SITE C CLEAN ENERGY PROJECT

Vegetation Clearing and Debris Management Plan

Site C Clean Energy Project

Revision 1: June 5, 2015

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Revision History

Version	Date	Comments
Draft	10-17-2014	**Draft**
Rev 0	05-19-2015	**Final Plan**
Rev 1	06-05-2015	**Final Plan, Revision 1**

Abbreviations and Acronyms

FLNRO ....British Columbia Ministry of Forest, Land and Natural Resource Operations

BC MOE ....British Columbia Ministry of Environment

BEC ....Biogeoclimatic Ecosystem Classification

BWBS ....Boreal White and Black Spruce zone

Ha .... Hectare

IFS... Industrial Forestry Service Ltd.

EIS.. Environmental Impact Statement

Km ....Kilometre

Kv .... Kilovolt

LiDAR .... Light Detection and Ranging

MW .... Megawatt

MoTI ....B.C. Ministry of Transportation and Infrastructure

OBSCR.. Open Burning Smoke Control Regulation

ROW...Right-of-way

GLOSSARY

Barge	A roomy, usually flat-bottomed boat used chiefly for the transport of goods on waterways and usually propelled by towing.
Bioenergy	Renewable energy made available from materials derived from biological sources (energy derived from biomass).
Biomass	Dry weight of organic matter (*i.e.*, plants and animals) in an ecosystem.
Boreal	Of or relating to the forest areas of the northern North Temperate Zone, dominated by coniferous trees such as spruce, fir, and pine.
Box Culvert	A wooden, open bottom culvert, usually constructed from on-site materials, utilized for the temporary, short term crossing of small streams or drainages.
Bridge Abutment	The end foundation upon which the bridge superstructure rests.
Cable Logging	A yarding system employing winches, blocks, and cables.
Coarse Woody Debris	Typically, sound or rotting logs, stumps, or large branches that have fallen or been cut and left in the woods, or trees and branches that have died but remain standing or leaning.
Coniferous Tree	Any of various mostly needle-leaved or scale-leaved, chiefly evergreen, cone-bearing gymnospermous trees or shrubs such as pines, spruces, and firs.
Conventional Harvesting	In the interior of British Columbia, harvesting of trees by using any combination of mechanical or hand felling and rubber-tired or tracked skidding equipment.
Crown closure	The percent crown closure in a forest stand is assessed from aerial photographs. Crown closure is based on the amount of ground area covered by the tree crowns (i.e., vertical projection).
Culvert	A tunnel or a drain under a road that carries water from a stream or drainage from one side to the other. Examples include plastic pipes, corrugated metal pipes, box culverts, and arch culverts.
Danger Tree	A tree that is hazardous because of location or lean, physical damage, overhead hazards, deterioration of the limbs, stem or root system, or any combination.
Deactivation	To render a road, trail or any excavated feature inactive or ineffective. For roads, deactivation measures include removal of culverts and bridges, re-contouring the slope, and in some cases planting or seeding.
Debris Trap	Engineered structure located across moving waterways to intercept and collect floating debris (such as fallen trees) and keeping it from continuing down-stream. Examples include fin-booms and shear booms.
Deciduous Tree	Broad-leaved tree that sheds all its leaves during one season (e.g., aspen, cottonwood).
Ephemeral	Lasting a very short time. In the case of ephemeral drainages, these include

	seasonal streams, non-classified drains and intermittent seepages that only flow during certain months of the year.
Feller Buncher	A type of motorized harvester used in logging. It consists of a standard heavy equipment base with a tree-grabbing device furnished with a circular saw or a pinching device designed to cut small trees off at the base. The machine then places the cut tree in a stack suitable for a skidder or forwarder, or other means of transport (yarding) for further processing (e.g., delimbing, bucking, loading, or chipping).
Fibre	The hard fibrous substance of trees which composes the body and its branches, and which is covered by the bark.
Freshet	A flood resulting from a heavy rain or a spring thaw.
Grubbing	Removal of stumps, roots, embedded logs, organics, and unsuitable soils before or concurrently with construction activities.
Hand Falling	To cut down a tree by using mechanical or non-mechanical hand tools (e.g. chainsaw) and without the use of heavy equipment.
Headpond	A wholly or partly filled artificial lake or reservoir storing water.
Helicoidal	Shaped like a spiral, resembling that of a screw thread.
Ice Bridge	A body of ice that forms across the width of a river and is strong enough to bear traffic.
Merchantable Tree	A tree that has attained sufficient size, quality and (or) volume to make it suitable for harvesting and transport to a processing plant.
Non-merchantable Tree	A trees that is unsuitable for harvesting and processing into other commercial products. This designation may result due to tree size, amount of rot, type of species or overall quality.
Partial Cutting	A harvest system in which only some of the trees are harvested. Retention may include leave trees based on size criteria, importance to wildlife, etc.
Permanent Access Road	For the purpose of this Plan, a newly constructed or upgraded existing road that will continue to be used after the commencement of reservoir filling.
Piling Bridge	A bridge where the roadway is supported by piles driven into the river or stream bed.
Project Activity Zone	Area within which the Project components will be found or will occur, but not including existing transportation infrastructure that will be used without modification to transport materials or personnel required for the Project.
Pulp	The fibrous material in a tree used to make cellulose products such as paper.
Riparian	Relating to the transitional area or zone found between land and a fresh-water feature such as a river, lake or wetland. In this plan the riparian zone is estimated with a 15-metre buffer around all water bodies.

Road Permit	An agreement entered into under the *Forest Act* that allows a person who has the right to harvest timber under a licence, agreement, or permit, to construct a road, or maintain an existing road on Crown land, other than a Forest Service Road.
Seismic Trail	A trail located along a seismic line, which is a straight line (usually 1 to 10 meters in width) cut through the forest by the oil and gas industry as part of resource exploration procedures.
Sensitive Soils	Soils that, because of their slope gradient, texture class, moisture regime, or organic matter content, have a very high hazard for displacement, surface erosion, or compaction.
Siltation	The (typically undesirable) increase in concentration and or deposition of waterborne silt in a body of water.
Skid Roads / Trails	An excavated or bladed logging trail used by tracked or rubber-tired skidders to drag logs from the felling site to a landing or roadside processing area. Skid trails are often utilized on slopes deemed too steep for the safe movement of machinery, or in protected areas to concentrate and minimize potential site degradation caused by machinery.
Skidder	A heavy, four-wheel or tracked machine used to haul logs, especially over rugged terrain. Crawler Tractors and Grapple Skidders are examples.
Skidder Crossing	A non-engineered crossing constructed over a small stream, drainage or wet area to allow access to heavy machinery without damaging stream banks or sensitive soils. Examples include rudimentary bridges constructed from on-site material; logs placed side by side (corduroy), and small diameter culverts.
Slope Stability	Susceptibility of a slope to erosion and slides.
Slumping	A mass movement process in which slope failure occurs on a usually curved slip surface and the unit moves downslope as an intact block, frequently rotating outward.
Temporary Access Road	For the purpose of this Plan, a newly constructed, existing or upgraded existing road that will be deactivated prior to the commencement of reservoir filling.
Waterborne	Floating on or transported by water.

1.0 Background

1.1 The Site C Clean Energy Project

The Site C Clean Energy Project (the Project) will be the third dam and generating station on the Peace River in northeast B.C. The Project will provide 1,100 megawatts of capacity and about 5,100 gigawatt hours of energy each year to the province's integrated electricity system. The Project will be a source of clean, reliable and cost-effective electricity for BC Hydro's customers for more than 100 years.

The key components of the Project are:

- an earthfill dam, approximately 1,050 metres long and 60 metres high above the riverbed;
- an 83 kilometre long reservoir that will be, on average, two to three times the width of the current river;
- a generating station with six 183 MW generating units;
- two new 500 kilovolt AC transmission lines that will connect the Project facilities to the Peace Canyon Substation, along an existing right-of-way;
- realignment of six segments of Highway 29 over a total distance of approximately 30 kilometers; and
- construction of a berm at Hudson's Hope.

The Project will also include the construction of temporary access roads, a temporary bridge across the Peace River, and worker accommodation at the dam site.

1.2 Project Benefits

The Project will provide important benefits to British Columbia and Canada. It will serve the public interest by delivering long term, reliable electricity to meet growing demand; contribute to employment, economic development, ratepayer, taxpayer and community benefits; meet the need for electricity with lower GHG impact than other resource options; contribute to sustainability by optimizing the use of existing hydroelectric facilities, delivering approximately 35 per cent of the energy produced at the W.A.C. Bennett Dam, with only five per cent of the reservoir area; and include an honourable process of engagement with First Nations and the potential for accommodation of their interests.

1.3 Environmental Assessment Process

The environmental assessment of the Project has been carried out in accordance with the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), the *BC Environmental Assessment Act* (BCEAA), and the Federal-Provincial *Agreement to Conduct a Cooperative Environmental Assessment, Including the Establishment of a Joint Review Panel of the Site C Clean Energy Project*. The assessment considered the environmental, economic, social, heritage and health effects and benefits of the Project, and included the engagement of Aboriginal groups, the public, all levels of government, and other stakeholders in the assessment process.

Detailed findings of the environmental assessment are documented in the Site C Clean Energy Project Environmental Impact Statement (EIS), which was completed in accordance with the Environmental Impact Statement Guidelines (EIS Guidelines) issued by the Minister of Environment of Canada and the Executive Director of the Environmental Assessment Office of British Columbia. The EIS was submitted to regulatory agencies in January 2013, and amended in August 2013 following a 60 day public comment period on the assessment, including open house sessions in Fort St. John, Hudson's Hope, Dawson Creek, Chetwynd, town of Peace River (Alberta) and Prince George.

In August 2013, an independent Joint Review Panel (JRP) commenced its evaluation of the EIS, and in December 2013 and January 2014 undertook five weeks of public hearings on the Project in 11 communities in the Peace region, including six Aboriginal communities. In May 2014, the JRP provided the provincial and federal governments with a report summarizing the Panel's rationale, conclusions and recommendations relating to the environmental assessment of the Project. On completion of the JRP stage of the environmental assessment, the CEA Agency and BCEAO consulted with Aboriginal groups on the JRP report, and finalized key documents of the environmental assessment for inclusion in a Referral Package for the Provincial Ministers of Environment and Forests, Lands and Natural Resource Operations.

Construction of the Project is also subject to regulatory permits and authorizations, and other approvals. In addition, the Crown has a duty to consult and, where appropriate, accommodate Aboriginal groups.

1.4 Environmental Assessment Findings

The environmental assessment of the Project focused on 22 valued components (VCs), or aspects of the biophysical and human setting that are considered important by Aboriginal groups, the public, the scientific community, and government agencies. In the EIS, valued components were categorized under five pillars: environmental, economic, social, heritage and health. For each VC, the assessment of the potential effects of the Project components and activities during construction and operations was based on a comparison of the biophysical and human environments between the predicted future conditions with the Project, and the predicted future conditions without the Project.

Potential adverse effects on each VC are described in the EIS along with technically and economically feasible mitigation measures, their potential effectiveness, as well as specific follow-up and related commitments for implementation. If a residual effect was found on a VC, the effect was evaluated for significance. Residual effects were categorized using criteria related to direction, magnitude, geographic extent, context, level of confidence and probability, in accordance with the EIS Guidelines.

The assessment found that the effects of the Project will largely be mitigated through careful, comprehensive mitigation programs and ongoing monitoring during construction and operations. The EIS indicates that the Project is unlikely to result in a significant adverse effect for most of the valued components. However, a determination of a significant effect of the Project was found on four VCs: Fish and Fish Habitat, Wildlife Resources, Vegetation and Ecological Communities, and Current Use of Lands and Resources for Traditional Purposes.

1.5 Environmental Assessment Conclusion

On October 14, 2014, the Provincial Ministers of Environment and of Forests, Lands and Natural Resource Operation decided that the Project is in the public interest and that the benefits provided by the Project outweigh the risks of significant adverse environmental, social and heritage effects (http://www.newsroom.gov.bc.ca/2014/10/site-c-project-granted-environmental-assessment-approval.html). The Ministers have issued an Environmental Assessment Certificate setting conditions under which the Project can proceed.

Further, on November 25, 2014, The Minister of Environment of Canada issued a Decision Statement confirming that, while the Project has the potential to result in some significant adverse effects, the Federal Cabinet has concluded that those effects are justified in the circumstances. The Decision Statement sets out the conditions under which the Project can proceed.

1.6 Development of Mitigation, Management and Monitoring Plans

Mitigation, management and monitoring plans for the Project have been developed taking into account the measures proposed in the EIS, information received during the Joint Review Panel hearing process, and the Report of the Joint Review Panel on the Project. Those plans are consistent with, and meet requirements set out in, the conditions of the Environmental Assessment Certificate and of the Decision Statement issued on October 14, 2014 and November 25, 2014 respectively.

In addition, in accordance with environmental best practices (Condition 3.1), these plans were informed by the best available information and knowledge, based on validated methods and models, undertaken by qualified individuals and apply the best available economically and technologically feasible mitigation strategies. These plans contain provisions for review and update as new information on the effects of the Project and on the efficacy of the mitigation measures become available.

2.0 Vegetation Clearing and Debris Management Plan

2.1 Objective

The objective of the Vegetation Clearing and Debris Management Plan is to provide an overview of clearing activities for the Site C Clean Energy Project. The Plan was initially provided in the EIS, as Appendix A of Volume 1. The Plan has since been revised and developed in accordance with Conditions 13 and 17 of the Environmental Assessment Certificate, as indicated in the table below.

EAC Condition Number	EAC Condition	Plan Reference
13	The EAC Holder must develop the Vegetation Clearing and Debris Management Plan.	
	The Vegetation Clearing and Debris Management Plan must be developed by a QEP.	Section 11 Qualified Professional
	The Vegetation Clearing and Debris Management Plan must ensure that clearing would be conducted in the approved Project Activity Zone only, and construction would be monitored by the QEP to prevent any unnecessary clearing.	Section 3.0 Clearing Planning Overview See also Section 2.0 of the CEMP, Environmental Management Roles and Responsibilities
	Specific to the transmission line component of the Project:	
	• The EAC Holder must not grub the right of way with the exception of transmission tower foundation pads, temporary work spaces and access roads.	Section 8.2 Transmission Line Corridor Clearing Requirements
	• Where conductor clearance allows, the EAC Holder must not remove riparian vegetation along watercourses or waterbodies crossed by the transmission corridor.	Section 8.2 Transmission Line Corridor Clearing Requirements
	To reduce erosion along steep or unstable slopes, the EAC Holder must apply best management practices for reservoir clearing along riparian areas and watercourses. Practices must include but not limited to the following:	
	• Retention of all trees on steep, unstable slopes that would be highly susceptible to landslides if the vegetation was removed.	Section 9.1.2 Slopes and Slope Stability
	• Retention of non-merchantable trees and vegetation in riparian areas within a 15 m buffer from the Ordinary High Water Mark. Merchantable trees and trees that may protrude above 455 m elevation may still be removed using clearing practices to maintain a	Section 9.1.3 Riparian Areas within the Reservoir

EAC Condition Number	EAC Condition	Plan Reference
	15 m machine-free zone from the OHWM.	
	The EAC Holder must provide this draft Vegetation Clearing and Debris Management Plan to Environment Canada, FLNR, MOE, Aboriginal Groups, Peace River Regional District and District of Hudson's Hope for review a minimum of 90 days prior to commencement of construction.	Section 2.2 Consultation
	The EAC Holder must file the final Vegetation Clearing and Debris Management Plan with EAO, Environment Canada, FLNR, MOE, Peace River Regional District, City of Fort St. John, District of Hudson's Hope and Aboriginal Groups, a minimum of 30 days prior to commencement of construction.	
	The EAC Holder must develop, implement and adhere to the final Vegetation Clearing and Debris Management Plan, and any amendments, to the satisfaction of EAO.	
17	As part of the Vegetation Clearing and Debris Management Plan, if the EAC Holder must conduct clearing activities during these specified critical time periods:	
	• Songbirds: May 1 through July 31;	Section 3.5 Environmental Management See also Section 4.17 of the CEMP, Wildlife Management
	• Trumpeter swan, raptors and owls: April 1 through July 31; and	
	• Sharp-tailed grouse: mid-April and mid-July (lek to nesting to hatching).	
	The EAC Holder must first develop and implement a nest and lek search protocol, in consultation with the FLNR and MOE. The EAC Holder must provide FLNR and MOE with all known nest and lek locations. The EAC Holder must flag these sites and require employees and contractors to avoid these sites.	Section 3.5 Environmental Management See also Section 4.17 of the CEMP, Wildlife Management
	The nest and lek search protocol must include specifications for buffers around active nest sites	Section 3.5 Environmental Management

EAC Condition Number	EAC Condition	Plan Reference
	and flagging, as required by FLNR.	See also Section 4.17 of the CEMP, Wildlife Management

2.2 Consultation

Many of the conditions require BC Hydro to consult or collaborate with certain government agencies and Aboriginal groups in respect of measures and plans required by the conditions.

BC Hydro began consultation on the Project in late 2007, before any decision to advance the Project to an environmental assessment. BC Hydro's consultation with the public, stakeholders, regional and local governments, regulatory agencies, and Aboriginal groups is described in EIS Section 9, Information Distribution and Consultation.

Additional information on the consultation process and a summary of issues and concerns raised during consultation are provided in:

- Volume 1 Appendix G, Public Information Distribution and Consulting Supporting Documentation
- Volume 1 Appendix H, Aboriginal Information Distribution and Consultation Supporting Documentation
- Volume 1 Appendix I, Government Agency Information Distribution and Consultation Supporting Documentation
- Volume 5, Appendix A01 to A29, Parts 2 and 2A, Aboriginal Consultation Summaries
- Technical Memo: Aboriginal Consultation

Draft versions of a number of the mitigation, management and monitoring plans required by the conditions were submitted to applicable government agencies and Aboriginal groups for comment on October 17, 2014.

Comments on these draft plans were received from various government agencies and Aboriginal groups during November and December 2014, and were considered in the revisions to these plans. BC Hydro's consideration of these comments is provided in the consideration tracking tables that accompany each plan.

On December 15, 2014, Treaty 8 Tribal Association (T8TA), on behalf of West Moberly, Saulteau and Prophet River First Nations, submitted to BC Hydro a letter in response to BC Hydro's request for comment on the Plans sent on October 17, 2014. The letter included several appendices, including the Joint Review Panel (JRP) Report and transcripts from the JRP hearings in December 2013 and January 2014. BC Hydro responded to the three First Nations on January 21, 2015 noting that the October 17 2014 request for comments on the plans was to provide an opportunity to the First Nations to submit to BC Hydro any information they wanted to provide in relation to the Plans. BC Hydro advised that it was aware of the information referred to in T8TA's letter when the plans were prepared, and advised that it was preparing a table setting out where any mitigation measures identified by representatives of the three First Nations during the hearings are considered in the draft plans and would provide that to the First Nations once complete. Accordingly BC Hydro's responses to those mitigation measures identified by the representatives of the three First Nations during the JRP hearings were provided to the EAO in a separate table by letter dated May 19, 2015. Aside from the December 15, 2014 letter, BC Hydro has not received further comments from these First Nations. A letter of understanding dated April 30, 2015 respecting provision of capacity funding to support review of the plans was entered into by BC Hydro and Saulteau First Nations (on behalf of Saulteau, West Moberly and Prophet River First Nations).

New draft plans (i.e., Housing Plan and Housing Monitoring and Follow-Up Program, and the quarry/pit development plans) were provided to the entities identified in the EAC conditions on April 7, 2015. The Vegetation and Wildlife Mitigation and Monitoring Plan was revised based on comments received on the October 17, 2014 version and based on discussions with Environment Canada and the BC Ministry of Environment, and was re-submitted to applicable entities on April 7, 2015.

Comments on the revised plans were requested by May 11, 2015 to allow for review, consideration of comments and finalization of the plans 30 days prior to the commencement of construction.

Comments were received by this requested date from:

- Fort Nelson First Nation
- Ministry of Forests, Lands and Natural Resource Operations (FLNRO), and
- Métis Nation British Columbia.

The Peace River Regional District submitted their comments on the plan on May 14, 2015. FLNRO submitted additional comments on May 15, 2015, including comments from the BC Ministry of Environment.

BC Hydro considered the comments provided and prepared final plans. On May 19, 2015, BC Hydro submitted the following mitigation, management and monitoring plans to the BC Environmental Assessment Office (BC EAO) for review:

- Construction Environmental Management Plan
- Construction Safety Management Plan
- Fisheries and Aquatic Habitat Management Plan
- Vegetation and Wildlife Mitigation and Monitoring Plan
- Vegetation Clearing and Debris Management Plan
- Aboriginal Plant Use Mitigation Plan
- Aboriginal Training and Inclusion Plan
- Business Participation Plan
- Emergency Services Plan
- Healthcare Services Plan
- Labour and Training Plan
- Cultural Resources Mitigation Plan
- Heritage Resources Management Plan
- Housing Plan and Housing Monitoring and Follow-Up Program
- Wuthrich Quarry Development Plan
- West Pine Quarry Development Plan; and

- Del Rio Pit Development Plan.

The CEA Agency and Environment Canada submitted comments on the revised plan on May 22, 2015. These comments were considered and the final plans were revised accordingly and submitted on June 5, 2015 to the entities identified in the EAC conditions.

2.3 Regulatory Context

Clearing of vegetation for the purposes of Site C construction will be undertaken in accordance with the EAC conditions, and with the conditions of permits required for clearing activities within the six sites of the Project Activity Zone, described in Section 3.1 below. These permits will typically include Occupant Licences to Cut (OLTC) issued under the *Forest Act,* Temporary Use Permits (TUP) under the *Land Act*, and any required Section 9 Approvals or Notifications for stream crossings under the *Water Act.*

BC Hydro and/or its Contractors will submit the appropriate permit applications for clearing activities to regulatory agencies. Those applications will be consistent with the information provided in the Vegetation Clearing and Debris Management Plan, but will provide site specific information and detail relevant to each area.

3.0 Clearing Plan Overview

3.1 Clearing Sites

Six areas are identified within the Project activity zone as requiring varying degrees of vegetation removal. Each area was identified based upon its purpose within the development of the Project, as follows:

- Dam site
- Quarries (Portage Mountain, West Pine, 85th Avenue, Area E, Wuthrich, Del Rio)
- Highway 29 Realignment Areas
- Access Roads
- Transmission corridor
- Reservoir

Each location is briefly described in the sub-sections that follow. The physical geography associated with each clearing site is shown in Table 1, and the clearing areas and volumes are shown in Table 2 and Table 3. The classification of forest area is based upon the British Columbia Land Cover Classification Scheme (BC MSRM 2002). All areas having tree crowns that cover more than five percent of the ground area were considered “forested” for the purposes of this plan. Within the Project activity zone, approximately 51 percent of the area is covered in forest (6,956 hectares), 29 percent is water (3,871 hectares), and the remaining 20 percent consists of roads, clay banks, gravel bars, pastures and areas with low growing vegetation (2,686 hectares).

Table 1 Clearing Sites by Physiographic Type

Clearing Sites	Project Clearing Sites, Area by Physiographic Type (hectares)						
	Forest	Water	Existing Roads	Exposed Soil	Cultivated	Shrubs	Total Area
Dam Site	1,435	199	105	128	0	168	**2,035**
Highway 29 realignment	194	16	42	58	71	37	**418**
Construction Materials Sites	394	1	22	59	0	151	**626**
Access Roads	169	4	5	2	6	11	**196**
Transmission Right-of-way	742	2	32	140	0	314	**1,231**
Reservoir[1]	4,021	3,649	82	195	540	520	**9,007**
Project Activity Zone	**6,956**	**3,871**	**288**	**580**	**618**	**1,201**	**13,513**
Percent of Total	51%	29%	2%	4%	5%	9%	**100%**

NOTES:

Note 1 The reservoir site excludes access roads and is to a 5-year beach erosion line. This erosion line is described in EIS Volume 2 Appendix B Geology, Terrain Stability and Soil Reports. The surface area of the reservoir post inundation will also include part of the dam construction site and will vary with the depth of the water. The reservoir's surface area will be 9,330 hectares when filled to the maximum normal level of 461.8 metres elevation.

The following tables detail the area and volume for clearing within the Project activity zone.

Table 2 Project Vegetation Area Cleared

Project Area Description	Area (hectares)						Total Area (ha)
	Dam Site	Highway 29 Realignment	Construction materials	Access roads	Transmission ROW	Reservoir	
Gross Land Area	1,836	402	625	193	1,229	5,358	**9,643**
Forest Area	1,435	194	394	169	742	4,021	**6,956**

Area cleared and stumps are removed	1,333	194	394	169	481	0	**2,571**
Area cleared and stumps are retained	102	0	0	0	241	2,330	**2,674**
Area cleared, stumps & non-merchantable trees are retained (i.e., riparian areas)	0	0	0	0	20	587	**607**
Total area cleared	**1,435**	**194**	**394**	**169**	**742**	**2,918**	**5,852**
Total forest area retained	**0**	**0**	**0**	**0**	**0**	**1,104**	**1,104**

Table 3 Site C Vegetation Volume Cleared

Project Area Description	**Volume (cubic metres)**						**Total volume (cubic metres)**
	Dam Site	**Highway 29 Realignment**	**Construction materials**	**Access roads**	**Transmission ROVW**	**Reservoir**	
Gross volume	636,232	51,747	184,371	85,889	293,041	1,865,776	**3,117,056**
Merchantable volume	292,883	23,986	89,456	40,663	131,645	914,229	**1,492,862**
Total merchantable volume cleared	**292,883**	**23,986**	**89,456**	**40,663**	**130,808**	**835,580**	**1,413,376**
Total merchantable volume retained	0	0	0	0	837	78,649	**79,486**
Total non-merchantable volume cleared	**343,349**	**27,761**	**94,915**	**45,226**	**140,090**	**536,653**	**1,187,994**
Total non-merchantable volume retained	0	0	0	0	21,306	414,894	**436,200**

3.1.1 Dam Site

The dam site includes the location of the permanent facilities including the Site C dam, spillways, generating facilities, access roads and transmission interconnection facilities, as well as temporary construction areas such as worker accommodations, on-site construction materials, spoil area, existing roads and new roads.

3.1.2 Quarries and Off-Site Construction Materials

A variety of quarried and excavated materials, such as riprap, bedding materials, rock, sand, gravel and till will be sourced off-site for the construction of the Project. Six locations have been identified as providing off-site construction materials within 150 kilometres from the dam construction site. These are the Portage Mountain, West Pine, 85th Avenue, Area E and Wuthrich quarries, and Del Rio Pit.

3.1.3 Highway 29 Realignment Areas

Highway 29 connects Hudson's Hope to Fort St. John and parallels the north side of the Peace River. Segments of the existing highway will be inundated by the Site C reservoir. Six locations covering approximately 30 kilometres along Highway 29 will be realigned away from the reservoir shoreline. These locations occur near Lynx Creek, Dry Creek, Farrell Creek, Farrell Creek East, Halfway River and Cache Creek.

3.1.4 Access Roads

Temporary and permanent roads will be used to provide access for equipment undertaking vegetation clearing and removal from the Project activity zone. Temporary clearing access roads will be located, designed and later deactivated in accordance with British Columbia standards and applicable guidelines, and the Construction Environment Management Plan (CEMP). Most of the temporary clearing roads are required to access the reservoir area for clearing.

3.1.5 Transmission Line Corridor

The transmission corridor will follow an existing BC Hydro transmission line leading from a substation located in the dam site area to the Peace Canyon Dam. Transmission right-of-way clearing will involve widening the existing transmission corridor to accommodate two new 500 kilovolt AC transmission lines and areas of interconnection to connect the Site C facilities to the existing Peace Canyon Substation.

3.1.6 Reservoir

The reservoir will extend approximately 83 kilometres up the Peace River between the Site C Dam to the Peace Canyon Dam. This area will be inundated by the Site C dam to a maximum normal reservoir level of 461.8 metres elevation. The reservoir will operate between the normal maximum reservoir level of 461.8 metres and minimum normal reservoir level of 460.0 metres. The reservoir minimum operating level of 455.0 metres is the lowest level at which the generating station could be operated if the reservoir had to be drawn down for any reason. The reservoir, as a clearing area, includes the shore line area to a five year beach erosion line (described in EIS Volume 2 Appendix B Geology, Terrain Stability and Soil Reports).

3.2 General Clearing Schedule

Table 4 describes the estimated clearing sites, areas and volumes to be cleared, by construction year, for the Project. Reservoir clearing shown in Years 3 and 4 could be delayed until Years 5 and 6 of the construction schedule.

Table 4 Volume Cleared by Clearing Site and Year

Year	Clearing Site	Area (hectares)	Merchantable Volume (m3)	Non Merch Volume (m3)	Total (m^3)
Site Preparation (Year 1)	Dam Site	1,435	292,883	343,349	636,232
	Highway 29 Re-alignment	88	9,516	10,619	20,135
	Construction Material Sites	27	5,695	5,750	11,445

	Access Road	66	11,864	14,922	26,786
	Reservoir	374	127,922	80,718	208,640
2	Construction Material Sites	218	60,180	57,454	117,634
	Access Road	27	8,271	8,124	16,395
	Reservoir	609	208,418	121,312	329,730
	Transmission Corridor	742	130,808	140,090	270,898
3	Highway 29 Re-alignment	106	14,470	17,142	31,612
	Construction Material Sites	150	23,581	31,711	55,292
	Access Road	34	9,161	10,308	19,469
	Reservoir (Year 3 or 5)	744	188,933	125,317	314,250
4	Access Road	42	11,367	11,872	23,239
	Reservoir (Year 4 or 6)	1,191	310,307	209,306	519,613
Grand Total		5,852	**5,852**	**1,187,994**	**2,601,370**

3.3 Vegetation Inventory

To support this clearing plan, an update to the British Columbia Ministry of Forests, Lands and Natural Resource Operations' vegetative resource inventory (VRI) was completed in 2011 by Industrial Forestry Service Ltd. for the Project activity zone. This was done to improve the accuracy of the existing forest inventory and address changes that had occurred in recent years as a result of tree growth, merchantability classifications and changes to the Peace River watercourse. The inventory update was carried out using 2007 colour photography in combination with extensive aerial and ground field verification. Vegetated areas were delineated and classified according to tree species, age, crown closure, height and site quality characteristics. Forest stand volumes were calculated using FLNRO growth models for both merchantable and total above-ground biomass[1]. Below-ground biomass was estimated as a

[1] Gross biomass estimates were derived using FLNRO growth models and are in oven dry tonnes (ODTs). These models do not include below ground biomass. Estimates were increased by 20 percent to incorporate below ground biomass (Kajimoto et al 1999; Naesset 2003). ODTs were converted to cubic metre equivalents. Merchantable volume is calculated using the FLNRO variable density yield prediction model (version 7) that calculates tree volumes in cubic metres (FLNRO 2011).

percent of total above-ground biomass. Additional information on this update and the vegetation inventory are provided in Appendices A and B respectively.

All of the Project component areas have varying degrees of vegetation. Non-vegetated areas include the Peace River, tributary streams and wetlands, clay banks, gravel bars and roads. Areas that are vegetated but lack tree cover have been broadly classified as “shrubs”, which include:

- Bryoids (mosses, liverworts or lichens) that exist in environments too harsh for vascular plants.
- Forbs and graminoids (natural shrubs that are distinguished from pastures).
- Medium-tall scrub willows (*Salix spp.*) which are abundant in burned-over areas.
- Dwarf evergreen (*Ledum groenlandicum* [Labrador tea], *Chamaedaphne calyculata* [leatherleaf]).
- Willows and scrub birch (*Betula glandulosa*) that may exist together with stunted black spruce.

Tree and shrub species that occur in the Project activity zone include white spruce (*Picea glauca*), Engelmann spruce (*Picea engelmannii*), black spruce (*Picea mariana*), tamarack (*Larix laricina*), lodgepole pine (*Pinus contorta var. latifolia*), subalpine fir (*Abies lasiocarpa*), trembling aspen (*Populus tremuloides*), black cottonwood (*Populus balsamifera ssp. trichocarpa*), balsam poplar (*Populus balsamifera ssp. balsamifera*), white birch (*Betula papyrifera*), choke cherry (*Prunus virginiana*), pin cherry (*Prunus pensylvanica*), as well as many willow species and alder. Areas in the Peace region where white spruce and Engelmann spruce ranges overlap, or where black poplar and balsam poplar ranges overlap, may result in some hybridization of these tree species. For simplicity, ‘spruce’ includes all spruce species and ‘poplar’ includes all poplar species. A discussion of tree merchantability criteria is provided in Section 3.4.

In addition to the living forest biomass, there is also woody biomass in the form of dead standing trees, windfall and deadfall throughout the Project area. This volume is included in the estimates of non-merchantable volume. The non-merchantable volume is estimated in the forest cover inventory using FLNRO total stand biomass equations (Kivari, et al. 2011). A location with a high volume of this dead vegetation is shown below. Varying quantities of wood chunks and whole trees are also introduced annually into the Project activity zone as a consequence of the annual freshet of the Peace River and its tributaries, bank erosion and heavy rainfall events. A photograph of some of the debris left by the 2011 freshet on the Peace River is shown in below.

Photograph 1. Natural ground-based debris

Photo Credit: Industrial Forestry Service Ltd. (2011)

Photograph 2. Natural waterborne debris

Photo Credit: Industrial Forestry Service Ltd. (2011)

3.3.1 Biogeoclimatic Classification

The Biogeoclimatic Ecosystem Classification (BEC) system is a hierarchical classification system used in British Columbia to classify ecological landscape units. Climate, vegetation and topography are the three main characteristics that define the BEC system (Meidinger and Pojar 1991). The Project activity zone extends primarily across the Boreal White and Black Spruce (BWBS) BEC zone, but also touches the Sub-Boreal Spruce (SBS) zone, in the subzones and variants described below.

3.3.1.1 Boreal White and Black Spruce

The Project activity zone extends across two subzones of the BWBS. The Boreal White and Black Spruce moist warm subzone (BWBSmw) accounts for 13,353 hectares, or 99 percent, of the Project activity zone. BWBSmw is characterized by a drier and warmer climate compared to the adjacent BWBS subzones found in higher elevations to the north and west. Forested habitats within this subzone are typically dominated by trembling aspen (*Populus tremuloides*) with balsam poplar (*P. balsamifera ssp. balsamifera*) common on lower slopes and along water courses (Delong et al. 2011). White spruce (*Picea glauca*) forests appear in moist sites. Lodgepole pine (*Pinus contorta var. latifolia*) forests occur as a seral species in drier and poorer areas. Black spruce (*Picea mariana*) can be found mixed with lodgepole pine on upland sites that have cold soils or limited rooting, and in organic soils with minor amounts of tamarack (*Larix laricina*). Common understory species include prickly rose (*Rosa acicularis*), highbush cranberry (*Viburnum edule*), bunchberry (*Cornus canadensis*), Labrador tea (*Ledum groenlandicum*), and kinnikinnick (*Arctostaphylos uva-ursi*).

The Boreal White and Black Spruce wet cool (variant 1) subzone (BWBSwk1) is similar to the BWBSmw with wetter, shorter summers and colder winters. The BWBSwk1 subzone is at higher elevations and comprises 47 hectares, or 0.4 percent of the Project activity zone.

3.3.1.2 Sub-Boreal Spruce

The Sub-Boreal Spruce Finlay-Peace wet cool (variant 2) subzone (SBSwk2) is distinguished from adjacent subzones (i.e., BWBSmw, BWBSwk1) by a wetter climate with higher summer precipitation, higher winter snowfall and a slightly longer growing season. Forested areas within this subzone are often climax forests dominated by hybrid white spruce (*Picea engelmannii, x glauca*) and subalpine fir (*Abies lasiocarpa*). On gently sloped upland sites, black spruce occurs with lodgepole pine, while along streams and rivers, hybrid white spruce occurs with black cottonwood (P. balsamifera, spp. trichocarpa). Stands of paper birch (*Betula papyrifera*) are also known to be present in the eastern region near Williston Lake (DeLong 2004). This subzone accounts for 0.8 percent of the Project activity zone.

3.4 Merchantable and Non-Merchantable Vegetation

Merchantable and non-merchantable volumes were estimated based on tree utilization specifications for stand merchantability in the timber supply reviews for the Dawson Creek and Fort St. John timber supply areas. Table 5 quantifies the dominant tree species and merchantable volume in the Project activity zone.

Table 5 Dominant Tree Species within the Project Activity Zone

Tree Species	Gross Area by Dominant	Merchantable volume	Percent of Total Volume

		Species (ha)	(cubic metres)	
Coniferous	Spruce	1,486	498,221	33.4%
	Pine	114	29,996	2.0%
	Tamarack	82	2,707	0.2%
Total Coniferous		**1,681**	**530,924**	**35.6%**
Deciduous	Cottonwood[1]	1,861	339,951	22.8%
	Aspen	3,052	557,443	37.4%
	Birch	361	63,937	4.3%
Total Deciduous		**5,275**	**961,331**	**64.5%**
Total All Species		**6,956**	**1,492,255**	**100%**

NOTES:

Old, decadent cottonwood stands are estimated to cover 468.5 hectares and equate to 182,950 cubic metres of volume. This volume is included as part of the total merchantable cottonwood volume identified above.

Of the total forested area potentially affected by the Project (6,956 hectares), coniferous-leading stands comprise 36 percent of the merchantable volume (530,924 cubic metres) and deciduous-leading stands of trees comprise 64 percent of the volume (961,331 cubic metres). Lowland areas throughout the Project activity zone contain substantial quantities of large, decadent cottonwood trees. Despite being classified as a merchantable species by the FLNRO, these decadent cottonwood trees offer challenges to effective harvesting and utilization due to advanced levels of decay. The merchantable volume associated with these cottonwood stands is estimated to be 183,000 cubic metres.

Non-merchantable vegetation is used to describe all of the biomass that does not meet the merchantability description. Biomass equations developed by FLNRO were applied to the vegetation resource inventory for the Project activity zone to calculate total stand biomass. These equations provided estimates for above-ground biomass and were derived in oven-dry tonnes. Since stump removal will need to be carried out in some parts of the Project activity zone, estimates of below-ground biomass were obtained by multiplying the gross biomass by 20 percent (Kajimoto et al 1999; Naesset 2003). Subtracting the merchantable volume from the total biomass volume (i.e., above- and below-ground) provided an estimate of the total non-merchantable vegetation in the Project activity zone. The total non-merchantable biomass within the Project activity zone, converted from oven dry tonnes to cubic metres, was estimated to be 1,636,000 cubic metres.

3.5 Environmental Management

The prescription for clearing vegetation varies by site location, taking into account Project construction requirements, as well as input received from FLNRO, Aboriginal groups, stakeholders, and factors such as reservoir mercury methylation, water quality, boater safety, utilization of forest resources, fish and fish habitat, and wildlife habitat.

A Construction Environmental Management Plan (CEMP) has been developed for the overall Site C Clean Energy Project; this CEMP applies to all activities undertaken in construction of the Project. The CEMP provides the basis for the development of the Environmental Protection Plans (EPPs) that will be prepared by Contractors prior to the commencement of construction activities to avoid or reduce impacts arising from construction and construction related activities.

A number of sections of the CEMP specifically address activities or requirements associated with vegetation clearing and debris management. Clearing contractors will be required to undertake clearing in accordance with an EPP that addresses all applicable requirements of the CEMP.

In OLTC applications, site-specific maps and details will be provided, including environmental specifications as applicable including special resource features and wildlife management areas, riparian management areas, terrain stability considerations, existing and new access roads, stream crossings, tenures, and other relevant information to the application area.

3.5.1 Bird Nests

The requirements of EAC Condition 17 are met through the CEMP, Section 4.17 Wildlife Management. In accordance with Section 4.17 of the CEMP, where feasible given Project requirements, vegetation clearing will take place during the Peace Region terrestrial wildlife least-risk windows for birds, as identified by BC and Environment Canada (Region 6).

Both the federal *Migratory Birds Convention Act* and Section 34 of the provincial *Wildlife Act* protect nesting birds. There are no provisions under the *Migratory Birds Convention Act* to authorize incidental take of occupied bird nests.

For clearing activities that occur between 1 March and 30 September, bird nest surveys will be required to be conducted in accordance with an established procedure specified in the Environmental Protection Plans associated with clearing activities, as follows:

- During Low Risk Nesting Periods: Restrictions would not normally apply. Where ground conditions permit, plan development activities within these timeframes.
- During Cautionary Nesting Periods: Any required clearing activities during this period will follow survey protocols for the Caution Nesting Period.
- During Critical Nesting Periods: Clearing activities should be avoided during this period. If clearing is required during this period, then survey protocols for the Critical Nesting Period should be followed.

An onsite bird biologist will be engaged to determine or confirm, in accordance with nest survey protocols, which nesting period, if any, is currently underway during field surveys.

3.6 Wood Utilization and Disposal

Wood that is removed within the Project activity zone as part of the vegetation clearing process will either be sold to the forest industry or disposed of in a manner described in Section 3.6.2. The forest products industry in northeastern BC utilize coniferous and deciduous sawlogs, pulp logs, wood chips and small quantities of waste wood. At a broader scale, the regional communities of Mackenzie, British Columbia and Grande Prairie, Alberta have sawmills, pulp mills and bioenergy facilities.

The amount of merchantable wood from Project clearing activities is estimated at approximately 1.4 million cubic metres, over a four-year period. The existing regional British Columbia forest industry (i.e., within a 100-kilometre radius of the Project) currently has the capacity to utilize all of the merchantable wood harvested from the Project activity zone. On a regional basis, the clearing for the Project will supply less than one-third of the forest industry's annual deciduous volume demand and one-seventh of the annual coniferous log demand.

The amount of non-merchantable wood that is estimated to exist within the Project activity zone is estimated at 1,636,000 cubic metres.

3.6.1 Merchantable Wood Utilization

Clearing contractors will be granted the merchantable timber as part of their contract, to provide them with the market incentive to sell the fibre to the forest products industry. As appropriate to each clearing site, specifications will be provided in each clearing contract to increase the merchantable value recovered, for example by specifying the roadside or central collection areas for harvested merchantable coniferous and deciduous trees for processing, specifying the processing of trees such as removing the limbs and tops, cutting the stems into commercial log lengths for loading, or chipping on site for pulp.

3.6.2 Non-Merchantable Wood Disposal

Non-merchantable wood consists of branches, tree tops, bark, foliage, stumps, roots, undersized trees, rotten and broken trees, waterborne woody debris and ground vegetation (e.g., brush). As appropriate to each clearing site, specifications will be provided in each clearing contract for the treatment of non-merchantable, for example within the dam site, quarries, Highway 29 realignments and access roads, all non-merchantable wood and debris will be removed from the site to allow construction activities to occur.

Within the transmission corridor and the reservoir, some non-merchantable fibre will be retained on-site to serve as fish or wildlife habitat, minimize soil erosion and reduce siltation. The amount of non-merchantable wood that is expected to be removed, and will need to be disposed of, is estimated at 1,188,000 cubic metres.

The options to dispose of this volume are:

- Sale or delivery to a waste wood biomass processing plant (i.e., charcoal plant, pellet plant or biomass power generating plant)
- Incineration (either on-site or off-site)
- Landfilling (biomass burial)
- Scattering

The preferred method of disposal is the sale and delivery of non-merchantable vegetation to a processing plant, however the regional mills largely self-source from their own operations. BC

Hydro has initiated a procurement process to seek an alternative industrial use for non-merchantable fibre from the Project area, and within this process field trials were underway as of 2014. If successful these efforts may result in an innovative, portable biochar plant that will convert non-merchantable fibre into higher value biochar[2]. Field tests are focused on testing the performance of biochar, when added to agricultural soils, in improving water retention, root development, and agricultural yields.

Contractors who do have non-merchantable fibre to dispose of will use typical methods, as allowed by regulation, including incineration, land-filling and scattering.

Incineration involves the piling and burning of non-merchantable wood on-site, or transporting the biomass a short distance to a forced-air incineration location. The BC Ministry of Environment regulates open burning activities through the application of the Open Burning Smoke Control Regulation. In anticipation of potential changes to the Regulation a Smoke Management Plan has been developed by BC Hydro and included in Appendix A of the CEMP.

Land filling of non-merchantable biomass is suitable in areas where burning may not be permitted or advisable due to the proximity to communities, and where large excavations and surplus material relocations are taking place as part of Project development. Land filling has the advantage of eliminating smoke-related emissions and locking up biomass in long-term storage thereby reducing greenhouse gas emissions.

Within the transmission corridor, and in reclamation areas, a combination of scattering non-merchantable wood in low vegetation density areas, or reducing the size of the non-merchantable wood through chipping or grinding and then scattering the fibre away from riparian areas, is a viable option.

4.0 Dam Site Clearing Requirements

4.1 General Description of Forest and Vegetation

Approximately 70 percent (1,435 hectares) of the area within the dam site is currently forested. Table 6 shows the approximate areas of existing physical land features within the dam site.

Table 6 Physical Land Features in the Dam Site

Feature	Area (ha)	Percent
Forest	1,435	70.5%
Water	199	9.8%
Existing roads	105	5.2%
Shrub	168	8.2%

[2] See Diacarbon http://www.diacarbon.com/diacarbon-establishes-bcs-first-biochar-field-trial-peace-river-region/

Exposed soil	128	6.3%
Gross Area	**2,035**	**100%**

The area and volume in these sectors are quantified in Table 7. For the purposes of this Plan, vegetation clearing was assumed to occur throughout both the "Potential Construction Area – subject to further design", and within the "Restricted Activities Zone – Limited Activities". It is possible that some of the forests within these two areas will be retained. Actual clearing areas will be specified in clearing contracts.

Table 7 Dam Site Area and Volume Classifications

Dam site area classification	Forest Area (ha)	Total Area (ha)	Merchantable Volume (cubic metres)	Gross Biomass (cubic metres)	vegetation clearing required
Construction Areas	1,280	1,787	264,432	571,102	Yes
Construction Area – Subject to further design[1]	27	43	7,201	15,073	Yes
Restricted Activities Zone - Limited Activities	128	206	21,250	50,057	Yes
Total to be Cleared	**1,435**	**2,035**	**292,883**	**636,232**	**n/a**

An estimated 292,883 cubic metres of merchantable timber exists at the dam site. Deciduous trees comprise 93 percent of this volume. The gross volume of biomass within the dam site is presently estimated to be 636,232 cubic metres.

Ground slopes across the dam site vary. Slopes greater than 45 percent are typically a barrier to conventional logging equipment (e.g., feller-bunchers and wheeled skidders). Table 6 shows that the majority of the dam site contains moderate slopes below 45 percent. Where slopes exceed 45 percent, skid roads will be constructed to facilitate the safe removal of vegetation and stumps.

4.2 Dam Site Clearing Approach

Within the dam site the general clearing approach is removal of all trees, shrubs, stumps and larger roots. The exception is an approximately 102 ha area upstream of the Moberly River on the south bank of the Peace River, in which stumps will be retained as the only purpose of the site is the relocation of surplus excavated materials.

All 1,435 hectares will be cleared and the estimated 292,883 cubic metres of merchantable tree volume will be removed. An estimated 343,044 cubic metres of non-merchantable biomass will be removed and disposed of, either by incineration or land filling.

Clearing will be carried out using a combination of feller-bunchers and hand-falling. Whole trees will be transported to log landings or the roadside using crawler tractors, line skidders and grapple skidders.

After trees have been transported to landings or the roadside, sorting, processing and debris disposal activities will occur. Logs and wood chips will then be transported by logging and chip trucks to processing facilities in the area.

As a general rule, on slopes exceeding 45 percent, hand-felling will be employed[3]. On the south-bank, slopes exceeding 75 percent are seldom sustained for more than 50 metres and short skid-roads will be used as necessary to facilitate the safe clearing and stumping of construction areas. On the north bank, steep hill-side sections are often sustained for 200 to 400 metres. In these areas, a more extensive network of skid roads will be required to facilitate the safe access for crawler tractors to remove logs and stumps prior to Project excavation activities.

OLTC applications include specific application areas, and any specifications relevant to environmentally sensitive areas, and subsequent permits are anticipated to establish such requirements.

5.0 Highway 29 Realignments Clearing Requirements

5.1 General Description of Forest and Vegetation

Table 8 lists the highway segments and quantifies the area and volumes of biomass and merchantable forest in each area. The total length of the realignment will be approximately 30 kilometres and cover approximately 418 hectares. About a third of this area is already cleared as it follows the existing highway right-of-way (42 hectares) or is over cultivated land (71 hectares). Exposed soil and shrub areas comprise 95 hectares, and water covers 16 hectares, leaving approximately 194 hectares of forest. The forest is predominately deciduous (80 percent). The total merchantable volume of both coniferous and deciduous tree species is 23,986 cubic metres. An estimated 19,266 cubic metres of merchantable deciduous fibre and 4,720 cubic metres of coniferous logs will be removed. Accumulated non-merchantable fibre is estimated at 27,761 cubic metres.

Table 8 Highway 29 Realignment Area and Volume

Realignment Section	Area (hectares)		Volume (cubic metres)			
	Gross	Forest	Merchantable coniferous logs	Merchantable deciduous	Total merchantable	Gross Biomass
Lynx Creek	106	48	1,186	4,866	6,052	13,319
Farrell Creek East	69	24	755	2,413	3,168	6,827
Halfway River	44	25	11	1,769	1,780	3,829
Farrell Creek	34	18	218	3,107	3,325	7,200

[3] See Reservoir area for retention strategies on steep slopes not within construction areas.

Dry Creek	26	16	106	1,820	1,926	4,267
Cache Creek	139	63	2,444	5,291	7,735	16,305
Total	**418**	**194**	**4,720**	**19,266**	**23,986**	**51,747**

The majority of the Highway 29 realignment sections occur in areas where slopes are relatively flat. Table 9 describes the forest area within each realignment section by slope classification.

Table 9 Highway 29 Forest Areas by Slope Classification

Realignment Section	**Forest area (ha) by slope classification**			
	0-45%	**46-70%**	**Greater than 70%**	**Total (ha)**
Lynx Creek	45	1	2	48
Farrell Creek East	21	2	2	24
Halfway River	23	0	2	25
Farrell Creek	17	0	1	18
Dry Creek	12	1	2	16
Cache Creek	54	3	5	63
Total Forest Area	**172**	**7**	**15**	**194**

5.2 Highway 29 Realignment Clearing Approach

Within the Highway 29 realignment sections, complete removal of commercial and non-commercial vegetation will be required. Vegetation will be removed primarily with conventional falling equipment (e.g., feller-bunchers) and the use of skidders to transport logs to roadside. Commercially-valued trees will be removed first. Non-merchantable fibre and stumps will be removed through the use of tracked bull-dozers.

As described in Section 3.5 above, clearing along Highway 29 realignments will be within the Ministry of Transportation and Infrastructure (MoTI) right of way, therefore management near riparian habitat, waterways and where activities could affect migratory birds will follow the guidelines established by the British Columbia Ministry of Transportation and Infrastructure for clearing and grubbing on highway construction projects (MoTI 2012). OLTC applications would include specific application areas, and any specifications relevant to environmentally sensitive areas, and subsequent permits are anticipated to establish such requirements.

6.0 Clearing for Construction Material Sites

6.1 General Description of Forest and Vegetation

The area and vegetative volume associated with each of the potential construction materials sites is identified in Table 10. Construction material sites require the clearing of an estimated 394 hectares of forested area and 89,456 cubic metres of merchantable volume.

Table 10 Construction Materials Sites Areas and Volume

Quarry Name	Area (ha)		Merchantable Volume (m^3)			Total Biomass Volume (m^3)
	Total	Forest Area for clearing	Coniferous	Deciduous	Total	
Portage Mountain	151	150	10,921	12,660	23,581	55,291
West Pine	104	89	18,681	2,382	21,063	43,456
85th Avenue [1]	111	13	0	1,551	1,551	3,390
Del Rio Pit	162	117	27,318	11,982	39,300	73,118
Area E	80	14	686	661	1,347	3,697
Wuthrich	18	13	0	2,614	2,614	5,419
Total	**626**	**394**	**57,606**	**31,850**	**89,456**	**184,371**

NOTES:

Note 1 Area and volume clearing for the 85th Avenue industrial site quarry includes the haul route leading to the dam site.

Note 2 Potential aggregate sites have been identified, but at this time none of this area is proposed for clearing for construction materials. Several of these sites are adjacent to the Highway-29 realignment or within the reservoir.

6.2 Construction Material Sites Clearing Approach

Within the construction materials sites, complete removal of commercial and non-commercial vegetation will be required. This clearing will result in the removal of all commercially-valued trees first, followed by stump and non-merchantable biomass removal. Vegetation clearing will result in an estimated 31,850 cubic metres of deciduous fibre and an estimated 57,606 cubic metres of coniferous fibre. Total biomass is estimated to be 184,371 cubic metres.

Clearing will only be undertaken in areas planned to be used within quarries. OLTC applications would include specific application areas, and any specifications relevant to environmentally sensitive areas, and subsequent permits are anticipated to establish such requirements.

7.0 Clearing for Access Roads

7.1 General Description

Access will be required to the Project construction areas, and access routes requiring clearing activity are described in four categories:

1. existing access roads requiring upgrade
2. new temporary all-season access roads
3. new temporary access roads
4. new temporary water crossings

In addition to access roads, a number of temporary water crossings will be required. 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 or ice. Examples of these types of crossings are provided in Appendix A. All water crossings will be developed in consideration of 1) Environmental Specification described in CEMP Section 4.5 Water Crossings and Instream Works, 2) MFLNRO Section 9 approvals and 3) terms and conditions associated with *Navigation Protection Act* approvals issued by Transport Canada.

The following sections provide an overview of the access roads as they relate to clearing requirements. Specific permit applications under the *Land Act* or for an OLTC will provide specific information on access roads including maps as required for these permit applications.

7.2 Existing Roads Requiring Upgrade

Existing roads that will require upgrading to access the future reservoir area and transmission corridor are shown in Figure 1. Approximately 54 kilometres of existing roads will require upgrading in the form of ditching, right-of-way brushing, re-establishment of culverts and spot gravelling. Many of these roads do not have proper names and are found at the terminal point of longer, more developed road networks. The biomass volume associated with upgrading these roads for forestry use is expected to be negligible.

On the south side of the reservoir, two existing road networks lead to the centre of the future reservoir area, 1) the Project Access Road, which transitions into the South Monias (also known as the Del Rio Road), and 2) the North Monias. A road leads to the south-west end of the reservoir, which will require upgrading for the portion of road occurring north of the existing transmission corridor.

Adequate road access within the transmission corridor is already in place as a result of the previous construction of two existing 138 kv transmission lines and ongoing maintenance.

Other existing roads that will require upgrading include portions of the Beaver Loop Road, Old Hope Road and Wilder Road.

All roads will be upgraded to the standards required by the British Columbia Ministry of Forest Lands and Natural Resource Operations as described in the Engineering Manual (FLNRO 2012).

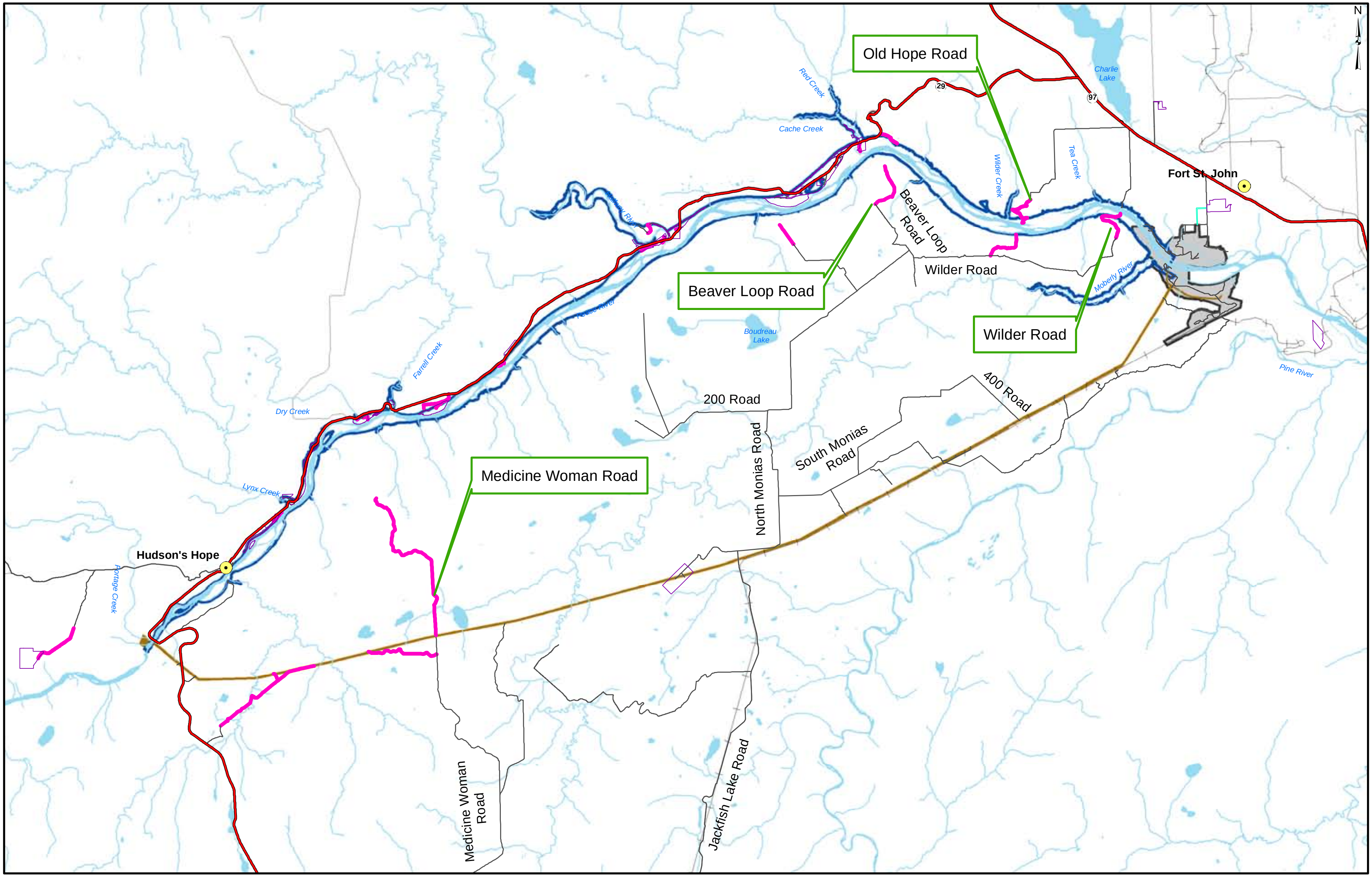
7.3 New Clearing Access Road Approach

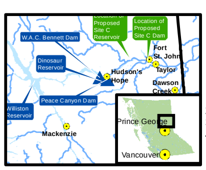
The approach for development of new temporary clearing access roads is:

1. Use existing access roads and limit the amount of new temporary access outside of the Project activity zone.
2. Avoid the construction of roads within the designated Ungulate Winter Range along the Moberly River.
3. Remove all vegetation from the access road corridor, with retention of some low-cut stumps where road use is for temporary winter access.
4. Undertake clearing along road corridors near riparian habitat in accordance with the CEMP Section 4.5.
5. Deactivate temporary clearing access roads in accordance with the CEMP once clearing activities are complete and where not required for other Project construction activities. Deactivation of roads accessing the south bank will include re-contouring side cuts where dictated by sideslope condition and the placement of coarse woody debris where available on the track outside of the reservoir to reduce potential future ATV access and to create habitat for small furbearers.

Figure 2 shows the location of temporary all-season and winter clearing access roads.

New access roads will be cleared by feller-bunchers to salvage merchantable logs. Non-merchantable fibre will be either burned on site or land filled. Temporary road construction down the slopes to the Peace River will be completed with excavators and tracked dozers and will employ standards set by the British Columbia Ministry of Forest Land and Natural Resource Operations' Engineering Manual (FLNRO 2012).





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

Proposed Reservoir
Dam Site Area
Transmission Corridor
Off-site Construction Materials
Conveyor Corridor
Existing Roads Requiring Upgrade
Roads
Highway
Railway

0 10 Km

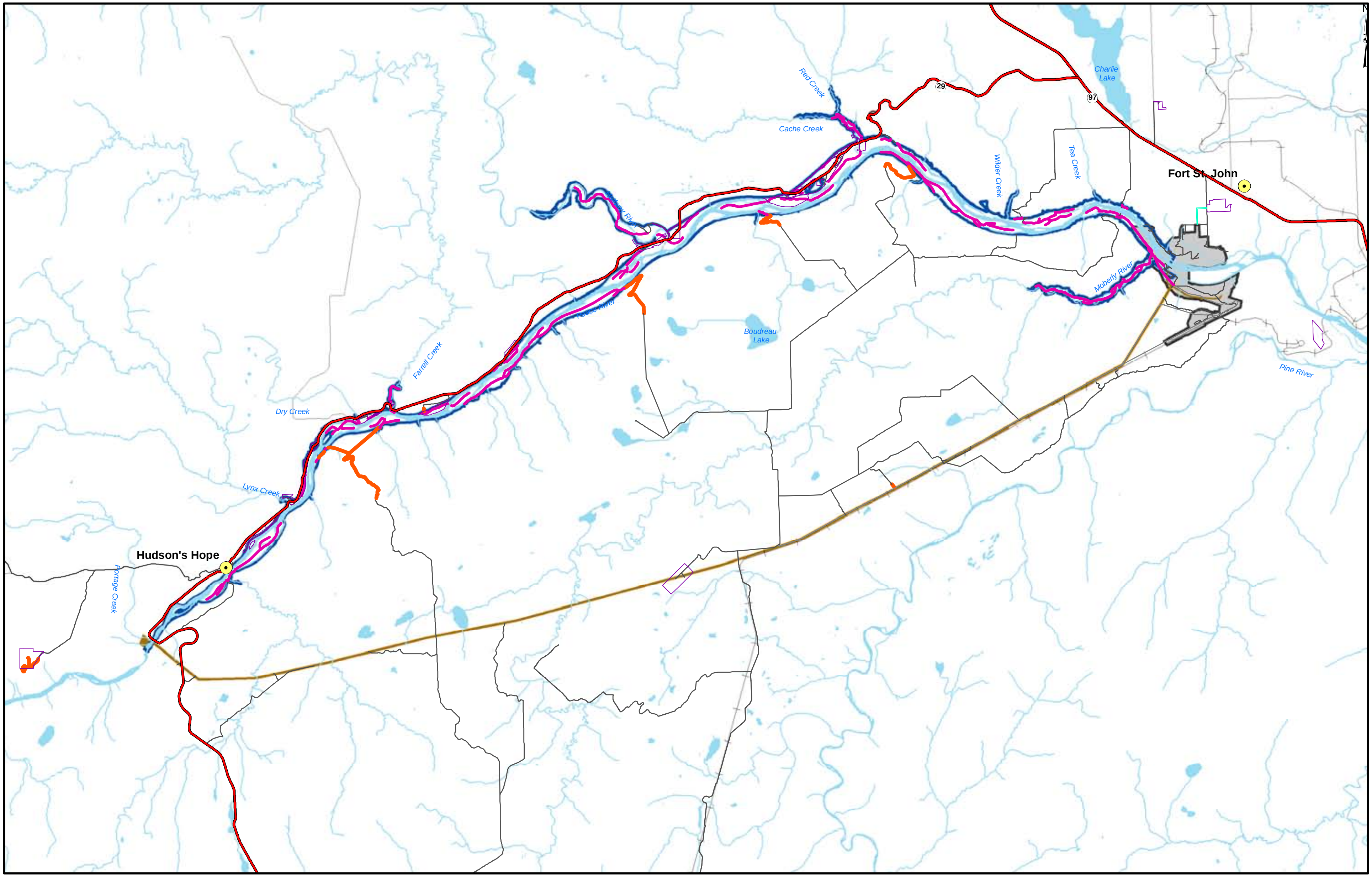
SITE C CLEAN ENERGY PROJECT

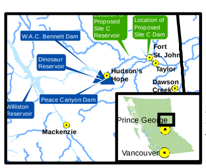
BC hydro

Figure 1:
Existing Roads
Requring Upgrade

DATE	December 06, 2012	DWG NO	1016-C14-A6210-1	R3

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification.





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- Proposed Reservoir
- Dam Site Area
- Transmission Corridor
- Off-site Construction Materials
- Conveyor Corridor
- Temporary All Season Access
- Temporary Winter Access
- Access Road to Dam Site
- Existing Roads
- Highway
- Railway

0 10 Km

Figure 2:
Proposed
Temporary Road Access

DATE	December 06, 2012	DWG NO	1016-C14-A6210-2	R3

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification.

7.3.1 Temporary All Season Access Roads

Figure 2 shows the general location of new temporary access routes. Approximately 70 kilometres of new temporary all season access roads, covering approximately 87 hectares, will be required leading to the reservoir area and the dam site.

Three short access routes) have been identified leading to the central portions of the future reservoir area. One longer route (9.6 kilometres) was identified leading to the south-west end of the reservoir.

The volume of merchantable trees associated with clearing the right-of-ways for these roads is approximately 13,505 cubic metres. Non-merchantable volume is estimated to be 17,821 cubic metres.

7.3.2 Temporary Winter Access Roads

Figure 2 shows the general location of new temporary clearing access routes. Access roads within the reservoir will include temporary winter access roads that will be deactivated after vegetation clearing has been completed in accordance with the CEMP. An estimated 128 kilometres of temporary winter access road will be required for reservoir clearing. Examples of temporary winter access roads are provided in Appendix A.

7.3.3 Temporary Water Crossings

An estimated 72 temporary water crossings will be required to access timbered vegetation on the islands and lowlands of the Peace, Halfway and Moberly rivers. The majority of these crossings (i.e., 46) will be winter crossings; 11 will be abutment bridges and 15 will be piling bridges. In many areas, “skidder-crossings” will be constructed to allow logging equipment to cross small streams, minor drainages and wet areas. An estimated 88 skidder-crossings will be required.

Additional detail regarding water crossings is provided in Appendix A. Site specific details on crossings will be included in applicable permit applications.

8.0 Transmission Line Corridor Clearing Requirements

8.1 General Description of Forest and Vegetation

The transmission line corridor is approximately 74 kilometres in length and the existing right of way has a cross-section which is 118 metres wide. Approximately 46 metres of the right-of-way had been previously cleared to support existing electrical requirements. The existing transmission corridor (exclusive of the Dam construction site, Del Rio quarry and Project Access Road) area is 1,231 hectares. Within this area 742 hectares is forested and will require vegetation clearing.

The forested area within the transmission corridor occurs primarily on a flat plateau that runs between the Moberly and Pine rivers. Soil here is composed of silts and or clays and is wet. Deciduous species, primarily trembling aspen, predominate at 61 percent of the merchantable volume. Coniferous species comprise 39 percent of the merchantable volume within the right-of-way. Most of this volume is white spruce (72 percent), with lodgepole pine (28 percent) contributing the remainder. The vegetative volume within the transmission right-of-way is shown in Table 11.

Table 11. Vegetation within Transmission Right-of-Way

Transmission Line Section	Forested Area (ha)	Merchantable Volume (m^3)			Biomass Volume (m^3)
		Deciduous	Coniferous	Total	
Transmission Corridor	742	79,749	51,896	131,645	293,041

8.2 Transmission Line Corridor Clearing Approach

Within the transmission corridor, clearing will include a combination of brushing vegetation to a maximum 30 centimetre stump height, falling trees within the corridor, full vegetation grubbing and partial cutting. Full vegetation grubbing will occur in transmission tower foundations, construction areas and access routes. Clearing vegetation to stump height, and select root removal to reduce future suckering of stems[4] in areas where deciduous forest cover exceeds 30 percent, will occur in most other areas between the transmission towers. Although small quantities of vegetation exist within the current 46-metre cleared corridor, additional clearing within this portion of the right-of-way is not generally proposed unless required for Project construction or maintenance of the existing right-of-way.

Where conductor clearances allow, riparian vegetation along watercourses or waterbodies crossed by the transmission line corridor shall not be removed. Where clearing within or adjacent to watercourses does occur, as described in section 3.5 above, it will be done in accordance with the CEMP.

West of the intersection of the Jackfish Forest Service Road with the existing right of way, 72 metres of new clearing width will be required. However, up to an additional 14 metres of clearing beyond the right-of-way will be required to remove danger trees and to create a wind-firm edge (Figure 3). East of the intersection of the of the Jackfish Forest Service Road and the existing right of way, 89 metres of new clearing will extend the right of way to a 135 metre cross sectional width. This width will include an additional 17 metres of right-of-way that will be used to accommodate the Project Access Road to the Dam site (Figure 4).

[4] Suckering occurs when a secondary shoot is produced from the base or roots of a woody plant that gives rise to a new plant. Deciduous tree roots are highly prone to ‘suckering’.

Figure 3 Cross-section A - West of Jackfish Lake Road (looking east)

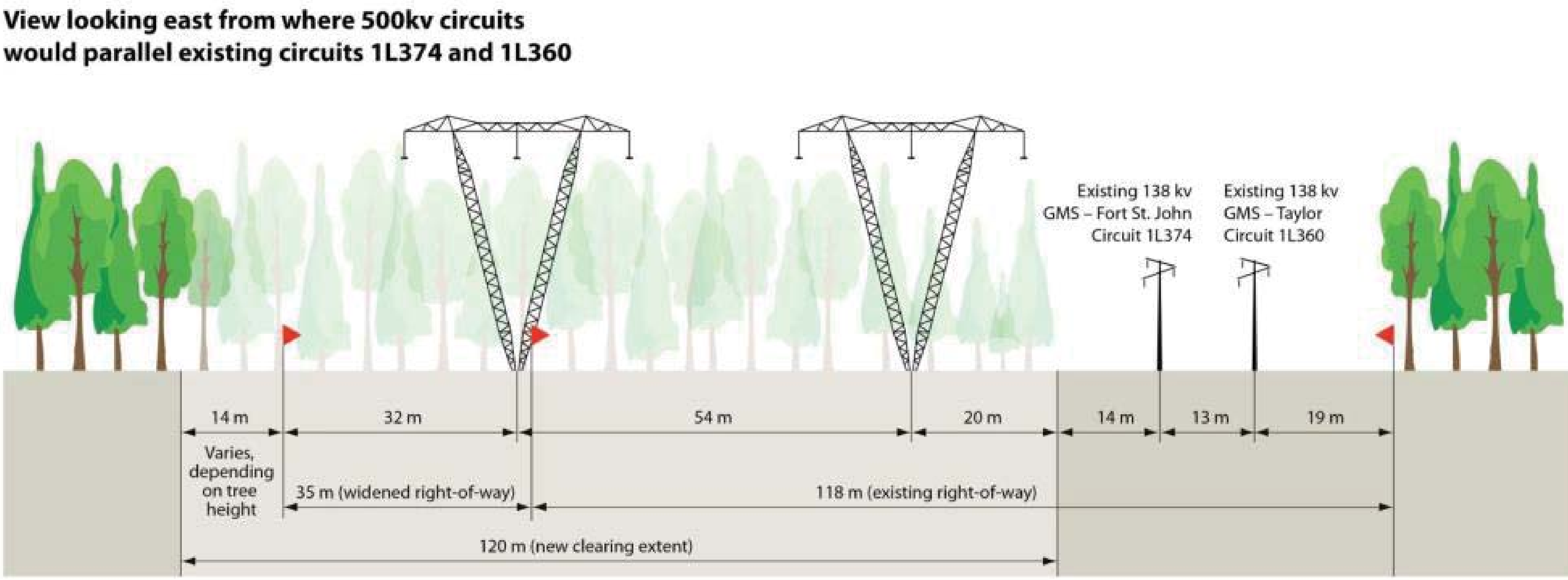


Table 12 shows the area and volume that will be cleared for the transmission right-of-way. The disposal strategy of merchantable logs and non-merchantable fibre is described in Section 3.6.

Table 12 Transmission Right-of-Way Estimated Clearing Area and Volume

Forest Area (hectares)				**Forest Volume cleared (cubic metres)**	
Vegetation Cleared to stumps	**Trees cleared, stumps and non-merch. trees retained (i.e., riparian areas)**	**Trees cleared and stumps removed**	**Total Clearing Zone**	**Merchantable volume cleared**	**Gross Volume cleared**
240	20	480	740	130,808	270,898

9.0 Reservoir Clearing Requirements

9.1 General Description of Forest and Vegetation and Other Factors

The reservoir will be 9,330 hectares when filled to the maximum normal reservoir level of 461.8 metres. Vegetation clearing is planned for the inundated terrestrial areas above the Peace River within the future reservoir area, and for an area above this elevation within which erosion is predicted over the first five years of reservoir operation.

The reservoir clearing site excludes areas within the dam site (345 hectares), Highway 29 realignment (114 hectares) and access roads (190 hectares) that will also be inundated at the time or reservoir filling. The strategy for clearing vegetation from within each of these sites is discussed in those respective sections.

9.1.1 Vegetation Inventory

The existing land classifications within the reservoir are river, exposed soils (i.e., gravel bars, roads, trails and clay banks), cultivated areas, shrub and forest. The area within each of these classifications is shown in Table 13.

Table 13 Topographic Features within the Reservoir

Feature	**Area (ha)**	**Percent**
Cultivated	540	6%
Exposed soil	195	2%
Shrubs	520	6%
River	3,649	41%
Existing Roads	82	1%

Forest	4,021	45%
Gross Area	**9,007**	**100%**

Fifty-seven percent of the forests within the reservoir are deciduous. The deciduous volume is comprised largely of cottonwood trees (55 percent), some of which are large decadent cottonwood trees growing in the valley bottoms and on islands. The remaining 43 percent of the forests are coniferous, with spruce trees comprising the majority of this volume. Table 14 describes the merchantable volume by leading species. The forest inventory for the Project activity zone identified 914,229 cubic metres of merchantable tree volume within the reservoir.

Table 14 Reservoir Area Tree Species

Tree species		**Gross area by leading species (ha)**	**Merchantable volume (m^3)**	**Total biomass volume (m3)**
Coniferous	Spruce	1075	385,430	732,006
	Pine	0.3	20	34
	Larch	34	1,344	3,742
Total Coniferous		**1,109**	**386,794**	**735,782**
Deciduous	Cottonwood	1634	289,814	604,702
	Aspen	955	178,610	400,290
	Birch	323	59,011	125,002
Total Deciduous		**2,912**	**527,435**	**1,129,994**
Total all species		**4021**	**914,229**	**1,865,776**

9.1.2 Slopes and Slope Stability

Where vegetation clearing is required on steep slopes, appropriate methods will be used including retention of all trees on steep, unstable slopes that would be highly susceptible to landslides if the vegetation was removed.

The Peace River Valley topography is characterized by a relatively flat river channel combined with islands that transition to steep side slopes along both the north and south sides of the valley. LiDAR remote sensing data was used to accurately measure ground elevations and calculate slope gradients. Steep slopes are prevalent along both north and south faces of the reservoir. The areas by slope classification throughout the reservoir site are shown in Table 15. About eleven percent of the forested area slopes in the reservoir exceed 70 percent. The majority of these steep slopes are along the perimeter of the reservoir and rarely extend upward more than 40 metres to the edge of the 5-year beach-line.

Table 15 Reservoir Slope Classifications

Slope Class	Forest Area (ha)	Percent Forest Area
0-35%	3,420	85%
35-70%	143	4%
70% +	457	11%
Total	**4,021**	**100%**

As a combined result of the steep side-slopes and the moisture that exists in wetlands on the plateaus above the Peace River valley, particularly on the south bank, incidents of ground slumping occur along the sides of the valley. Evidence of this slumping is seen in Photograph 4. Slope stability analysis was completed by BGC Engineering Inc. (please see EIS Volume 2 Appendix B Geology, Terrain Stability and Soil Reports). This analysis identified historic landslides, slide deposits and classified the terrain based on its stability and associated operating risks for vegetation clearing and road construction. A description of the terrain classifications within the reservoir and the forest area within each class is provided in Table 16. The terrain classification system shown in Table 16 is used to identify areas of slope stability concern and to guide harvesting and road construction activities in the province of British Columbia. An example of a terrain class V slope within the reservoir is shown in Photograph 3.

Table 16 Terrain Stability Classification

Terrain Classification	Interpretation [1]	Forest Area (ha)
I	No significant stability problems exist	3086
II	There is a very low likelihood of landslides following timber harvesting or road construction. Minor slumping is expected along road cuts, especially for 1 or 2 years following construction.	92
III	There is a low (<30%) likelihood of landslide initiation following timber harvesting or road construction. Minor slumping is expected along road cuts, especially for 1 or 2 years following construction.	237
IV	Expected to contain areas with a moderate (30-70%) likelihood of landslide initiation following timber harvesting or road construction. Wet season construction will significantly increase the potential for road-related landslides.	211
V	Expected to contain areas with a high (>70%) likelihood of landslide initiation following timber harvesting or road construction. Wet season construction will significantly increase the potential for road-related landslides.	396
Total		**4,021**

NOTES:

Please see volume 2 appendix b geology, terrain stability and soil reports

As a result of these slope and terrain stability classifications: 1) within the reservoir, 396 hectares of forest are in Terrain Class V and will not be cleared as a result of risks to both worker safety and environmental damage; 2) special clearing techniques may be required for approximately 457 hectares of forest in Terrain Class III and IV. These techniques may involve hand-falling trees down the slope and reaching up the slope with a skidder cable or excavator arm to safely draw the vegetation to areas where wheeled or tracked skidders can forward the vegetation to a roadside.

Photograph 3 Steep slopes on south side of the Peace River

Credit: Industrial Forestry Service Ltd.

Photograph 4 Terrain Class V slope

Credit: Industrial Forestry Service Ltd.

9.1.3 Riparian Areas within the Reservoir

Where vegetation clearing is required near waterways, a riparian zone for the protection of fish and water quality will be preserved as described in Section 4.5 of the CEMP, including retention of non-merchantable trees and vegetation in riparian areas within a 15 m buffer from the Ordinary High Water Mark (OHWM). Merchantable trees and trees that may protrude above 455 m elevation may still be removed using clearing practices to maintain a 15 m machine-free zone from the OHWM.

Within the reservoir site, approximately 936 hectares are classified as riparian area, of which 665 hectares is forested. In order to ensure that clearing of the reservoir activity zone manages for the preservation of a riparian zone during the construction period, a 15 metre buffer from the ordinary high water mark of all defined watercourses will be established to preserve non-merchantable vegetation in these riparian zones. This 15-metre distance is consistent with the definition used for slopes less than 50 percent in the *Approved Work Practices for Managing Riparian Vegetation* October 2003, developed by BC Hydro, Fisheries and Oceans Canada and the British Columbia Ministry of Water, Lands and Air Protection for prescribing riparian maintenance on transmission line corridors. Merchantable timber that exists within riparian zones is typically taller than 15 metres in height. These stems will be either hand-felled with the tree top falling outside of the riparian area (to be pulled out by the top using skidder cables, or feller-bunchers will reach into the zone with a cutting arm that will cut and extract the timber without damaging the soils within the riparian zone.

Table 17 Reservoir Riparian Areas

Reservoir	Gross Area (ha)	Forested Area (ha)	Merchantable volume (m^3)	Non-merchantable volume (m^3)
Riparian Area	936	665	125,170	131,652

9.1.4 Access to Islands

Approximately 28 percent of the forest area in the reservoir area (1,141 hectares) and 33 percent of the volume (306,215 cubic metres) exists on 65 islands within the Peace River. Due to varying water levels at different times of the year, the transportation of harvesting equipment to islands will only be possible through a combination of access methods. The establishment of temporary bridges, ice bridges (weather dependent), snow and gravel that will be pushed over culverts, helicopters and barges were considered. Investigations, including pre-field and field study, concluded the following:

- All islands could be accessed by helicopter.
- All of the islands could be accessed by some form of bridge structure. Many of these structures may be as simple as ice or snow crossings over box culverts (e.g. in side channels or where the water flow is slower).
- Ice bridges across the main channel of the Peace River are not feasible due to the typically higher water flow into the Peace River during winter months from the Peace Canyon Generating Station.
- Information pertaining to average water currents, water temperatures and winter air temperature shows that ice formation on the upstream reaches of the Peace River has been rare. BC Hydro ice specialists have indicated that in any given year there is approximately a 50 percent chance that the Peace River ice front will extend into British Columbia. Although ice fronts have been observed as far as the District of Taylor roughly 20 percent of the time, this has not occurred since 1996, and was close in 2011 (EIS Volume 2 Appendix G Downstream Ice Regime Technical Data Report).
- Ice formation does occur most years on the Halfway and Moberly rivers. Winter water flows down these two rivers are substantially less in comparison to the Peace River. Equipment access up the Moberly and Halfway rivers during winter months is therefore feasible as a result of low water levels and frozen gravel bars. (BC Hydro 2009).
- Barges could be used to access forested island areas in the Peace River east of the Halfway River; however upstream of the Halfway River, the shallow water depths observed will prohibit the safe operation of barges for both delivery of forest-clearing machinery and extraction of trees (Sundve 2011, pers. comm.).

Examples of some of the islands that exist within the Peace River are provided by Photograph 5 and Photograph 6. As a result of the consultations and field investigations, access to islands in the Peace River will be by temporary bridge and by helicopter (where road access was restricted). Access to islands and to isolated timber along the Halfway and Moberly rivers will be by snow and ice crossings if water levels and temperatures permit, or by temporary bridge where the conditions did not warrant a snow or ice crossing.

Photograph 5 Islands in the centre of the Peace River

Credit: Industrial Forestry Service Ltd. (2011)

Photograph 6 Low water access to islands in the Peace River

Credit: Industrial Forestry Service Ltd. (2011)

9.1.5 Other Concerns in the Reservoir

The development of the clearing approach for the reservoir site was completed in consideration of potential influences of vegetation clearing on fish habitat, mercury methylation, water quality, boater safety, future recreational use and the level of filling. Information pertaining to each of these topics is discussed in their respective chapters in the Environmental Impact Statement (EIS). The applicability of this information with respect to reservoir clearing is summarized as follows:

- Fish Habitat – vegetation that remains within an inundated reservoir can provide good quality fish habitat (please see Volume 2 Section 12 Fish and Fish Habitat).
- Mercury Methylation – clearing all vegetation from the bottom of a reservoir will reduce mercury in fish by a negligible amount, (see Volume 2 Section11.9 Methylmercury).
- Recreation – clearing vegetation such that vegetation tops do not extend beyond the waterline improves recreational opportunities and boater safety (see Volume 3 Section 25 Outdoor Recreation and Tourism and Section 26 Navigation).
- Greenhouse gases – retaining vegetation in the reservoir reduces greenhouse gas emissions (see Volume 2 Section 15 Greenhouse Gases).
- Dam operations – remove vegetation from areas that would fall into the reservoir through wave action and erosion within a few years post inundation and float to the spillway (see Volume 2 Appendix B Part 2 Preliminary Reservoir Impact Lines).

9.2 Reservoir Clearing Approach

Based on a review and analysis of the factors unique to the future reservoir environment, as discussed in Section 9.1, a clearing strategy for the reservoir was developed.

Portions of the reservoir site are included in the dam site and access roads. These areas will be cleared according to Section 3.2 and Section 6.3.2 of this plan. The remaining area within the reservoir site contains 4,021 hectares of forest. In order of priority, the guiding principles for clearing are:

1) Retain vegetation in areas where worker safety is a concern due to ground instability (i.e., Terrain Class V).
2) Restrict clearing methods in riparian areas, to manage for water quality and wildlife habitat prior to reservoir inundation.
3) Adjust clearing to the 5-year “beach” line to limit the amount of debris entering the reservoir post-inundation.
4) Remove vegetation for navigational safety issues that will arise post-inundation.
5) Remove merchantable logs that could be used by the regional forest products industry.
6) Retain non-merchantable standing trees for future fish habitat.
7) Evaluate other resource concerns as they arise and retain or remove vegetation accordingly.

In balancing these factors, a reservoir clearing-decision matrix was developed that will be followed for reservoir clearing in spatially specific areas. The reservoir clearing decision matrix is shown in Figure 4.

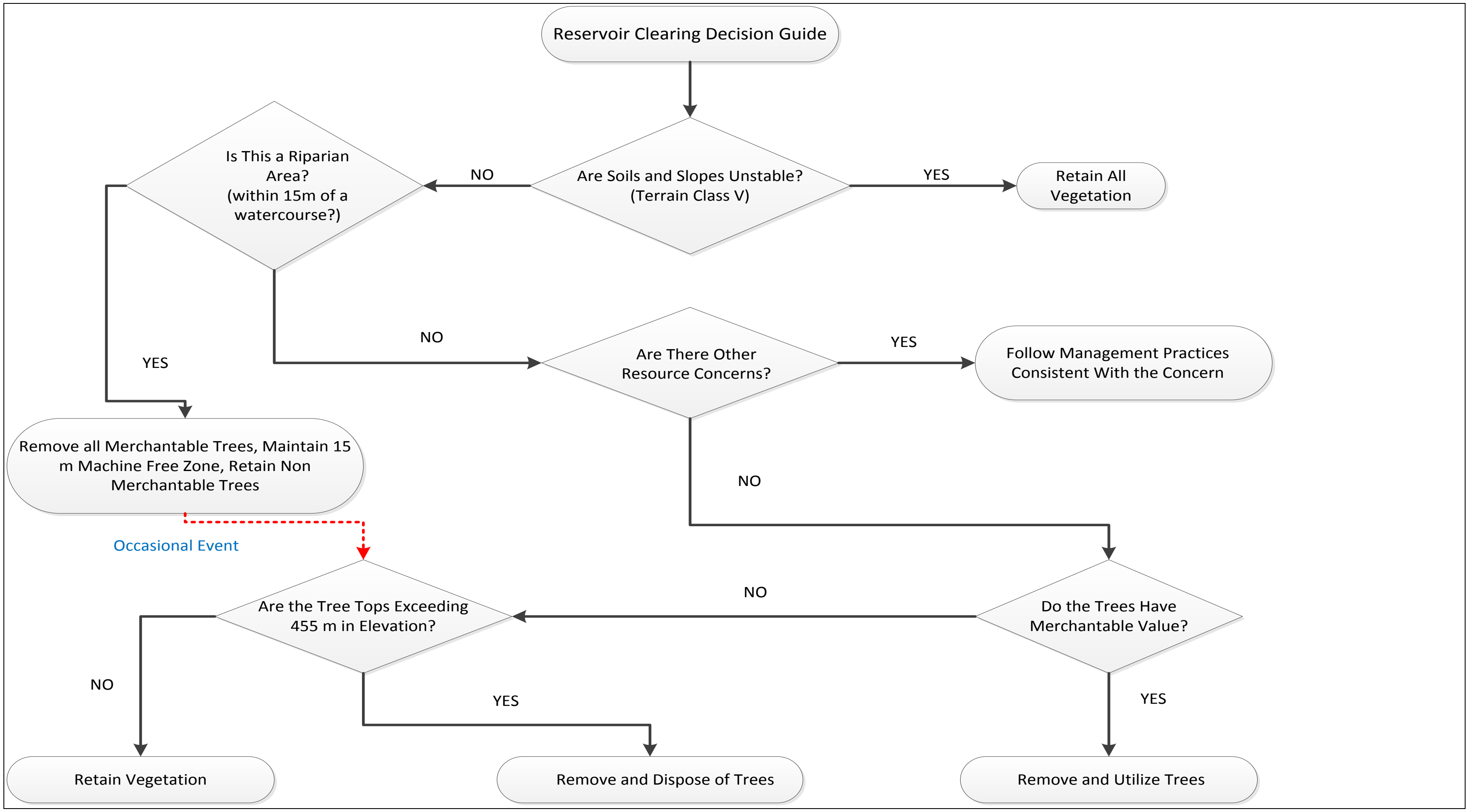


Figure 4 Reservoir Vegetation Clearing Decision Matrix

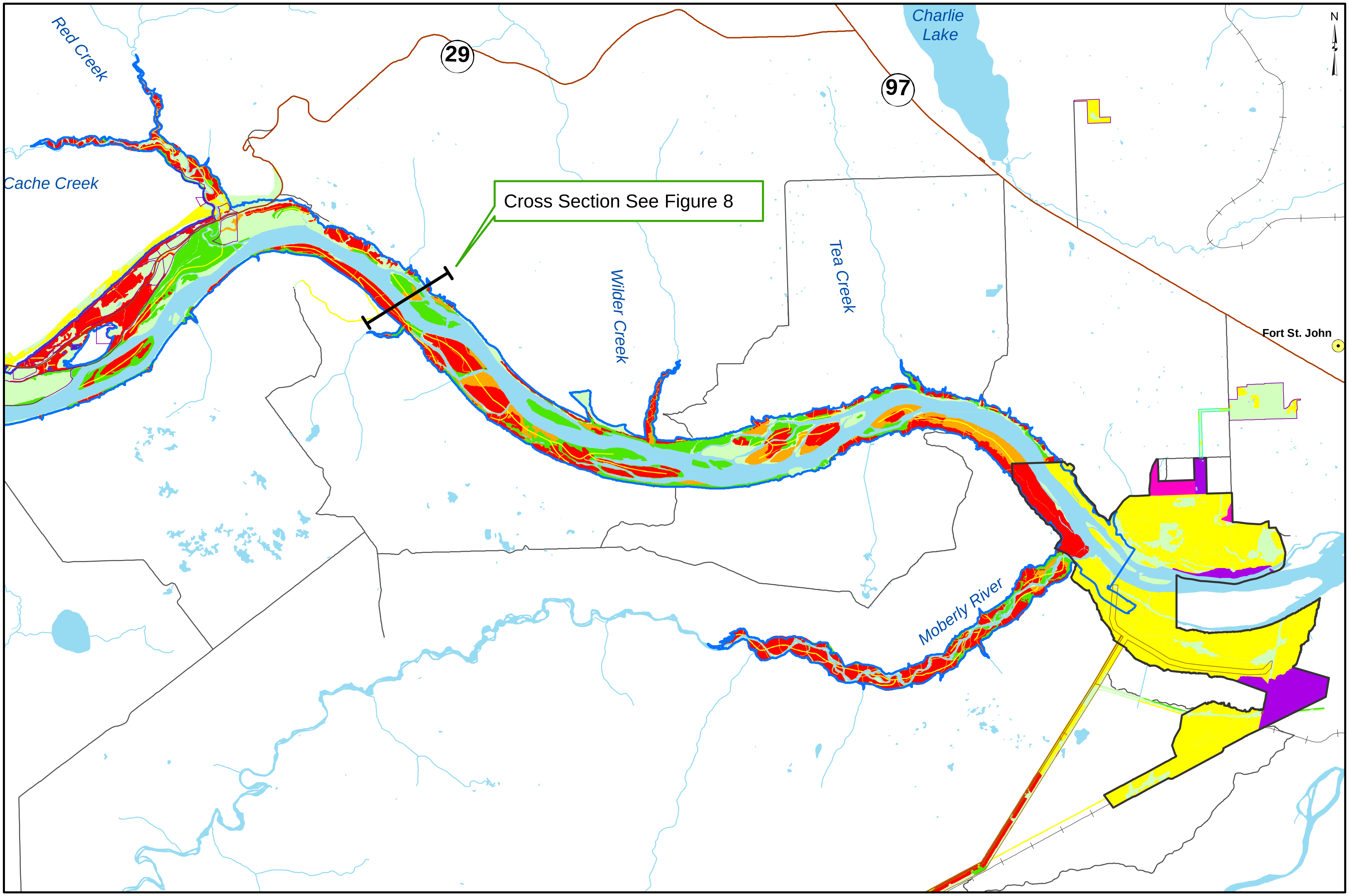
The vegetation clearing decision matrix for the reservoir site will result in the clearing of 2,918 hectares of forest, which is 73 percent of the forested area within the reservoir site. Clearing will salvage 835,580 cubic metres of merchantable wood or 91 percent of the merchantable logs within the reservoir site. These trees will be offered for sale to the forest industry. Clearing will also salvage remove 536,653 cubic metres of non-merchantable fibre. Table 18 shows the areas and volumes within the reservoir site that will be cleared. Within the reservoir site, 56 percent of the merchantable volume cleared (469,787 cubic metres) will be deciduous and 44 percent (365,793 cubic metres) of the volume will be coniferous.

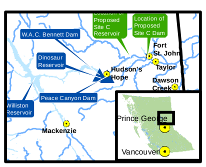
Table 18 Reservoir Clearing

Reservoir	Area (ha)	Merchantable Volume (m^3)	Non-Merchantable Volume (m^3)	Total Biomass (m^3)
Total Forest	4,021	914,229	951,547	1,865,776
Forest for clearing	2,918	835,580	536,653	1,372,233

Figure 5, Figure 6, and Figure 7 show the locations of these areas within the east, central and western portions of the Project activity zone, respectively. As an example, Figure 8 provides a cross-sectional illustration of the clearing matrix results.

Clearing will be carried out primarily using conventional harvesting equipment (i.e., feller-bunchers, crawler tractors, line skidders and/or grapple skidders). Approximately seven percent of the volume (55,802 cubic metres) will be hand felled and removed by helicopter. Only in a few very restricted sites where access by helicopter will be unsafe, will felling occur and then the vegetation will either be incinerated on site or left to float out after reservoir inundation. The volume associated with these sites is estimated to be 2,252 cubic metres.





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of BC

Clear Vegetation and Grub	Proposed Reservoir	Clearing Subject to Further Design
Clear Merchantable Trees	Dam Site Area	Limited Clearing
Clear Vegetation	Transmission Corridor	Existing Roads
Retain Vegetation	Off-site Construction Materials	Highway
Non Treed	Conveyor Corridor	Railway

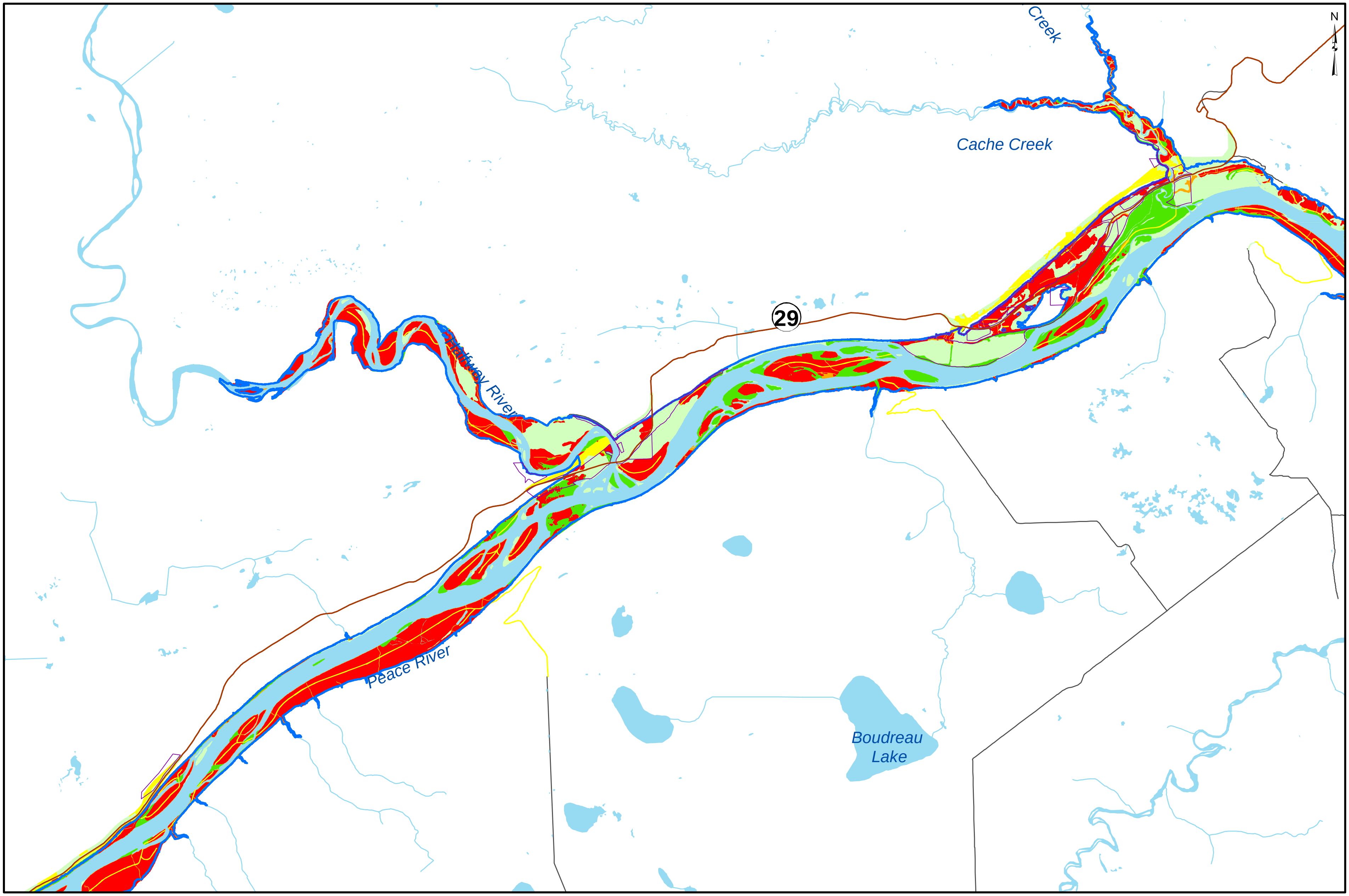
SITE C CLEAN ENERGY PROJECT

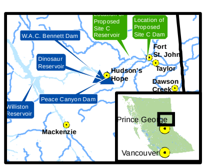
BC hydro

Figure 5: Project Activity Zone Clearing Strategy (Eastern Portion)

DATE	December 06, 2012	DWG NO	1016-C14-A6210-3	R3

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification.





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of BC

- Clear Vegetation and Grub
- Clear Merchantable Trees
- Clear Vegetation
- Retain Vegetation
- Non Treed
- Proposed Reservoir
- Dam Site Area
- Transmission Corridor
- Off-site Construction Materials
- Existing Roads
- Highway
- Railway

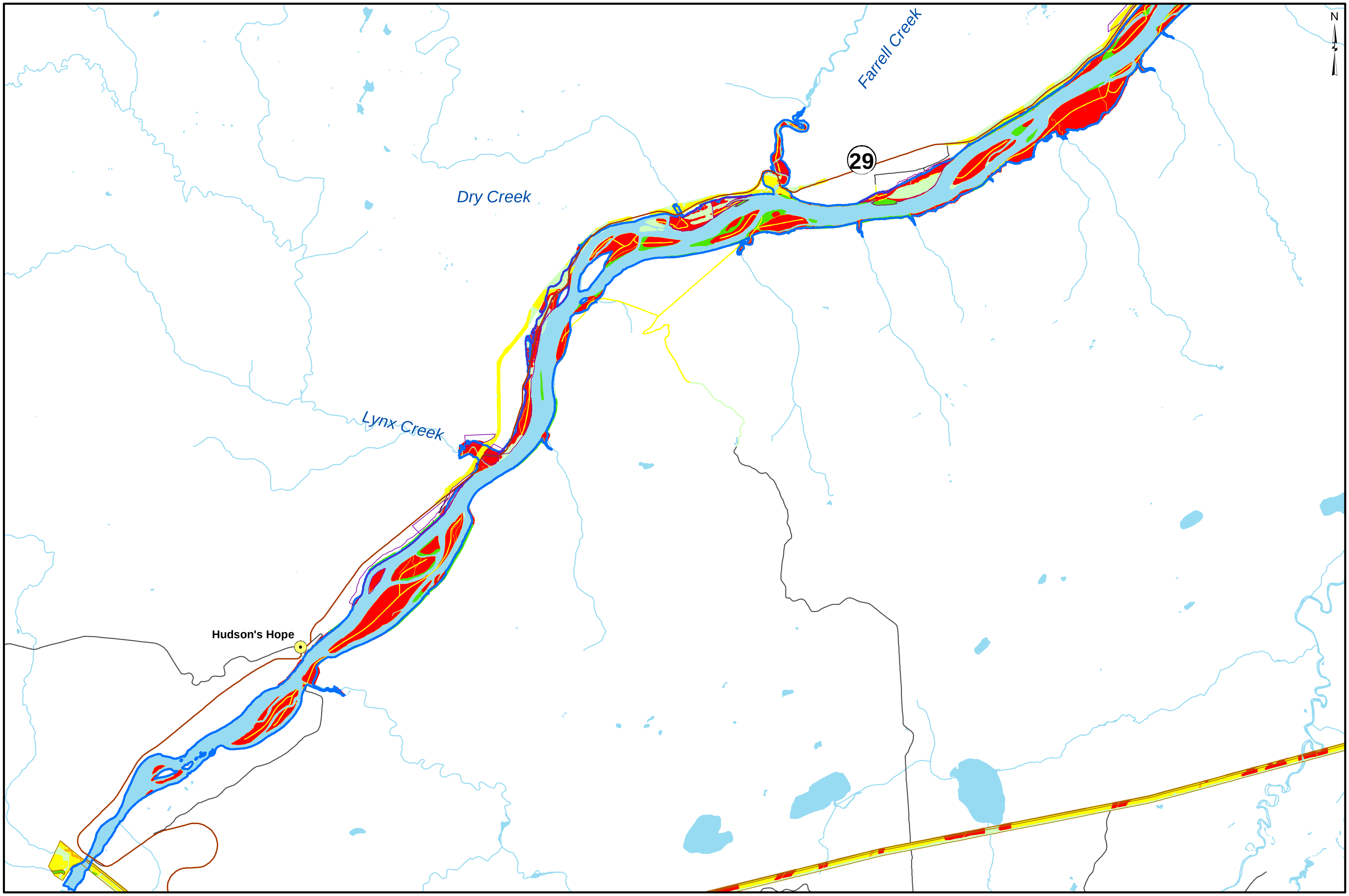
SITE C CLEAN ENERGY PROJECT

BChydro

Figure 6: Project Activity Zone Clearing Strategy (Central Portion)

DATE	December 06, 2012	DWG NO	1016-C14-A6210-4	R3

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification.



Clear Vegetation and Grub
Clear Merchantable Trees
Clear Vegetation
Retain Vegetation
Non Treed
Proposed Reservoir
Dam Site Area
Transmission Corridor
Off-site Construction Materials
Existing Roads
Highway
Railway

0 5 Km

Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of BC

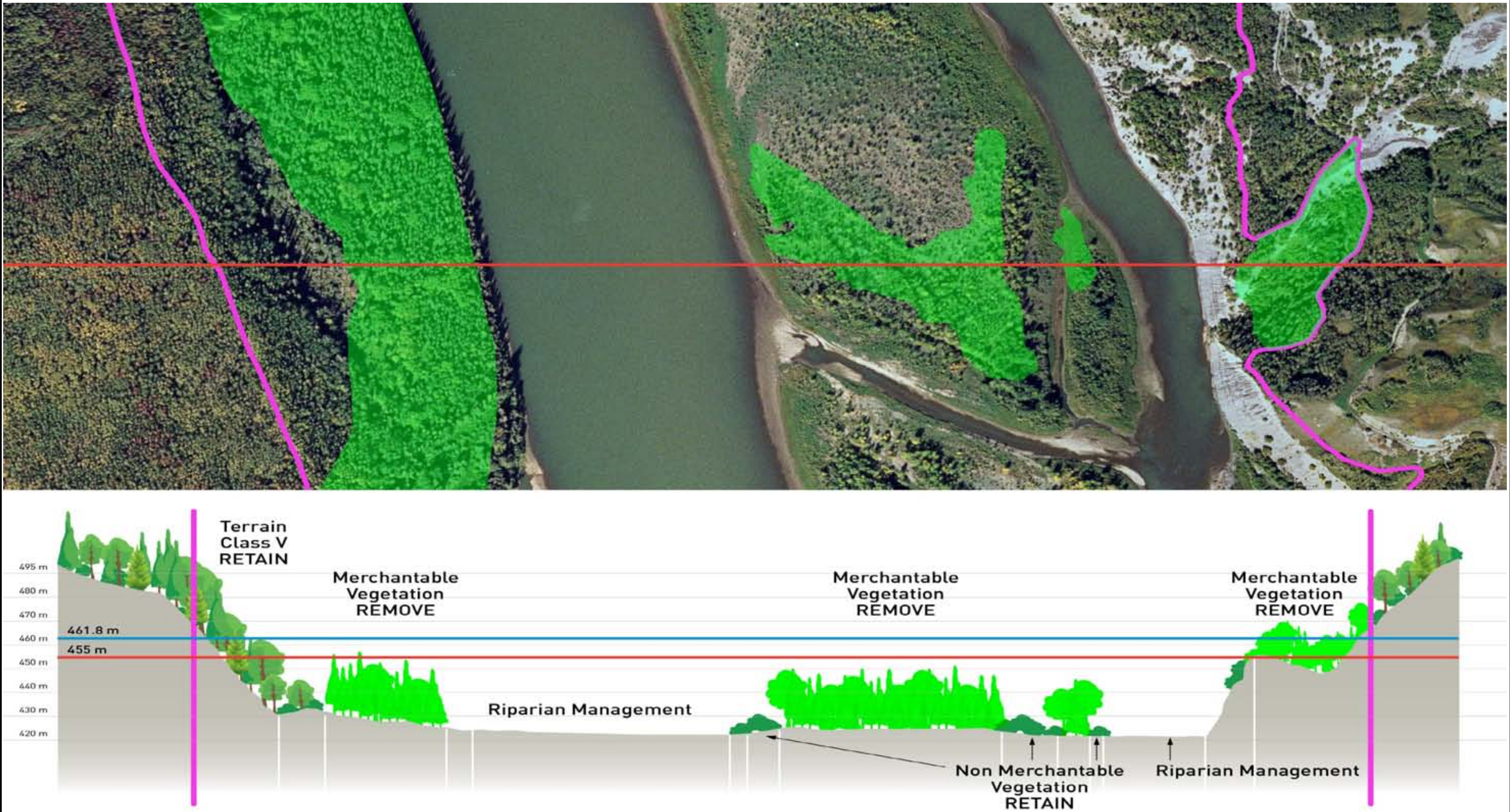
SITE C CLEAN ENERGY PROJECT

BC hydro

Figure 7: Project Activity Zone Clearing Strategy (Western Portion)

DATE	December 06, 2012	DWG NO	1016-C14-A6210-5	R3

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification.



BC hydro

SITE C CLEAN ENERGY PROJECT

Figure 8 Cross-sectional illustration of the clearing matrix results

Construction of the Site C Clean Energy Project is subject to required regualtory approvals including environmental certification

9.3 Reservoir Clearing Schedule

Vegetation clearing is scheduled to occur over a four-year time horizon.

Vegetation clearing in the eastern portion of the reservoir site (i.e., from the dam site to Cache Creek and including the Moberly) will occur in years one and two of the Project Schedule. Clearing activities will be coordinated with dam site vegetation clearing in order to reduce equipment congestion later in the Project work schedule.

Clearing vegetation from the central and western portions of the reservoir site upstream from Cache Creek scheduled to occur in years three and four of project construction. In consideration of timing of industry's need for timber from clearing, and the outcome of other concerns around recreational use and visual quality during the construction period, the clearing currently planned for years three and four within the reservoir may be moved into years five and six of the construction schedule. The options for the clearing of the upper portions of the reservoir were presented as part of BC Hydro Fall 2012 public consultation, however BC Hydro did not receive specific comments on these clearing schedule options.

Table 19 Reservoir Clearing by Season and Year

Reservoir	Summer		Winter		Yearly Total	
	Area (ha	Merchantable Volume (m^3)	Area (ha)	Merchantable Volume (m^3)	Area (ha)	Merchantable Volume (m^3)
Year 1	12	1991	362	125931	374	127,922
Year 2	129	26693	480	181725	609	208,418
Year 3 (or 5)	128	22360	616	166572	744	188,933
Year 4 (or 6)	60	7011	1131	303296	1191	310,307
Total	**329**	**58,055**	**2,588.5**	**777,524**	**2,917.5**	**835,580**

10.0 Managing Waterborne woody debris

10.1 Waterborne Woody Debris General Description

Naturally occurring woody debris will enter the Peace River and its tributaries each year as a result of the spring freshet, wind, wave and ice action that erodes shorelines and undercuts river banks, forest litter, beaver dams and debris jams. This is a natural occurrence that varies in intensity depending on the severity of the annual spring freshet. Photograph 7 and Photograph 8 illustrate locations in the Peace River watershed where an estimated 23,000 cubic metres were deposited naturally during a 50-year flood event in 2011.

Photograph 7 Natural woody debris at confluence of Peace and Moberly rivers

Credit: Industrial Forestry Service Ltd. (2011)

Photograph 8 Natural woody debris along Peace River

Credit: Industrial Forestry Service Ltd. (2011)

Woody debris will enter the reservoir site during the headponding event and at reservoir-filling due to vegetation clearing debris that could not be removed during clearing activities. This material will eventually float down the reservoir to the dam site. At other dam sites in British Columbia, this material is prevented from entering the dam through the uses of log booms that capture the floating material. This material is then removed using boats to push the debris to a crane that extracts it from the reservoir. Photograph 9 and Photograph 10 show the removal of waterborne woody debris from the Dinosaur Reservoir. During the construction of the Site C dam, waterborne woody debris will need to be captured and removed from the river to ensure worker safety within the dam site construction area and prevent passage through diversion tunnels . During operations reservoir debris management will be required for both boater safety and dam operational purposes.

Photograph 9 River boat used to push woody debris

Credit: Industrial Forestry Service Ltd. (2011)

Photograph 10 Crane used to extract woody debris

Credit: Industrial Forestry Service Ltd. (2011)

During dam construction and early reservoir operations there will be five key periods that will result in pulses of floating debris being transported down river or down reservoir:

- Year 1 – natural floating debris mobilisation
- Year 3 – Peace River channelization phase. The estimated debris volume is approximately double Year 1, due to channelization of the river at the dam site and associated upstream headponding.
- Years 4 and 5 – Peace River diversion phase. The estimated debris volume will pulse again, due to diversion of the river at the dam site and further upstream headponding.
- Years 7 and 8 – Reservoir filling phase. The estimated debris volume will pulse again, in stages as the reservoir is filled.
- Operations phase – early years. During the early years of reservoir operations shoreline erosion will result in recruitment of woody debris and a directional general wind driven movement of debris within the reservoir.

The estimated debris volumes, by location, in the Peace River throughout project construction and early years of operation are illustrated in Figure 9. Figure 9 takes into account existing debris within the project footprint as a result of natural events (e.g., log jams, beached logs from the 2011 flood), unavoidable woody debris created during clearing activities (e.g. residual woody material not removed as merchantable timber or waste wood not disposed of as biofuel, pile and burn, landfill, or new technology) and post-inundation debris (IFS 2014). In all phases the general direction of debris movement and accumulation is downstream.

The proposed location of construction phase waterborne woody debris catchment sites are shown in Figure10.

Figure 9 Debris Collection Boom Locations

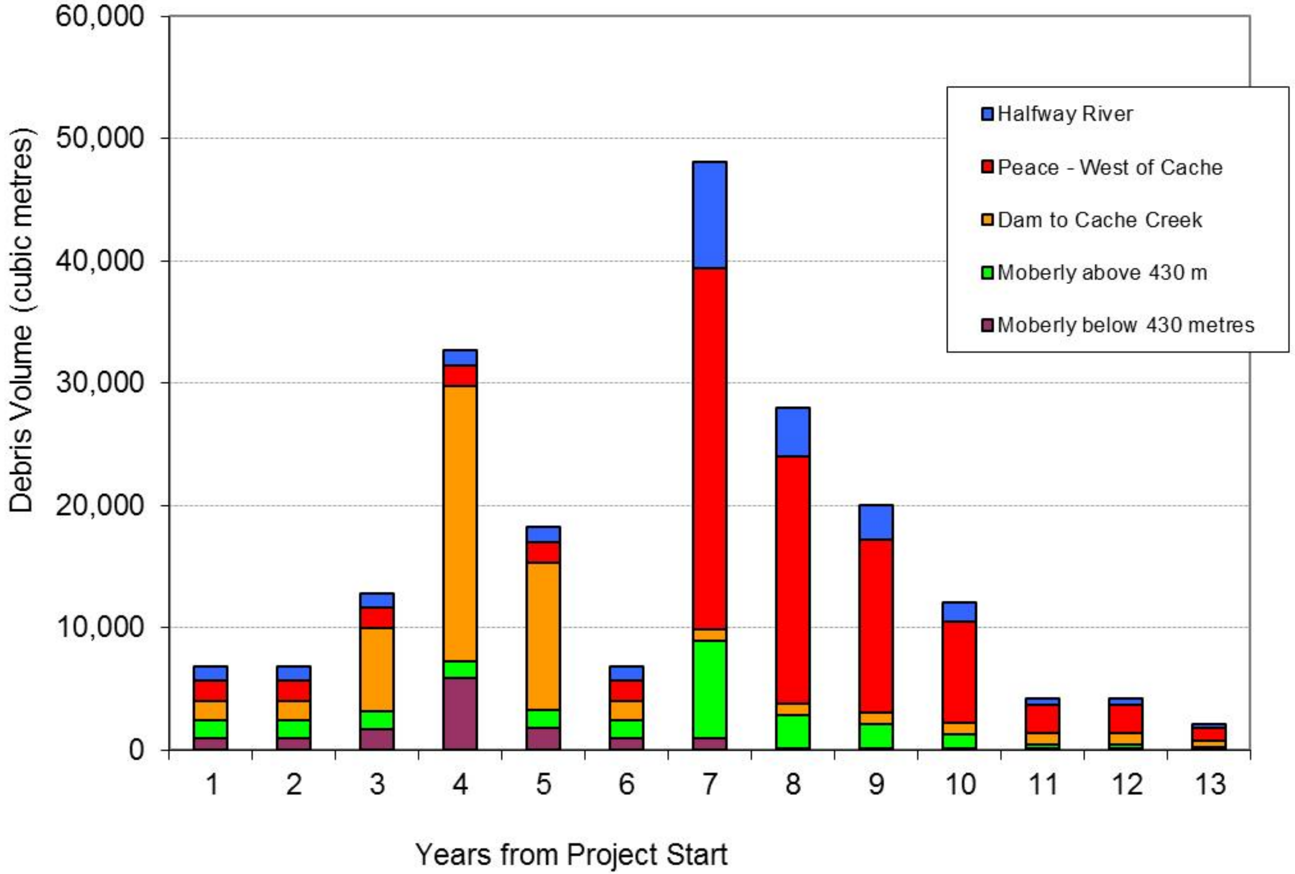
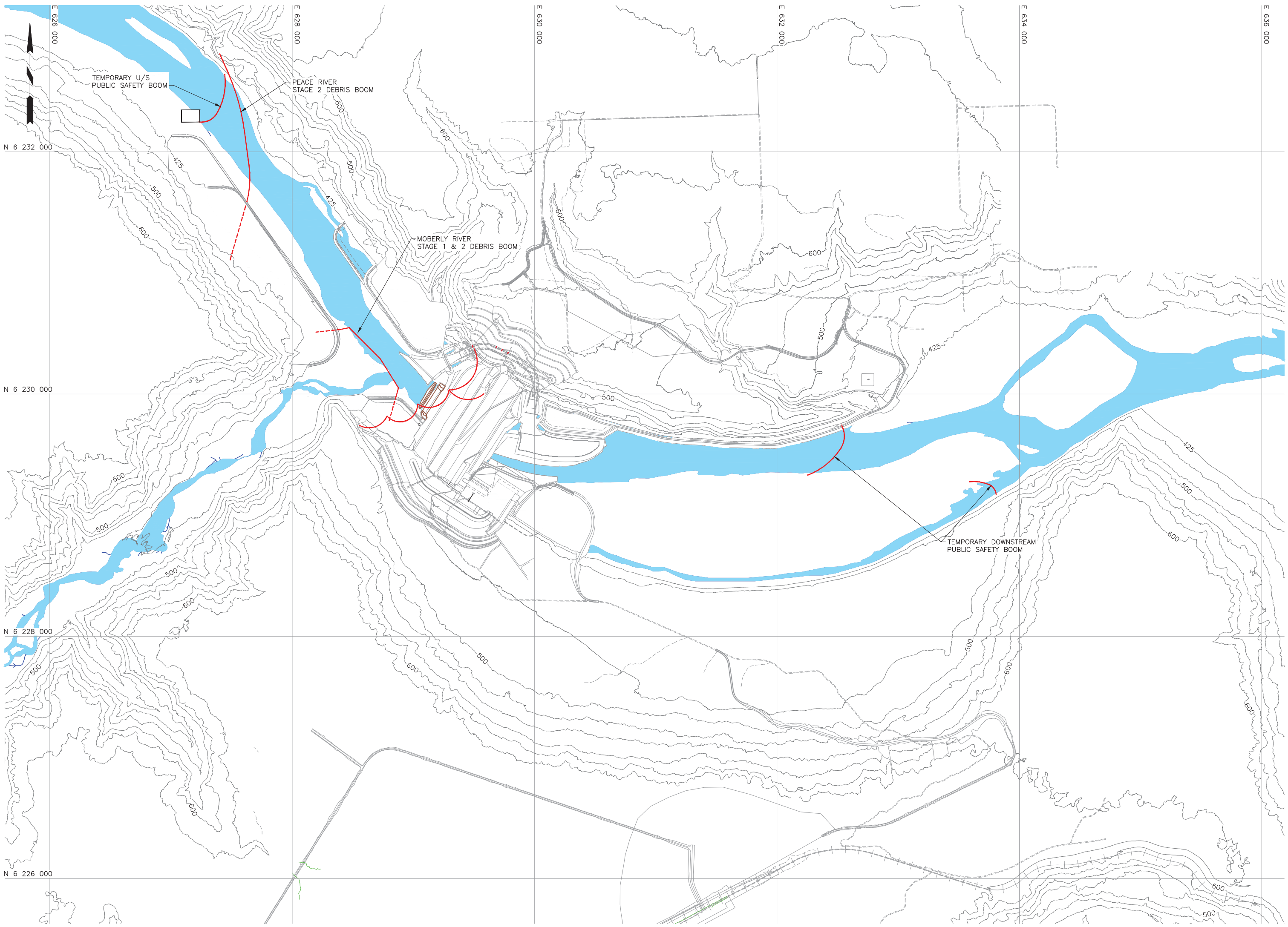


Figure 10



PLAN
1:12500

0 500m
1:12500

NOT FOR CONSTRUCTION

ALL DIMENSIONS ARE IN METRES, UNLESS OTHERWISE SHOWN

INTEGRATED ENGINEERING TEAM

SITE C CLEAN ENERGY PROJECT | BC hydro | Klohn Crippen Berger | SNC•LAVALIN

SITE C CLEAN ENERGY PROJECT

MAIN CIVIL WORKS
PLAN
GENERAL ARRANGEMENT

REF#	DRAWING NUMBER	TITLE	REF#	DRAWING NUMBER	TITLE	NO	REMARKS	DATE	DESIGNED	INDEP CHK	DFTG	DFTG CHK	INSP	REV	ACPT
REFERENCE DRAWINGS			REFERENCE DRAWINGS			REVISIONS									

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11.0 Qualified Professional

This plan was prepared by Paul Veltmeyer, RFP, Lead Forester, Site C Clean Energy Project.

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APPENDIX A

Clearing Roads and Bridge

ROADS

A variety of road systems will be utilized in this clearing plan. Many of the existing roads that will be accessed are public roads under the jurisdiction of the Ministry of Transportation and Infrastructure. Other existing roads are under the jurisdiction of the British Columbia Ministry of Forests, Lands and Natural Resource Operations (FLNRO). These roads include Forest Service Roads and Road Permit roads. Forest Service Roads are the responsibility of the FLNRO or assigned to another jurisdiction that is active on the road for the purpose of harvesting timber. Road Permit roads are the responsibility of an assigned Road Permit holder; most common are British Columbia Timber Sales licensees or major forest license holders who have the right to harvest timber under a forest license or other license. Additional information regarding road use can be found in the British Columbia *Forest Act:*

http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/96157_00 .

Many of these roads are presently built to an industrial standard that is suitable for transporting the equipment and materials prescribed within the clearing plan. These include the Project Access, North and South Monias, 200, 400, Beaver Loop, Wilder and Medicine Woman roads.

Other existing roads, including active Road Permit roads and deactivated Road Permit roads, will require upgrades including road surface widening, vegetation brushing, and upgrades to water crossings, danger tree removal and signage. The development of four new roads will be required on the south side of the Peace River to access the Reservoir.

The roads that require upgrades or full development are grouped into three classes: existing upgrade; new (temporary) all-season; and new (temporary) winter. All of the existing roads and new all-season road developments will be assigned Road Permit roads. The new all-season roads include all access routes outside of the reservoir site. The new winter roads include all new roads within the reservoir site except for at the dam site, where additional access information is provided in Volume 1 Section 4. Table I-1 is a summary of the type, length and location of the roads to be utilized. Table I-2 is a summary of road schedule by year of development.

Table I-1 Summary of total road distances

Access Road Type	Access to Reservoir	Trans-mission ROW	Reservoir	Dam Site	Portage Mt. Quarry	Total
	Distance (kilometres)					
Existing Upgrade	38	13	0	0	3.3	54
New – All Season	20	31 [1]	0	17	2.5	70
New – Winter	0	0.0	116	0	0	116

Note:

Note 1 this includes part of the Project Access Road

Table I-2 Summary of year of activity

Access Road Type	Year 1	Year 2	Year 3	Year 4

	Distance (kilometres)			
Existing Upgrade	17	20	18	0
New – All Season	53	3	14	0
New - Winter	22	26	22	45

Following are examples of an existing road and a seismic trail requiring upgrades south of the Peace River – the most common upgrade will be brushing and road surface gravelling.

Photograph I-1 Existing road requiring upgrades

Credit: Industrial Forestry Service Ltd. (2011)

Photograph I-2 Existing Seismic Trail

Credit: Industrial Forestry Service Ltd. (2012)

BRIDGES

A variety of water crossing structures will be built as part of the clearing plan. The majority of the required structures are located within the reservoir to access numerous islands and isolated patches of merchantable timber. An estimated 98 crossings will be required.

The water crossings are grouped into three classes: (1) winter crossing; (2) abutment bridge; and (3) piling bridge. The winter crossings will include snow covered box culverts placed across the drainages, snow-filled dry back channels or log-filled, fabric-covered ephemeral drainages. Abutment bridges will be utilized in areas where narrow stream channels and open water exists. Piling bridges will be utilized over all large water-body crossings. A number of metal culverts may also be required in areas were the road system crosses non-fish bearing and ephemeral streams. The following is a summary of the type, length and general location of water crossings to be utilized. Photograph I-3 provides an example of an existing abutment bridge over a stream crossing south of the Peace River – several stream/creek crossings will require the installation of a new culvert or abutment bridge. Figure I-2 provides example of various bridge pilings (the most common of which are driven piles). Figure I-3 provides example of various bridge abutments - the most commonly used in forest road applications are timber sill.

Table I-3 Water crossings

Crossing Type	Crossing Distance (metres)				
	Access to Reservoir	Transmission Line	Reservoir	Dam Site	Total
Winter Crossing	0	0	2,861	0	2,861
Abutment Bridge	9	0	296	0	305
Piling Bridge	0	0	1,703	0	1,703
Required Culverts >500millimetre	9	0	37	0	46

Photograph I-3 Existing abutment bridge

Credit: Industrial Forestry Service Ltd. (2011)

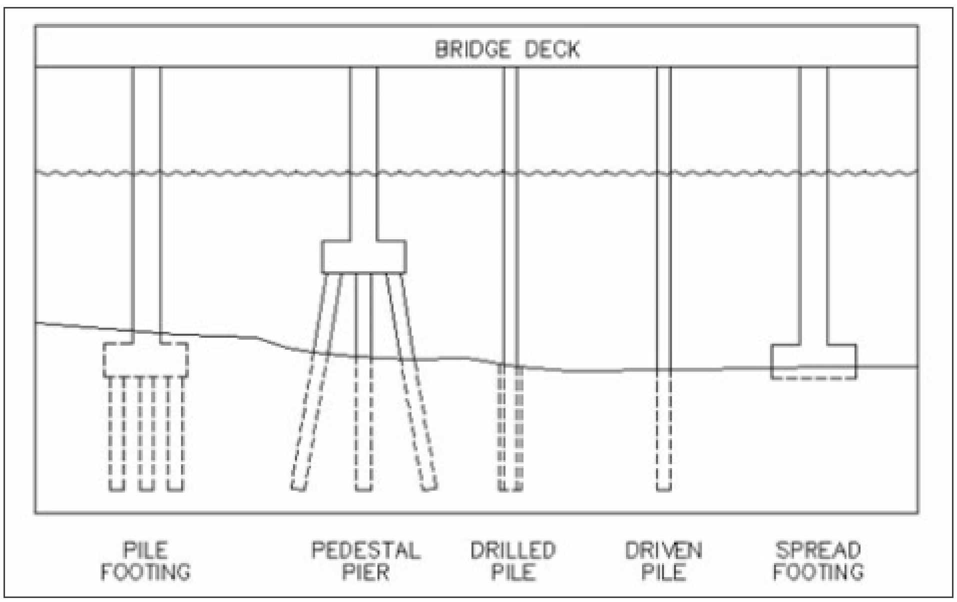

Figure I-2 Example of various bridge pilings

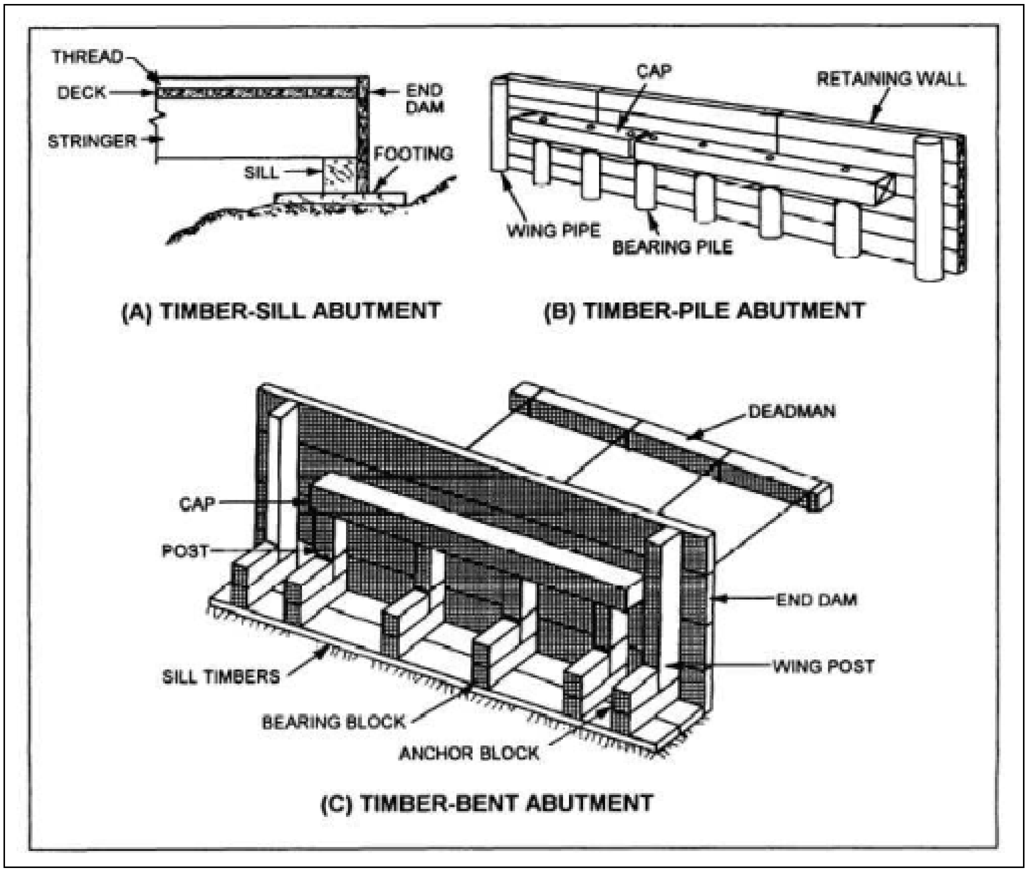

Figure I-3 Example of various bridge abutments