; however, issues related to topography and private land ownership were barriers. Of the three proposed new BC Hydro reservoir boat launches, the closest launch will be located 30 km from Fort St. John at Bear Flat.

26.6 Residual Effects

26.6.1 Characterization of Residual Effects

The residual effects are characterized according to Table 8.3 of the EIS Guidelines. The definitions of the criteria are provided in Table 26.7. The residual effects on navigation and aviation were characterized by considering the key aspects described in Section 26.4.

Table 26.7 Characterization Criteria for Residual Navigation and Aviation Effects

Criterion	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	This refers to the ultimate long-term trend of the environmental, social, economic, heritage, or health (e.g., increase, decrease, or neutral).	**Adverse:** condition of the VC is worsening in comparison to baseline conditions and trends
		Positive: condition of the VC is improving in comparison to baseline conditions and trends
		Neutral: condition of the VC is unchanged in comparison to baseline conditions and trends
Magnitude	This refers to the amount of change in a key indication or variable relative to baseline case (low, moderate, high). Consideration is given to such factors such as the uniqueness of the effect and comparison to natural or background variation.	**Low:** effect is negligible from baseline conditions
		Moderate: effect would cause an increase with regard to baseline, but is within historical norms
		High: effect results in changes beyond historical norms
Geographical Extent	The geographic area in which an environmental, economic, social, heritage, or health effect of a defined magnitude occurs.	**Site-specific:** the expected measurable changes are within the Project activity zone
		Local: the expected measurable changes are within the LAA
		Regional: the expected measurable changes are within the RAA
Frequency	The number of times during a project or a specific project phase that an environmental, economic, social, heritage, or health effect may occur.	**Once:** occurs once
		Continuous: occurs on a regular basis and at regular intervals
		Sporadic: occurs rarely and at irregular intervals
Duration	The period of time required until the VC	**Short-term:** effect is limited to < 1 year

Criterion	Description	Quantitative Measure or Definition of Qualitative Categories
	returns to its baseline condition, or the effect can no longer be measured or otherwise perceived.	**Medium-term:** effect occurs > 1 year, but not beyond the construction of the Project
		Long-term: effect lasts beyond the construction phase and up to 10 years of the operations phase
		Far future: effects extends > 10 years for the life of the Project
Reversibility	This refers to the degree or likelihood to which to which the existing baseline conditions can be regained after factors causing the effect are removed. Effects can be reversible or irreversible.	Effect **reversible** with reclamation and/or over time
		Effect **permanent** and cannot be reversed with reclamation and/or over time
Context	This refers to the extent to which the area within which an effect may occur has already been adversely affected by human activities, is ecologically fragile, and has little resilience and resistance to imposed stresses.	**Resilient:** the area is resilient to change because new infrastructure and opportunities can replace the existing ones
		Not resilient: the area has little resilience to change, as new infrastructure and opportunities could not overcome changes to the baseline
Level of Confidence	This is an evaluation of the scientific certainty one has in the review of project-specific data, relevant literature, and professional opinion. The EIS will include a statement on the level of confidence in the assessment of direction magnitude, extent , duration, frequency, and reversibility.	**Low:** Low certainty and understanding of effect results in concerns regarding effectiveness of mitigation
		Moderate: Moderate certainty and understanding of effect results in a number of concerns regarding effectiveness of mitigation
		High: High certainty and understanding of effect confirms certainty and effectiveness of mitigation
Probability	The likelihood that an adverse effect would occur	**Low:** effect is unlikely to occur
		High: effect is almost certain to occur
		Unknown: likelihood is unknown

During construction and operation, the magnitude of the adverse effect on navigability of the Peace River, due to the restriction in access past the dam site, would be low, as boaters would still be able to access both the areas upstream and downstream of the dam site from launches in these locations. The baseline information shows that navigation use in the LAA is recreational, that vessel transits generally originate from and return to the same boat launch, and that the key point of current access is the Peace Island Park boat launch. The vessel transit count in 2012 identified an average of 1.3 vessel transits per day past the dam site during the peak recreation season, whereas the outdoor recreation assessment identifies that as many as 100 boats per day may be elsewhere, on other reaches of the Peace River or on local tributaries. With the Project, boaters who are destined for upstream areas would still be able to access these areas using the new boat launches on the reservoir. Boaters destined for downstream areas would still be able to access these areas using the Peace Island or Clayhurst boat launches.

The social context is one of resilience, in that boaters will be able to adapt to new conditions by planning for their trip in a manner that would not require transit past the dam site in order to reach either upstream or downstream destinations. The mitigation measures proposed would provide enhanced access, facilities, and opportunities for recreation on the Site C reservoir. The Bear Flat boat launch would be 30 km from Fort St. John, which would be closer than the current site at Halfway River, and will have enhanced amenities such as parking and day use areas. All three reservoir launches would provide access to boating destinations upstream such as Halfway River and Hudson's Hope. In addition, the key destinations downstream, such as the Pine River and the Peace River to Clayhurst, remain accessible via the Peace Island and Clayhurst boat launches, maintaining and providing for a further variety and a choice of experience for users, including a riverine environment in which to navigate. These opportunities are described in Section 26.4.3.

Geographic context of the effects would be site-specific, only affecting transit past the dam site. All other navigation considerations within the LAA were deemed to have no residual adverse effects. The dam, as a permanent structure, would result in far future, continuous, and permanent change to navigability. The probability of an adverse effect on navigability, and the level of confidence in this assessment, is high.

Table 26.8 summarizes residual effects on navigation and aviation.

Table 26.8 Characterization of Residual Navigation and Aviation Effects

Effect	Phase	Residual Environmental Effect								
		Direction	Magnitude	Geographical context	Duration	Frequency	Reversibility	Social Context	Level of Confidence	Probability
Changes to navigability and navigation use	Construction	Decrease (adverse)	Low	Site specific	Far-future	Continuous	Permanent	Resilient	High	High

26.6.2 Standards or Thresholds for Determining Significance

All of the residual effects criteria were taken into consideration in the determination of significance, as described above in Section 26.6.1. Particular consideration was given to magnitude, geographic context, duration, and social context, since together they are the key criteria for understanding change in relation to navigability and navigation use, and how area users would experience or adapt to change in relation to the Project. Specifically:

- Magnitude is an important factor in identifying the extent to which navigability and navigation use would continue to be available upstream and downstream of the dam site
- Geographical extent is an important factor in identifying the area of navigability and the navigation use that would be affected
- Duration is an important factor in identifying the length of time for which navigability and navigation use would be affected, and whether the change would be considered permanent
- Social context was considered in relation to the future navigation environment and ability for people and communities to adapt to changes (resiliency) through new infrastructure and navigational opportunities

Significant adverse residual effects on navigation would occur if the following thresholds combined were exceeded:

- Magnitude is moderate or high
- Geographical extent is local or regional
- Duration is long term or far future
- Social context is not resilient

26.6.3 Determination of Significance of Residual Effects

When the above residual effects criteria are considered in combination, the magnitude of the effect is low, the geographical extent is site-specific, and the duration is generally far future (i.e., while new infrastructure is being developed, some navigation opportunities will be reduced; however, over the far future, navigation experiences and opportunities would not be less than the baseline, but in fact would be expanded to include new types of navigable uses on the reservoir). With the Project being located in a resilient social context, it is assumed that people and communities will be able to adapt to these changes in navigation experiences and opportunities.

Considering all aspects of the navigation VC, and implementation of the mitigation measures, the Project's net effect on navigation is considered not significant (Table 26.9).

Table 26.9 Summary of Assessment of Potential Significant Residual Adverse Effects

Valued Component	Project Phase	Potential Adverse Effects	Key Mitigation Measures	Significance Analysis of Residual Effects
Navigation	Construction	Changes to navigability and navigation use	A boater communications plan, as part of the Public Safety Management Plan, would enable trip planning and safety for boaters' recreational boating activities in consideration of the restricted navigation zones at the dam site, and of any temporary navigation or boat launch access closures associated with active work areas for reservoir clearing, Highway 29, and Hudson's Hope shoreline protection construction. Development of three boat launches, accessible via Highway 29, along the Site C reservoir provides more accessible, improved boat launch facilities that would support navigability and navigational use. BC Hydro proposed funding to community groups to re-establish recreational sites on the Site C reservoir and downstream, and will re-establish and create new use patterns and access. BC Hydro provision of technical support to outdoor recreational providers facilitates further public and private sector investment opportunities associated with the use of the Site C reservoir and downstream. BC Hydro will fund the development of a Navigation and Recreation Opportunities Plan intended to enable the local communities to plan for boating and recreation opportunities created by the Site C reservoir.	Not significant

26.7 Cumulative Effects Assessment

26.7.1 Screening of Cumulative Effects

A screening of the Project's potential contribution to the cumulative effects of past, current, and announced future projects was done according to the procedures described in Volume 2 Section 10 Effects Assessment Methodology. The screening process establishes two conditions to warrant further assessment. These conditions are:

- The Project results in a residual effect
- The effect is likely to act in a cumulative fashion with those of other projects and activities (i.e., spatial and temporal overlap) within the RAA

The project results in a residual effect on water-based navigation. There are no other water-based projects within the RAA. Although the Project overlaps in time and space with recreational activities in the RAA, there is no adverse cumulative effect of these activities combined with the Project on water-based navigation.

26.8 Monitoring and Follow-Up

As described in Volume 5 Section 35 Summary of Environmental Management Plans, BC Hydro will commit to regular monitoring of shoreline conditions during the early years of Site C reservoir operations. Monitoring program results would support implementation of prescribed Public Safety Management Plan boater communication protocols related to managing for navigation hazards and public safety within the Site C Reservoir.

BC Hydro will be responsible for the implementation of proposed mitigation measures, including mitigation identified in the Volume 3 Appendix E Outdoor Recreation Mitigation Plan.

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