

**From:** [Cuddy, Andrew EMLI:EX](#)  
**To:** [Ralston, Bruce EMLI:EX](#)  
**Subject:** FW: MO QUESTIONS - Site C/Milburn  
**Date:** May 7, 2021 3:25:15 PM  
**Attachments:** [OAG Meeting Request Re Site C.msg](#)

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Here it is.

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**From:** Cuddy, Andrew EMLI:EX  
**Sent:** March 31, 2021 12:43 PM  
**To:** Ralston, Bruce EMLI:EX <[s.17](#)>  
**Subject:** FW: MO QUESTIONS - Site C/Milburn

Please see below and attached. We should chat later.

---

**From:** Jang, Monica EMLI:EX <[Monica.Jang@gov.bc.ca](mailto:Monica.Jang@gov.bc.ca)>  
**Sent:** March 31, 2021 12:01 PM  
**To:** Cuddy, Andrew EMLI:EX <[Andrew.Cuddy@gov.bc.ca](mailto:Andrew.Cuddy@gov.bc.ca)>  
**Cc:** Mihlar, Fazil EMLI:EX <[Fazil.Mihlar@gov.bc.ca](mailto:Fazil.Mihlar@gov.bc.ca)>  
**Subject:** MO QUESTIONS - Site C/Milburn

Hi Andrew,

See below response from Les on your two questions today:

s.12; s.13; s.14

s.12; s.13; s.14

s.12; s.13

FYI,

M.

**From:** Cuddy, Andrew EMLI:EX  
**To:** Ralston, Bruce EMLI:EX  
**Subject:** FW: Site C Update  
**Date:** May 10, 2021 11:19:50 AM

---

Hi Minister, FYI below is an update from Les on the latest Site C Project Assurance Board meetings.

---

**From:** MacLaren, Les EMLI:EX <Les.MacLaren@gov.bc.ca>  
**Sent:** May 10, 2021 6:38 AM  
**To:** Mihlar, Fazil EMLI:EX <Fazil.Mihlar@gov.bc.ca>; Cuddy, Andrew EMLI:EX <Andrew.Cuddy@gov.bc.ca>  
**Cc:** Wieringa, Paul EMLI:EX <Paul.Wieringa@gov.bc.ca>; Sopinka, Amy EMLI:EX <Amy.Sopinka@gov.bc.ca>; Rowe, Katherine EMLI:EX <Katherine.Rowe@gov.bc.ca>; Foster, Doug FIN:EX <Doug.Foster@gov.bc.ca>  
**Subject:** Site C Update

Fazil/Andrew

s.12; s.13

s.12; s.13      This was the first meeting with Mitchell Gropper as Chair and with Amanda Farrell, Cathy McLay and Fred Cummings participating as PAB members. Peter Milburn also attended.

The PAB subsequently had an orientation session on May 4 (second session is May 11), and a Special Workshop on Risk on May 7.

April 19 Meeting:

The new Chair opened with thanks to John Nunn for his work as Chair (John remains Chair of the Capital Projects Committee of the BCH Board). The Chair noted PAB's focus will be on safety, budget, schedule, risk, quality, and contract/claims management. A new sub-committee on Claims Management was struck that included the three new PAB members joining.

s.13; s.17



The Engineering Services Agreement change is a \$48M increase to the contracts for SNC Lavalin and Kohn Crippen Berger for the period June 1, 2021, to May 31, 2022. This contract is structured for annual releases to cover services, and each increase is treated as a separate direct award contract which has been highlighted by critics (even though the SNC and KCB teams are integrated with the BCH on-site team and critical to advancing the project).

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s.12; s.13; s.17

May 4 Orientation Session #1:

Although this session was optional for existing PAB members, almost all attended. The Site C team provided orientation materials and an overview of the project, including a construction sequencing and drone videos. The session also covered project governance and oversight, safety, construction updates for on- and off-site activities, the right bank foundation enhancements, and environmental programs, social commitments and indigenous relations. Orientation Session #2 is scheduled for May 11.

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There was very good discussion of these issues, and the new PAB members were fully engaged.

Doug may have some further observations from these meetings.

*Les MacLaren*

Assistant Deputy Minister

Electricity and Alternative Energy Division

BC Ministry of Energy, Mines and Low Carbon Innovation

Office: 778-698-7183

Cell: 250-889-3479

*Energizing BC—clean, sustainable and productive*

**From:** [Allen, Doug](#)  
**To:** [Ralston, Bruce EMLI:EX](#)  
**Cc:** [O'Riley, Christopher](#); [Cuddy, Andrew EMLI:EX](#); [Wanamaker, Lori PREM:EX](#)  
**Subject:** Fwd: Update on Arbitration Notice Site C  
**Date:** May 18, 2021 1:11:42 PM

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**[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.**

Minister:

PRHP (Acciona and Samsung) issued a "Notice of Arbitration" yesterday. See summary of the issue below.

PAB and the Hydro Board will be informed today. We will be discussing the related implications, if any, for the commercial strategy going forward. s.17  
s.17

Shall keep you posted once the full implications of the "Notice of Arbitration" are understood.  
Best regards,  
Doug

Sent from my iPad

Begin forwarded message:

**From:** s.19  
**Date:** May 18, 2021 at 11:45:08 AM PDT  
**To:** "Allen, Doug" <Doug.Allen@bchydro.com>  
**Subject:** RE: Update

As discussed, high level notes on the Notice to Arbitrate.

s.19

s.13; s.14; s.17

s.13; s.14; s.17

s.19

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s.13; s.14

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Doug may have further comments.

*Les MacLaren*

Assistant Deputy Minister

Electricity and Alternative Energy Division

BC Ministry of Energy, Mines and Low Carbon Innovation

Office: 778-698-7183

Cell: 250-889-3479

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**From:** Cuddy, Andrew EMLI:EX  
**To:** Ralston, Bruce EMLI:EX  
**Subject:** FW: Site C Update  
**Date:** June 21, 2021 4:27:14 PM

---

FYI below – latest Site C update from the Project Assurance Board. Key points highlighted in yellow.

---

**From:** MacLaren, Les EMLI:EX <Les.MacLaren@gov.bc.ca>  
**Sent:** June 21, 2021 10:09 AM  
**To:** Mihlar, Fazil EMLI:EX <Fazil.Mihlar@gov.bc.ca>; Cuddy, Andrew EMLI:EX <Andrew.Cuddy@gov.bc.ca>  
**Cc:** Wieringa, Paul EMLI:EX <Paul.Wieringa@gov.bc.ca>; Sopinka, Amy EMLI:EX <Amy.Sopinka@gov.bc.ca>; Rowe, Katherine EMLI:EX <Katherine.Rowe@gov.bc.ca>; Foster, Doug FIN:EX <Doug.Foster@gov.bc.ca>  
**Subject:** Site C Update

Fazil/Andrew

Doug Foster and I attended the Site C Project Assurance Board (PAB) meeting on June 15. In addition to project updates focused on safety, environmental/social/ Indigenous Relations and risk, the PAB discussed a focused presentations on quality assurance, and the commercial strategy for the Main Civil Works contract. The BCH Board joined part of the meeting to approve the quarterly performance report to March 31, balance of plant (mechanical) contract award, the next change orders for the Generating Station and Spillways contractor (AFDE) to implement the right bank foundation enhancements, an increase for the MCW contractor, and approval of the new \$16B budget (conditional on receiving a formal written approval from the Province).

Safety/ESG/Risk:

All cases associated with the COVID Outbreak have cleared, and the extended Outbreak declaration expires June 23. As of June 15 there were 4 active cases, three with AFDE and one cultural monitor who had been in hospital in Prince George and was recovering in his community. 1,663 first vaccine doses and 1,200 second doses had been administered. with Moderna vaccine now available. <sup>s.13</sup>

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BC

Hydro met its targets in April and May using trap and truck techniques. Two new wells and a treatment plant for water supply to Hudson's Hope have been completed to replace and intake from the river and pumping system that will be impacted by the reservoir. The District is working through some capacity, taste and odour issues with the new treatment plant.

Based on input from Peter Milburn, EY, PAB and the PAB Commercial Sub-Committee, BCH has



June 29, 2021

Honourable Bruce Ralston  
Minister of Energy, Mines & Petroleum Resources  
PO Box 9052, Stn Prv Govt  
Victoria, BC  
V9W 9E2

Dear Minister Ralston,

**Re: Site C Project, Quarterly Progress Report No 21**

Enclosed is the twenty-first Quarterly Progress Report for the Site C Project, for the reporting period of January 1, 2021 to March 31, 2021. Quarterly Progress Report No. 21 includes information about project activities up to end of March 2021.

This Quarterly Progress Report, reports on the February 26, 2021 Government announcement that the current cost estimate to complete the Site C Project is \$16 billion, which includes a new expected in-service date of 2025, among other significant updates including the COVID-19 pandemic, geotechnical review from the independent dam experts on the foundation enhancements, Milburn recommendations and other updates during the quarter. Subsequent to the reporting period in June 2021, Treasury Board approved the current cost estimate, and this is now the approved budget for the project.

This document is intended to meet the requirement of the Site C Reporting and Accountability Framework. The BC Hydro Board of Directors approved the report on June 15, 2021.

Sincerely,



Doug Allen  
*Chair, BC Hydro Board of Directors*

Enclosure

cc: Chris O'Riley, President & Chief Executive Officer  
s.19

June 29, 2021

Mr. David M. Morton  
Chair and CEO  
British Columbia Utilities Commission  
Suite 410, 900 Howe Street  
Vancouver, B.C. V6Z 2N3

Dear Mr. Morton:

**RE: British Columbia Utilities Commission (BCUC or Commission)  
British Columbia Hydro and Power Authority (BC Hydro)  
Site C Clean Energy Project PUBLIC Quarterly Progress Report No. 21**

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Today, we are filing Site C Quarterly Progress Report No. 21 that covers the period of January 1 to March 31, 2021.

During this reporting period, the Government of British Columbia announced the Site C Project would continue based on a cost estimate of \$16 billion, which included a new expected in-service date of 2025. Earlier this month, Treasury Board approved this cost estimate, and this is now the approved budget for Site C. This information is being disclosed consistent with the requirements under section 14 of the Budget Transparency and Accountability Act.

As the cost estimate was approved by government subsequent to the reporting period, the project's overall health for this quarter remains "red." Our next progress report to the Commission in the fall of 2021, will reassess the project health based on the newly approved budget and revised project schedule.

As I acknowledged in my previous letter to the Commission of March 18, 2021, we continue to manage significant risks on the Site C Project. These risks include the ongoing COVID-19 pandemic and the associated impacts to on-site construction activities; the continuation of commercial negotiations with contractors; design finalization, procurement and execution of the foundation enhancements; and the ability to attract and retain skilled workers. We continue to work with Peter Milburn, EY Canada, the Technical Advisory Board, the external independent dam experts, and the Project Assurance Board to manage these risks.

Despite these risks, our objective is to complete Site C within the approved budget and we're managing the Project to that cost.

The ongoing COVID-19 pandemic continued to impact dam-site construction activities during the first quarter of 2021. On December 29, 2020, the Provincial Health Officer posted the Industrial Projects Restart Order, which required a slow and controlled return of workers at five industrial camps in Northern B.C., including Site C, following the holiday season. BC Hydro worked closely with Northern Health to implement all

components of the order and gradually increase worker numbers safely over the reporting period. The Order did have impacts on our construction activities, primarily the generating station and spillways works, which we further detail in this progress report. Recently, we have seen significant improvements with the number of COVID-19 cases associated with the Project declining and we continue to make progress with onsite vaccinations with support from Northern Health. In addition, the outbreak at Site C that was announced by Northern Health in late April was officially declared over on June 23, 2021.

While we managed a number of challenges during the quarter, we also achieved some important construction milestones, including the completion of both the upstream and downstream cofferdams. This work, which needed to be in place before spring freshet, was completed ahead of schedule. The cofferdams create a dry construction area to continue construction activities with the earthfill dam. The team also made progress on the second 500 kV 75-kilometre-long transmission line and the first two turbine runners (out of six) have arrived at site from Brazil.

Finally, I wanted to update the Commission on the status of implementing the Milburn recommendations. Mr. Milburn's review of the project included 17 recommendations aimed at improving oversight, governance, risk management and construction and claims management on the project.

Most of the recommendations from the Milburn review have been implemented. The Province announced last month a restructured Site C Project Assurance Board to strengthen its independence and increase its expertise. Other recommendations that have been implemented include enhancing the project's risk management processes and creating a dedicated commercial management team.

BC Hydro continues to work with government to complete the implementation of the remaining recommendations by the end of the summer.

The next progress report, covering the period April 1 to June 30, 2021, will be filed in the fall of 2021.

A confidential version of the Report is being filed with the BCUC only under separate cover.

Yours sincerely,



Chris O'Riley  
President and Chief Executive Officer  
BC Hydro

**From:** [Allen, Doug](#)  
**To:** [Ralston, Bruce EMLI:EX](#)  
**Cc:** [Cuddy, Andrew EMLI:EX](#); [O'Riley, Christopher](#); [McCallion, Amy](#)  
**Subject:** Update  
**Date:** July 4, 2021 1:20:39 PM

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[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Minister

Your are meeting with Mitchell Gropper, Chair of PAB, on July 6th. ~~s.13~~

s.13

s.13; s.16

Best regards,  
Doug

Sent from my iPad

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-BCHydroDisclaimerID5.2.8.1541

revised its risk reporting with additional information including risk velocity – the speed at which the impacts of the risk occurring would be realized. Risks have been re-prioritized based on velocity, cost impact range, and mitigation effectiveness. Additional quantitative information, including the 3-point estimate and amount included in the P50 budget has also been added. PAB members were supportive of the changes, and asked that quarterly risk trends be included.

#### Quality Assurance:

While contractors are responsible for the quality of the work specified under their contracts, BC Hydro has plans in place to monitor engineering, construction and manufacturing quality. This includes work at site, but also international QA with in-market representatives reviewing things like turbines and generator components being manufactured by Voith in Sao Paulo, Brazil and other countries. With international travel restricted, BCH has been participating in virtual quality reviews at various hold points in the manufacturing process.

Current areas of QA focus include: grouting in the main dam trench (going better than expected and likely to complete before August 1 target date); GSS contractor concrete tensile strength (below target for 28 and 56 days, moving into acceptable range by 90 days – adjusting fly ash component of concrete mix to address); and earlier concerns with steel sections of the penstocks were addressed with the GSS subcontractor and by bringing in Powertech Labs to verify weld quality.

#### EY Report:

s.12; s.13

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#### Technical Advisory Board Report:

TAB continues to hold regular virtual workshops with the engineering team to review the design details for the right bank enhancements and the grouting results from the main dam core trench. Mr. France and Dr. Hoeg are monitoring as well. The PAB will be getting presentation from the TAB on their recent work on June 24.

#### Approvals:

BCH Board members joined for approvals and discussion of the MCW Commercial Strategy. The Quarterly Report to March 31 was discussed and Board and PAB members will send comments to the Site C Team. A cover memo from Chris O conveying the report will be added to include subsequent events and context (COVID developments and communication of the \$16M budget). Doug, Paul W, Amy S and I had a follow-up discussion with the Site C team on communication of the new budget.

s.13; s.17

s.13; s.17

PAB and the BCH Board approved authorizing the CEO to enter into the Balance of Plant Mechanical Contract for up to \$84.5M (\$71.1M base and \$14.4M contingency) consistent with the re-baselined P50 budget amount. Four bids were evaluated, and the evaluation committee's preferred proponent, Mitchell Installations, bid \$69.1M.

PAB and the BCH Board discussed the MCW Commercial Strategy and potential opportunities within that strategy. PRHP continues to submit inflated claims and to seek large global settlements. s.13

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BCH noted that with progress this year, including excavation of the main dam core trench and foundation grouting proceeding faster than plan, there may be opportunities for targeted acceleration and/or work resequencing (doing some activities like till placement in parallel rather than sequentially) to de-risk future contractor leverage against milestones. If these accelerations can be achieved, they would need to occur early in the summer construction season to be effective. s.13

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Doug may have further commentary.

*Les MacLaren*

Assistant Deputy Minister

Electricity and Alternative Energy Division

BC Ministry of Energy, Mines and Low Carbon Innovation

Office: 778-698-7183

Cell: 250-889-3479



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In 2014, the Site C Budget at FID was set at \$8.335B (including \$679M in contingency) in addition to a Project Reserve of \$440M.

Can you confirm the P value at FID of the \$8.335B budget? (According to the BCUC Site C Inquiry, this was equal to a P48 – see page 119).

Yes, confirmed.

Can you confirm the P value at FID of the \$8.335B plus the \$440M Project Reserve? (According to the BCUC Site C Inquiry, the total contingency needed for a P90 at FID would have been \$1.7B, and the \$1.119B in contingencies allocated (\$679M in base + \$440 reserve) was equal to just under a P75 – see attachment 1 of F1-15).

Yes, confirmed.

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### **2021-07-26 – Site C PAB Update**

Doug Foster and I have attended three Site C Project Assurance Board (PAB) meetings in the past two weeks:

s.13; s.17

- July 19 for a workshop on safety; and
- July 23 for the regular monthly PAB meeting.

#### **July 14**

s.13; s.17

#### **July 19**

The PAB previously requested a special workshop on safety. BCH reviewed the comprehensive measures to focus on safety for both BCH and contractors led by both a Safety Team and Construction Management. While the contractors as employers are responsible for the safety of their work scopes and workers, BCH as owner is responsible for communicating safety hazards and providing assurance on contractors' Safety Management Systems. The site has a number of areas where BCH and contractors are "prime contractors" responsible for coordinating safety of all contractors and employees in their safety area.

s.13

BCH has been on the site for 6 years and has learned a lot, but there is still a lot of activity ahead. For the upcoming year there will be major material movement with traffic control, heavy equipment interactions, equipment-human interactions, and silica safety risks. In addition, there will be new contractors on site for the balance of plant work, and the right bank foundation enhancements layered on to the existing contractors and their base work.

Safety statistics are good and trending favourably. The PAB was impressed with the safety culture at BCH<sup>s.13</sup> .13

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July 23

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At PAB's request, BCH presented an update on the schedule for the main earthfill dam and approach channel given the SWA and progress on the design of the right bank foundation enhancements, respectively.<sup>s.13; s.17</sup>

s.13; s.17

s.12; s.13

Doug may have further commentary.

*Les MacLaren*

Assistant Deputy Minister

Electricity and Alternative Energy Division

BC Ministry of Energy, Mines and Low Carbon Innovation

Office: 778-698-7183

Cell: 250-889-3479

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**From:** [Cuddy, Andrew EMLI:EX](#)  
**To:** [Ralston, Bruce EMLI:EX](#)  
**Subject:** FW: FYI: Site C Outbreak  
**Date:** August 16, 2021 1:28:04 PM  
**Importance:** High

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fyi

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**From:** Giles, Alison GCPE:EX <Alison.Giles@gov.bc.ca>  
**Sent:** August 16, 2021 11:23 AM  
**To:** Tseng, Eugene EMLI:EX <Eugene.Tseng@gov.bc.ca>  
**Cc:** Cuddy, Andrew EMLI:EX <Andrew.Cuddy@gov.bc.ca>  
**Subject:** FW: FYI: Site C Outbreak  
**Importance:** High

Looks like IH will be issuing an IB at some point today about an COVID outbreak at Site C.

Pertinent details from IH follow (missing part at end must be Labour Day weekend):

s.13

**From:** [MacLaren, Les EMLI:EX](#)  
**To:** [Mihlar, Fazil EMLI:EX](#)  
**Cc:** [Jang, Monica EMLI:EX](#); [Foster, Doug FIN:EX](#); [Sopinka, Amy EMLI:EX](#); [Fischer, Carl M FIN:EX](#)  
**Subject:** OAG Meeting Request Re: Site C  
**Date:** Tuesday, August 18, 2020 2:50:11 PM

---

Hi Fazil

Doug, Amy and I had a call with Sheila Dodds and her team this afternoon about the Site C Main Civil Works contract. BC Hydro earlier this year provided the OAG team with access to the MCW procurement documents, the MCW contract, contract management documents, settlement agreements, and a couple of internal audits. On the procurement process, the OAG has concluded that it was "solid" relative to leading practise.

s.13

Les

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**From:** MacLaren, Les EMPR:EX <Les.MacLaren@gov.bc.ca>  
**Sent:** July 9, 2020 12:52 PM  
**To:** Mihlar, Fazil EMPR:EX <Fazil.Mihlar@gov.bc.ca>  
**Cc:** Jang, Monica JEDC:EX <Monica.Jang@gov.bc.ca>  
**Subject:** Re: OAG Meeting Request with Grant Main

Yes. I have looped in Doug Foster. He and I led the engagement with OAG on a previous Site C audit that was suspended when the project was referred to the BCUC in 2017.

Les

On Jul 9, 2020, at 12:11 PM, Mihlar, Fazil EMPR:EX <[Fazil.Mihlar@gov.bc.ca](mailto:Fazil.Mihlar@gov.bc.ca)> wrote:

Have you been contacted by OAG? See below. Fazil

Sent from my iPhone

Begin forwarded message:

**From:** "Main, Grant TRAN:EX" <[Grant.Main@gov.bc.ca](mailto:Grant.Main@gov.bc.ca)>  
**Date:** July 9, 2020 at 11:12:50 AM PDT  
**To:** "Wanamaker, Lori FIN:EX" <[Lori.Wanamaker@gov.bc.ca](mailto:Lori.Wanamaker@gov.bc.ca)>, "Mihlar,

Fazil EMPR:EX" <[Fazil.Mihlar@gov.bc.ca](mailto:Fazil.Mihlar@gov.bc.ca)>

**Subject: FW: OAG Meeting Request with Grant Main**

Hi Lori, Fazil – this request has come in to my office. Sharing and appreciate your perspective on how best I respond to be helpful for you.

Thanks

gm

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**From:** Wood, Chelsea TRAN:EX <[Chelsea.Wood@gov.bc.ca](mailto:Chelsea.Wood@gov.bc.ca)>

**Sent:** July 7, 2020 5:24 PM

**To:** Main, Grant TRAN:EX <[Grant.Main@gov.bc.ca](mailto:Grant.Main@gov.bc.ca)>

**Subject:** FW: OAG Meeting Request with Grant Main

Hi Grant - meeting request from OAG. Should Kevin R. and Nancy also be included on this meeting?

Thanks,

Chelsea

---

**From:** Hughes, Andrea <[AHughes@bcauditor.com](mailto:AHughes@bcauditor.com)>

**Sent:** July 7, 2020 1:44 PM

**To:** Plamondon, Lea TRAN:EX <[Lea.Plamondon@gov.bc.ca](mailto:Lea.Plamondon@gov.bc.ca)>; Wood, Chelsea TRAN:EX <[Chelsea.Wood@gov.bc.ca](mailto:Chelsea.Wood@gov.bc.ca)>

**Subject:** OAG Meeting Request with Grant Main

**CAUTION:** This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello Lea and Chelsea,

Sheila Dodds, Assistant Auditor General, has asked that I be in touch to see about setting up a meeting with Grant Main and two members of OAG staff (please see Sheila's message below). If possible, our team is anticipating that the meeting will take about an hour and are hoping to arrange something in early to mid-August. Along with Sheila, members of OAG staff who would be in attendance are Laura Hatt, Executive Director and Jacquie MacDonald, Director.

In looking at our staff's calendars, they currently have the following availability:

- Monday, August 10 – any time
- Tuesday, August 11 – between 10:30 a.m. and 12:00 p.m.
- Wednesday, August 12 – any time

Thursday, August 13 – any time after 11:00 a.m.

- Monday, August 17 – any time
- Tuesday, August 18 – any time between 10:00 a.m. and 2:00 p.m.
- Wednesday, August 19 – any time after 11:00 a.m.
- Thursday, August 20 – any time after 10:30 a.m.

Are there any dates and times in there that Grant would be available?

Please see Sheila's message below regarding the purpose of this meeting:

*We would like to meet to discuss a potential audit of the management of the Main Civil Works contract for the Site C project. We are specifically interested in understanding where you see an audit by our office adding value.*

*If you would like additional staff to attend this meeting, please let us know. We are also happy to follow up with key staff after our discussion.*

*I am including Jacquie MacDonald and Laura Hatt who are responsible for developing a proposal for the potential audit. By way of background, I have also attached the Notification Letter that was sent to BC Hydro.*

*Thanks very much and we look forward to meeting with you.*

*Sincerely,*

*Sheila Dodds*

I look forward to hearing from you.

With kindest regards,  
Andrea

**Andrea Hughes**

Administrative Services Coordinator  
Office of the Auditor General of British Columbia  
623 Fort Street Victoria, BC V8W 1G1  
P: 250.419.6234 | F: 250.387.1230  
[ahughes@bcauditor.com](mailto:ahughes@bcauditor.com) | [www.bcauditor.com](http://www.bcauditor.com)  
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s.14; s.16



Page 027 of 716 to/à Page 028 of 716

Withheld pursuant to/removed as

s.13 ; s.14 ; s.16

PRIVILEGED & CONFIDENTIAL  
COMMON INTEREST PRIVILEGE

s.13; s.17

s.13; s.14; s.16; s.17

Page 030 of 716

Withheld pursuant to/removed as

s.13 ; s.14 ; s.16 ; s.17

Page 031 of 716

Withheld pursuant to/removed as

s.13 ; s.14 ; s.16

**From:** Cuddy, Andrew EMLI:EX  
**To:** Ralston, Bruce EMLI:EX  
**Subject:** FW: Site C Update  
**Date:** September 1, 2021 2:45:51 PM

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Fyi below.

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**From:** MacLaren, Les EMLI:EX <Les.MacLaren@gov.bc.ca>  
**Sent:** September 1, 2021 11:42 AM  
**To:** Mihlar, Fazil EMLI:EX <Fazil.Mihlar@gov.bc.ca>; Cuddy, Andrew EMLI:EX <Andrew.Cuddy@gov.bc.ca>  
**Cc:** Wieringa, Paul EMLI:EX <Paul.Wieringa@gov.bc.ca>; Rowe, Katherine EMLI:EX <Katherine.Rowe@gov.bc.ca>; Sopinka, Amy EMLI:EX <Amy.Sopinka@gov.bc.ca>; Foster, Doug FIN:EX <Doug.Foster@gov.bc.ca>; Jang, Monica EMLI:EX <Monica.Jang@gov.bc.ca>  
**Subject:** Site C Update

Fazil/Andrew:

Doug Foster, Amy Sopinka and I attended the Site C Project Assurance Board regular monthly meeting on August 23. Key agenda items were: approval of a commercial strategy and funding for the approach channel component of the Right Bank Foundation Enhancements; approval of the second of six Balance of Plant contracts (electrical); and approval of the updated cost and schedule risk analyses.<sup>s.13</sup>

Project Update:

Health Authorities declared another COVID outbreak on August 18 based on 41 positive tests and 110 isolations since August 4. Spread has been both from the community and within multiple contractor crews. As of August 22, there were 31 active cases and 91 isolations (36 in camp; 54 at home; and 1 in hospital). Over 80% of the cases were either unvaccinated or had only one dose. Safety measures have been ramped back up, including mask wearing when working on the various work fronts and stopping workers in camp from leaving to socialize the community. The on-site clinic continues to administer vaccinations.

s.13

1

s.13

Page 033 of 716

Withheld pursuant to/removed as

s.12 ; s.13 ; s.17

In Camera:

One item of note was a discussion on recruitment of a successor to s.19 as EVP for Site C. s.19 is.22 and has agreed to stay on for 6 months after a successor is chosen. BCH is quietly working with headhunters to identify a candidate. The BCH Chair would like the new EVP to be based in or spend more time in Fort St John for a greater authority presence.

Also of note is the increasingly productive working relationship between BCH and EY, and their work with EMLI and FIN. Upcoming work EY is focusing on is related to claims, and using the enhanced risk management system to focus on and strategically manage potential upcoming claims.

Doug or Amy may have further commentary.

*Les MacLaren*

Assistant Deputy Minister  
Electricity and Alternative Energy Division  
BC Ministry of Energy, Mines and Low Carbon Innovation  
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*Energizing BC—clean, sustainable and productive*

**From:** [Cuddy, Andrew EMLI:EX](#)  
**To:** [Ralston, Bruce EMLI:EX](#)  
**Subject:** FW: Summary notes from Sept 7 meeting with PNG sector  
**Date:** September 8, 2021 10:33:01 AM

---

Fyi below

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**From:** Mah-Paulson, May EMLI:EX <May.Mah-Paulson@gov.bc.ca>  
**Sent:** September 8, 2021 9:44 AM  
**To:** Cuddy, Andrew EMLI:EX <Andrew.Cuddy@gov.bc.ca>  
**Cc:** Mihlar, Fazil EMLI:EX <Fazil.Mihlar@gov.bc.ca>; Jang, Monica EMLI:EX <Monica.Jang@gov.bc.ca>; Coley, Simon J EMLI:EX <Simon.Coley@gov.bc.ca>  
**Subject:** Summary notes from Sept 7 meeting with PNG sector

Hi Andrew – at Roundtable yesterday, Minister Ralston indicated he would be interested in seeing some notes from yesterday's meeting with the PNG sector:

Summary notes from Sept 7 meeting with PNG sector

- EMLI (Fazil Mihlar, Simon Coley and May Mah-Paulson) and OGC (Paul Jeakins) met with approximately 55 industry and association representatives of the PNG sector; the previous meeting was on Aug 23
- EMLI and OGC provided updates and high level KM's

s.13

/

- Commitment made to meet with industry again next week

May Mah-Paulson, P.Eng.



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Page 037 of 716

Withheld pursuant to/removed as

s.13 ; s.16

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**OPERATING LOSSES COULD ADD ANOTHER \$5.5 BILLION TO THE COST OF SITE C**

The Site C dam is likely to result in accumulated operating losses of \$5.5 billion for the first 15 years of operation. The losses result from the cost of production (primarily debt service) exceeding the additional sales revenue. For a number of years, the new power supplied by the dam will add to BC Hydro's surplus power and will be exported at a much lower price than the cost of production. Over time BC Hydro forecasts that domestic demand will begin to reduce the surplus, and all the new power will be used for domestic purposes by year 16.

BC Hydro has not provided an annual loss projection, nor a plan for covering these losses. Its current rate change submission to the BC Utilities Commission covers the fiscal years 2022/23 to 2024/25. As a result, it does not provide information on Site C's annualized debt service costs, nor the forecast of additional sales revenue. This paper provides a high-level estimate of the operating losses, and possible funding measures.<sup>1</sup>

**1.0 Estimating the Increase in Expenditures**

In February 2021, the government announced that the new estimate for the Site C project had jumped from \$10.7 billion to \$16.0 billion. Some detail as to what this forecast included were included in BC Hydro's F23 to F25 rate request application (RRA) filed with the BC Utilities Commission dated 31 August 2021. The public utility stated that the amortization cost impact on the rates would not be addressed until the next rate filing, probably September 2023. As some of the new capacity would be activated in FY2024/25, BC Hydro did include funding for additional staff and operating expenses in the requested rate increase for that year.

The largest annual cost impact of the Site C project is debt service cost, which is a function of the amount borrowed, the amortization term and the cost of borrowing (the interest rate). BC Hydro has said that all of the \$16.0 billion will be borrowed. It has implied that the amortization period will be 84 years, rather than the 70-year period

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<sup>1</sup> In June 2017, I estimated the net losses of a \$8.8 billion Site C project; see [https://www.bcpolicyperspectives.com/media/attachments/view/doc/occasional\\_paper\\_no\\_33\\_cost\\_estimates\\_of\\_site\\_c\\_24\\_june\\_2017/pdf/occasional\\_paper\\_no\\_33\\_cost\\_estimates\\_of\\_site\\_c\\_24\\_june\\_2017.pdf](https://www.bcpolicyperspectives.com/media/attachments/view/doc/occasional_paper_no_33_cost_estimates_of_site_c_24_june_2017/pdf/occasional_paper_no_33_cost_estimates_of_site_c_24_june_2017.pdf)

that was used in earlier estimates.<sup>2</sup> In its current RRA, BC Hydro said the existing deferral in the Site C regulatory account (forecast at \$613 million by 2025/26) will be recovered from ratepayers over 84 years,<sup>3</sup> and it has confirmed to the writer that the balance in the deferral account is part of the \$16.0 billion project cost that will be amortized. No provision has been made in my estimate for any financial settlement for infringement of the Treaty 8 rights.<sup>4</sup>

I have used a 3.6% interest rate to estimate the annual debt service cost using standard amortization tables. The interest rate is a key assumption. As of 31 March 2021, BC Hydro's average weighted cost of borrowing was 3.6%, down from 4.0% in the prior year.<sup>5</sup> Approximately \$8.0 billion of the total Site C cost was borrowed by the end of the last fiscal year, so this portion of the \$16 billion total was included in the 3.6% average cost.

Finally, I have assumed \$45 million in additional annual operating costs, including \$10 million for staff, operating costs, and grants in-lieu, plus \$35 million in increased water rentals paid to the province.

Assuming a 84-year amortization of \$16.0 billion at 3.6% the annual payment for principal and interest is \$605 million, and a \$650 million annual increase in total operating expenditures. This equates to a cost per MWh of \$127.

## Other Scenarios

Table 1 shows four scenarios, with Scenario A as the primary forecast. Scenario B assumes the original 70-year amortization period and results in a higher annual cost. Scenarios C and D assume that the annual debt service cost is reduced by committing \$3.0 billion of BC Hydro's equity to reduce the amount borrowed. These two options lower the annual increase in the debt service costs.

**Table 1 — Operating Scenarios With 3.6% Borrowing Cost (\$=million)**

	<b>Scenario A</b>	<b>Scenario B</b>	<b>Scenario C</b>
Total Borrowed	\$16 Billion	\$16 Billion	\$14 Billion
Amortization	84 Years	70 Years	84 Years

<sup>2</sup> In its RRA, BC Hydro said the existing deferral in the Site C regulatory account (forecast at \$613 million by 2025/26; see RRA, Chapter 7, section 7.7.3.4) will be recovered from ratepayers over 84 years, and it has confirmed to the writer that the balance in the deferral account is part of the \$16.0 billion project cost that will be amortized.

<sup>3</sup> BC Hydro RRA F23 to F25, Chapter 7, section 7.3.3.4.

<sup>4</sup> <https://vancouversun.com/news/politics/vaughn-palmer-how-many-times-do-we-have-to-stand-here-and-defend-our-treaty-rights>

<sup>5</sup> BC Hydro Annual Report 2020/21, p.87.

Annual Debt Service	605	625	530
Operating Expenditures	10	10	10
Water Rental	35	35	35
ANNUAL TOTAL	650	670	575
\$/MWh	\$127	\$131	\$113

Using 84 years rather than 70 years at 3.6% on \$16 billion adds approximately \$7.0 billion in interest costs over the period, or \$83.3 million per year (equivalent to 1.5% rate increase). BC Hydro had been assuming a 70-year amortization period, but the increase in the total cost estimate, partly offset by lower borrowing costs, likely resulted in the longer payback period and the extended amortization.<sup>6</sup>

## 2.0 Estimating Site C Sales Revenue

To estimate BC Hydro's net operating loss caused by the operation of the Site C dam one must subtract the anticipated sales revenue from the annual expenditures. The sales revenue is a function of the volume of electricity (GWh) sold and the price. The three main domestic customer classes pay different prices. For example, in 2020/21 Residential customers paid an average of \$116.42 per MWh, while Large Industrial customers paid an average of \$61.26 per MWh.<sup>7</sup> Power exported (Trade) generated an average of only \$42.52 per MWh last year.

### Total Power Available

Last year BC Hydro reported that it generated from owned sources or purchased through long-term contracts with independent power producers (IPPs), approximately 64,500 GWh, of which some 8,300 GWh was exported.<sup>8</sup> With the addition of Site C's 5,100 GWh by 2026/27 (see Appendix Table A1 for the phase-in), the surplus sales will grow until Domestic sales grow to absorb the surplus.

This estimate assumes that the gross domestic production available (after line loss) will be 62,100 GWh for 2025/26 and plateau at 64,500 GWh for the next 15 years.<sup>9</sup>

<sup>6</sup> [https://www.bchydro.com/news/press\\_centre/news\\_releases/2016/70-year-economic-life-site-c.html](https://www.bchydro.com/news/press_centre/news_releases/2016/70-year-economic-life-site-c.html)

<sup>7</sup> BC Hydro Annual Report 2020/21, p. 22.

<sup>8</sup> Table 4 in

[https://www.bcpolicyperspectives.com/media/attachments/view/doc/occasional\\_paper\\_no\\_76\\_bc\\_hydro\\_annual\\_report\\_5\\_sept\\_2021/pdf/occasional\\_paper\\_no\\_76\\_bc\\_hydro\\_annual\\_report\\_5\\_sept\\_2021.pdf](https://www.bcpolicyperspectives.com/media/attachments/view/doc/occasional_paper_no_76_bc_hydro_annual_report_5_sept_2021/pdf/occasional_paper_no_76_bc_hydro_annual_report_5_sept_2021.pdf)

<sup>9</sup> BC Hydro is attempting to reduce the IPP commitment for the period under review.

## Forecasting Sales Revenue and Operating Loss

BC Hydro included its December 2020 Domestic sales (load) forecast in its recent rate request filing with the BCUC.<sup>10</sup> This forecast shows total Domestic sales of 56,513 GWh in 2025/26, when the additional power from Site C begins to come on-stream. By 2040/41, BC Hydro forecasts that total Domestic sales will be approximately 64,000 GWh.

Assuming an average price of \$102.40/MWh for the Domestic sales, and \$42.50/MWh for the export price, it is possible to estimate the annual losses from the generation of the Site C power priced at \$127.00/MWh.

For the period 2025/26 to 2032/33, all the Site C production is surplus to Domestic requirements and would be exported at a loss of approximately \$84.00/MWh. The annual loss is \$428.4 million for seven years, plus \$225.5 million for the partial 2025/26 year. The total operating loss for the first eight years is approximately \$3.2 billion.

For the balance of the 15-year period BC Hydro forecasts that Domestic sales will grow by approximately 400 GWh per year, which significantly increases the revenue received for the Site C power (by about \$60/MWh) compared to the revenue received by exporting the power. By year 15 (2040/41) the December 2020 forecast suggests that all but 500 GWh of the additional Site C power will be required for Domestic sales.

However, the average 2020/21 price for the Domestic market is still almost \$25/MWh less than the cost of generation, which means that as Domestic sales grow to absorb the Site C surplus, BC Hydro will still be suffering losses.

Using a simple average Domestic price, rather than tracking the forecast sales to each customer class, I have estimated that the net losses for the 2033/34 to 2040/41 years at between \$2.2 billion and \$2.5 billion.<sup>11</sup> Annual inflationary Domestic rate increases would reduce the loss because most of the Site C annual cost is a relatively fixed amortization cost.

## 3.0 Funding Options

By this estimate BC Hydro is facing a potential cumulative operating loss of approximately \$5.5 billion after the first 15 years of operation of the Site C dam. This equates to an average Domestic rate increase for BC Hydro customers of approximately 10% for the period.

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<sup>10</sup> Appendix F, p. 4 of 256; [https://docs.bcuc.com/Documents/Proceedings/2021/DOC\\_64006\\_B-2-1-BCH-F23-F25-RR-Appendix-public.pdf](https://docs.bcuc.com/Documents/Proceedings/2021/DOC_64006_B-2-1-BCH-F23-F25-RR-Appendix-public.pdf) pdf 183/2694.

<sup>11</sup> In 2035/36, for example, of the 5,100 GWh available some 3,150 would be exported (for a loss of \$246 million) and 1,950 GWh would be sold domestically (for a loss of \$47 million). In 2039/40, the export sales drop to 1,750 (a \$147 million loss) while domestic sales consume 3,350 GWh (a loss of \$84 million).

BC Hydro has not indicated how it will pay for the losses; it has yet to acknowledge that major losses are pending. It has asked the BCUC to treat the 2024/25 rate request as tentative pending a later review (presumably for the 2025/26 and later years) of the capital costs that will be allowed to be recovered in future rates.<sup>12</sup>

### **a) Deferral Option**

Given the desire of the government and most interveners to keep electricity rate increases as low as possible it is probable that BC Hydro will ask the BCUC to defer the operating losses in a regulatory account. This could have the effect of spreading the \$5.5 billion in potential losses over a longer time period, thereby reducing the much of the annual rate increase required to eliminate the annual loss.<sup>13</sup>

If the payback period were deferred over a long period (e.g., 84 years to match the debt amortization) the rate stability objective achieved by avoiding a rate shock would be in conflict with the objective of intergenerational equity. Why should future generations of ratepayers be required to pay for the operating losses incurred by the current ratepayers?

### **b) Increase Electricity Sales**

The government has been making announcements about encouraging the use of more hydroelectricity as part of the CleanBC initiative. Some of the rate reduction programs use deferral accounts to fund temporary price subsidies, especially in the Large Industrial sector.<sup>14</sup> Others provide incentives to switch home heating from natural gas to electric heat pumps.<sup>15</sup>

As yet there is no firm forecast as to what additional GWh sales will be realized from these new programs. The rising cost of natural gas may assist in the switch to electricity, but a Site C induced jump in the price of BC Hydro's electricity would widen the price difference between electricity and gas for heating.

### **c) Commit \$2.0 billion in BC Hydro Equity**

The current plan has BC Hydro borrowing all of the estimated \$16.0 billion for the Site C project. According to BC Hydro's first quarter 2021/22 report, there is approximately \$2.0 billion in equity net of "regulatory assets." If this equity were used to replace borrowing the annual operating cost would be reduced by \$75

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<sup>12</sup> [https://docs.bcuc.com/Documents/Proceedings/2021/DOC\\_64391\\_A-3-Panel-Letter-DSM-and-SiteC.pdf](https://docs.bcuc.com/Documents/Proceedings/2021/DOC_64391_A-3-Panel-Letter-DSM-and-SiteC.pdf) p. 2.

<sup>13</sup> The government could soften the blow to ratepayers by lowering the high return on equity required of BC Hydro.

<sup>14</sup> <https://www.bchydro.com/powersmart/business/programs.html>

<sup>15</sup> <https://www.bchydro.com/powersmart/residential/rebates-programs/home-renovation/renovating-heating-system/fuel-switching.html>



million (Table 1—Scenario C). This would reduce the Site C cost from \$127/MWh to \$113/MWh and lower the annual losses.

#### **d) Subsidize Site C Losses with Carbon Tax Revenue.**

Some form of taxpayer subsidy to cover the first 15 years of losses would recognize the extraordinary nature of the decision to proceed with this expensive dam project in the absence of a readily defined market for the additional power. As noted in the earlier study, directing some of the additional provincial carbon tax to help offset the first 15 years of operating losses would be in keeping with the objectives of the tax.<sup>16</sup> It would help to avoid the shock of a 10% rate increase, or the dilemma of forcing future generations to pay operating losses incurred in the short and mid-term.

There is precedent for subsidizing electricity prices with taxpayer funds. Ontario already subsidizes its residential electricity rates with taxpayer funds. The federal government has agreed to subsidize the Muskrat Falls project to avoid the rate shock expected from that costly Hydro dam and transmission project.

©Richard McCandless October 13, 2021. <https://www.bcpolicyperspectives.com/>

The writer is a retired senior BC government public servant whose paper describing the BC government's manipulation of the finances of BC Hydro from 2008 to 2014 was published by *BC Studies* in November 2016. *BC Studies* published his paper on the 40-year financial history of ICBC in 2013. He is an intervener in the BC Utilities Commission's recent reviews of ICBC's and B.C. Hydro's rate requests.

## **APPENDIX**

### **Increase to Domestic GWh Supply**

The six generators at Site C will be brought online in phases commencing December 2024 and ending November 2025.<sup>17</sup>

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<sup>16</sup>

<sup>17</sup> See F23 to F25 RRA, Table 6-60; [https://docs.bcuc.com/Documents/Proceedings/2021/DOC\\_64005\\_B-2-BCH-F23-F25-RRR-public.pdf](https://docs.bcuc.com/Documents/Proceedings/2021/DOC_64005_B-2-BCH-F23-F25-RRR-public.pdf) p. 6-125 (pdf 948/1079).

Using the actual owned and long-term contracted generating capacity from FY2020/21, Site C will add 5,100 GWh capacity by FY 2026/27; with 2,685 GWh added in FY2025/26, and an additional 2,415 GWh added in FY2026/27. Table 333 shows the assumed generating capacity.

**Table A1—Phase-In of Site C Capacity (GWh)**

	<b>FY2025/26</b>	<b>FY2026/27</b>
Domestic Generation		
Owned - Hydro	49,796	49,796
Site C	2,685	5,100
Thermal	150	150
Total	52,630	55,046
Indep. Power Purchase	14,600	14,600
Line Loss	(5,100)	(5,100)
Net Available	62,130	64,545
Domestic Sales	56,513	57,255
Surplus/(Deficit)	5,617	7,290

Source: Generation (except for Site C) projected from 2020/21 annual report. Sales forecast from F23 to F25 RRA, Load Forecast from Appendix F, p. pdf 256;  
[https://docs.bcuc.com/Documents%2fProceedings%2f2021%2fDOC\\_64006\\_B-2-1-BCH-F23-F25-RRA-Appendix-public.pdf](https://docs.bcuc.com/Documents%2fProceedings%2f2021%2fDOC_64006_B-2-1-BCH-F23-F25-RRA-Appendix-public.pdf)

**From:** [Cuddy, Andrew EMLI:EX](#)  
**To:** [Ralston, Bruce EMLI:EX](#)  
**Subject:** FW: Site C Update  
**Date:** October 6, 2021 9:12:10 AM

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FYI below – latest update from the PAB. See the points highlighted in yellow in particular.

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**From:** MacLaren, Les EMLI:EX <Les.MacLaren@gov.bc.ca>  
**Sent:** October 6, 2021 7:36 AM  
**To:** Mihlar, Fazil EMLI:EX <Fazil.Mihlar@gov.bc.ca>; Cuddy, Andrew EMLI:EX <Andrew.Cuddy@gov.bc.ca>  
**Cc:** Wieringa, Paul EMLI:EX <Paul.Wieringa@gov.bc.ca>; Sopinka, Amy EMLI:EX <Amy.Sopinka@gov.bc.ca>; Rowe, Katherine EMLI:EX <Katherine.Rowe@gov.bc.ca>; Foster, Doug FIN:EX <Doug.Foster@gov.bc.ca>; Jang, Monica EMLI:EX <Monica.Jang@gov.bc.ca>  
**Subject:** Site C Update

Fazil/Andrew

Doug Foster and I attended the Site C Project Assurance Board regular monthly meeting on September 27. s.13

s.13

s.13 There were no decisions/approvals at the meeting.

Project Update  
s.13

- A second COVID outbreak was declared by Northern Health on August 19. BCH has subsequently reported there have been no new cases linked to the outbreak since mid-September, and if this persists the outbreak could be declared over October 11. As of October 1 there were 24 active cases, none related to the outbreak.
- With support of Northern Health, BC Hydro is collecting vaccination status for all Site C workers, and has initiated asymptomatic rapid testing of individuals identified through contract tracing (150 tests with 5 follow-ups as of October 1). BCH reports that Northern Health is very supportive of BCH's actions to be essentially self-sufficient with its clinic, vaccinations, contract tracing and testing. Northern Health is otherwise overwhelmed and cannot keep up with contract tracing.
- Traffic and vehicle safety risk has increased with the hauling of dam fill material using large trucks. One way haul roads and berms to separate lanes on two-way roads have been implemented.
- All required permits and leaves to commence construction for clearing in the western reservoir area and the Right Bank Foundation Enhancements, respectively, have been issued. An EA

Certificate amendment is outstanding that would allow trucking of dam fill material as a back up in the event that till conveyor is out of service for an extended period. As till can only be placed above certain temperatures, that activity will be suspended over the winter so the EA Amendment is not currently critical.

s.13; s.16; s.18.1

- s.13

- s.13

- The Auditor General will review procurement governance and fraud risk management in October/November as part of a larger cross-government project.

#### Risks/Commercial

- In addition to the traffic risk noted above, risks associated with COVID and securing permits following the Blueberry River First Nation court ruling have increased.

s.13

- Subsequent to the PAB meeting there was media coverage of issues with the North Shore Water Treatment Plant where Acciona is the lead partner. EMLI, BCH, MoTI and FIN have worked on messaging related to Site C and other major projects where Acciona is involved (Broadway Skytrain and Pattullo Bridge replacement).

#### Schedule

s.13

Doug may have further commentary.

*Les MacLaren*

Assistant Deputy Minister

Electricity and Alternative Energy Division

BC Ministry of Energy, Mines and Low Carbon Innovation

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*Energizing BC—clean, sustainable and productive*

**From:** [Cuddy, Andrew EMLI:EX](#)  
**To:** [Ralston, Bruce EMLI:EX](#)  
**Subject:** FW: Construction Photos: Installation of first pile in spillway  
**Date:** October 8, 2021 7:45:26 PM

---

fyi

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**From:** MacLaren, Les EMLI:EX <Les.MacLaren@gov.bc.ca>  
**Sent:** October 8, 2021 5:10 PM  
**To:** Mihlar, Fazil EMLI:EX <Fazil.Mihlar@gov.bc.ca>; Cuddy, Andrew EMLI:EX <Andrew.Cuddy@gov.bc.ca>; Wieringa, Paul EMLI:EX <Paul.Wieringa@gov.bc.ca>; Sopinka, Amy EMLI:EX <Amy.Sopinka@gov.bc.ca>  
**Cc:** Foster, Doug FIN:EX <Doug.Foster@gov.bc.ca>  
**Subject:** FW: Construction Photos: Installation of first pile in spillway

Big day at Site C. The first of the piles for the Right Bank Foundation Enhancements was installed this morning (photos below), and the last of the roller-compacted concrete for the dam core buttress was placed at 1:00 am this morning. This completes the MCW's RCC work on the project.

Les

---

**From:** s.19  
**Sent:** October 8, 2021 12:27 PM  
**To:** MacLaren, Les EMLI:EX <Les.MacLaren@gov.bc.ca>  
**Subject:** FW: Construction Photos: Installation of first pile in spillway

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

As discussed.

s.19

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**From:** s.19  
**Sent:** Friday, October 8, 2021 12:12 PM  
**To:** O'Riley, Christopher <[Chris.Oriley@bchydro.com](mailto:Chris.Oriley@bchydro.com)>; Allen, Doug <[Doug.Allen@bchydro.com](mailto:Doug.Allen@bchydro.com)>; 'Mitchell Gropper' <[mgropper@farris.com](mailto:mgropper@farris.com)>  
**Cc:** Deeley, Anna <[Anna.Deeley@bchydro.com](mailto:Anna.Deeley@bchydro.com)>  
**Subject:** Construction Photos: Installation of first pile in spillway

The first right bank foundation enhancement pile (pile 143) has now been installed in the spillway (installed this morning). See photos below.

It is pretty amazing what the team accomplished in the past 5 months including finalizing the design, obtaining our LCC permit, procuring the steel and mobilizing Aecon foundations in parallel with finalizing the commercial terms. We could not have accomplished this on such an accelerated timeline without our strong working relationship with AFDE and the hard work of the GSS team. Great job!

s.19









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s.19

Pronouns: he/him/his

BC Hydro

s.19

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# BC HYDRO ISSUES NOTE

Issue:	SITE C MCCANDLESS REPORT
Spokesperson:	Media Relations

## ISSUE SUMMARY

A commentary written by a retired senior public servant argues that the accumulated operating losses for Site C will be \$5.5 billion for the first 15 years of operation.

## BACKGROUND

- Richard McCandless is a retired senior B.C. government public servant who regularly publishes papers on BC Hydro and other crown corporations.
  - McCandless has registered and participated in multiple recent BC Hydro revenue requirements applications.
- In his paper published on October 13, 2021 – *Operating Losses Could Add Another \$5.5 billion to the Cost of Site C* – McCandless argues the accumulated losses over the first 15 years of operation for the Site C project will likely be \$5.5 billion.
- The paper also explores his ideas to fund the losses he calculates, noting a significant (10 per cent) rate increase may be required, and/or other options like the use of a regulatory account or a taxpayer subsidy.
- McCandless argues that for several years, the new power produced from Site C will add to BC Hydro's surplus power and will be exported at a much lower price than the cost of production.
- In the report, McCandless acknowledges the \$5.5 billion projection is his own estimate based on a mix of BC Hydro's and his personal assumptions/scenarios:
  - The \$16 billion cost of the project will be recovered from taxpayers over an 84-year amortization period at an interest rate of 3.6 per cent, which works out to a \$605 million annual interest payment.
  - There will be \$45 million in additional annual operating costs, including \$10 million for staff, operating costs and grants in-lieu and \$35 million increased water rentals paid to the province.
  - The total annual cost of \$650 million (\$605 million plus \$45 million) works out to a production cost \$127 per megawatt hour.
- McCandless' projections are based on an average price of \$102.40 per megawatt hour for domestic sales and \$42.50 for exports.
  - McCandless argues all electricity produced by Site C will be surplus to domestic requirements from 2025/26 to 2032/33.
  - McCandless argues this power will be exported at \$42.50 per megawatt hour, resulting in a loss of \$3.2 billion over eight years.

- McCandless argues that as domestic sales grow due to increased demand from 2032/33 to 2040/41, the losses over that period will be between \$2.2 - \$2.5 billion.

### **Inaccuracies with report**

- BC Hydro has identified a number of critical issues with the report.
- Mr. McCandless incorrectly notes that BC Hydro "...stated that the amortization cost impact on the [customer] rates would not be addressed until the next rating filing, probably September 2023."
  - BC Hydro's latest application with the BCUC covering 2022/23 through 2024/25 includes Site C costs applicable during that period, including amortization and finance charges in 2024/25 when the first generating assets come into service.
  - The rate increases included in the application already incorporate Site C costs (including amortization and finance charges) associated with that period.
  - It is correct that there will be additional rate impacts in 2025/26 related to Site C (including amortization as the remaining assets come into service) and this is already noted and will be reflected in future applications.
  - It is also possible that a long-term rate forecast will be provided during the proceeding (if requested) that will enable further discussion / explanation, including that BC Hydro cumulative rate increases are forecast to be below forecast inflation over the decade covering 2020/21 through 2029/30 (which includes all Site C costs entering rates)
- Mr. McCandless is incorrectly characterizing near-term supply imbalances as "operating losses" resulting from Site C.
  - Aligning the long-term benefits of a multigenerational investment with short-term electricity demand is challenging. BC Hydro expects that over the next 20 years the demand for electricity will continue to grow, yet there will be an initial period where the Site C output will be surplus to domestic needs.
  - However, this period is expected to be short and exported to external markets, generating revenues to partially offset the cost of service for these early years.
  - After this short initial surplus period Site C generation will be needed and used to serve BC Hydro's customers.
  - The years Site C output is surplus do not represent incremental costs to ratepayers, but rather the same costs being incurred earlier.
  - There are no long-term losses from Site C coming in earlier than domestic requirements.
- Mr. McCandless incorrectly assesses the implications of what he calls "operating losses" resulting from Site C.

- Site C costs (like all BC Hydro costs) and export revenues are included in the revenue requirements applications to the BCUC to be recovered from ratepayers.
  - BC Hydro's allowed net income is set in a way that its costs are recovered and the utility can earn net income.
  - Site C coming into operation will thus not drive "operating losses" for BC Hydro.
- Accordingly, Mr. McCandless' analysis of resulting rate impacts and "funding options" (including taxpayer subsidy) are unnecessary.

## **KEY MESSAGES**

- BC Hydro is committed to completing the Site C project in the most prudent and efficient way possible.
- We are building Site C to meet the long-term clean electricity needs of our customers and the project will ensure rates remain low for customers.
- Once built, Site C will be a source of clean, renewable and affordable electricity in B.C. for decades to come.
- While the project has had challenges, completing it will help keep rates low.
- Site C will help meet the province's future load growth, provide clean water powered energy and position the economy to recover from the impacts of COVID-19.

## **TOP QUESTIONS AND ANSWERS**

### **1. What is BC Hydro's response to Mr. McCandless' latest report?**

- Mr. McCandless's report makes a number of incorrect assumptions.
- These include incorrectly stating that Site C amortization costs are not included in BC Hydro's latest revenue requirements application.
- The report also incorrectly assumes BC Hydro will incur operating losses from Site C that require funding to cover.
- BC Hydro expects to keep cumulative customer rates below inflation over time, including the recovery of all Site C costs.

### **2. This report says Site C is likely to lose \$5.5 billion in its first 15 years of operation and that these losses must be funded somehow. Is this accurate?**

- No, this is not accurate.
- Site C will not result in operating losses and a funding source will not be required.

- 3. This report says it will be years from now before there is enough demand to sell Site C power domestically. If that's the case, won't Site C bleed money for it's first decade or more?**
  - We are building Site C to meet our long-term electricity needs for the next 100 years.
  - Site C will be a cost-effective source of clean energy for our customers.
  - We expect that we will require the energy and capacity from Site C by about 2030.
  - After an upfront capital cost, large hydroelectric projects like Site C have low operating costs and a long life – more than 100 years with maintenance and refurbishment).
- 4. The report says the electricity produced by Site C will ultimately work out to be \$127 per megawatt hour. Is this accurate?**
  - We are unable to replicate Mr. McCandless' calculation of the Site C's costs per megawatt hour.
  - Capital projects like Site C do have a higher cost impact in the early years of operations.
  - However, costs decline over time as debt is repaid and interest costs decrease.
- 5. The report says power from Site C will be exported at \$42.50 per megawatt hour, resulting in a loss of \$3.2 billion over eight years. Is this accurate?**
  - No, we expect domestic customers to require Site C power earlier than the eighth year of operation.
  - This means the power is not expected to be exported for the time that Mr. McCandless references.
- 6. The report mentions the amortization period was originally 70 years. Now it's 84. What's the reason for the change and what impact does it have on rates?**
  - The 84 years reflects the weighted average of the useful life of the Site C assets based on the costs associated with the updated Site C budget.
  - Our approach to recovering the costs of Site C is consistent with how we amortize the costs of other BC Hydro capital projects.
- 7. Isn't load demand going down? Why do you still need Site C?**
  - We are building Site C to meet our long-term electricity needs for the next 100 years.
  - Site C will be a cost-effective source of clean energy for our customers.
  - We expect that we will require the energy and capacity from Site C by about 2030.
- 8. Will Site C be increasing rates for customers when it comes into service?**
  - We recently filed our three-year Revenue Requirements Application (RRA) for 2023 to 2025.
  - Site C is one of the reasons rates will increase in the third year – that's when it starts to come into service and the rates increase reflects a partial year of amortization.
  - Rates are also expected to increase because of reliability investments related to the Mandatory Reliability Standards, cybersecurity and vegetation management.
  - BC Hydro expects to keep cumulative customer rates below inflation over time, including the recovery of all Site C costs.

## **2021-10-25 – Site C PAB Update**

Fazil,

Doug Foster and I attended the Site C Project Assurance Board meeting on 25 October; with Les in attendance for a portion of it. The following is a summary of that meeting. Doug and Les may have additional comments.

### **Construction Update**

The August COVID-19 outbreak was declared over on October 12, however, there continues to be a steady number of cases identified and cleared. As of October 12, there were 17 active cases and 45 isolations. There has been a spike in vaccinations since mandatory vaccination is now required for commercial and charter flights. BC Hydro estimates that between 75% to 83% of the Site C workers are vaccinated based on the vaccination status information recently collected at the instruction of the Northern Health Authority.

The Project met a major milestone with Peace River Hydro Partners (PRHP) completion of the roller-compacted concrete (RCC) program on October 8. PRHP continues to exceed expectations on productivity with the Summer Works Acceleration on the Earthfill Dam, which was aided by the good weather. To date, 7 of the 48 piles required for the Right Bank Foundation Enhancement work have been placed. PRHP are currently excavating the Approach Channel, however that work is not progressing as quickly as expected and BC Hydro is working to finalize agreements that would complete the approach channel by April 1, 2022.

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Reservoir clearing, transmission line work and highway construction continue to progress to plan.

Richard Raine, an independent construction advisor, visited the site and confirmed the observations of BC Hydro management - good progression on multiple work fronts,

### **Costs**

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### **Risks**

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The Office of the Auditor General will be conducting two audits on Site C: payment verification (fraud) audit and a general performance audit.

#### Quarterly Progress Report

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#### Commercial Update

BC Hydro continues to advance multiple commercial negotiations with PRHP. A tentative agreement on the right bank design changes was reached in early October and work on the settlement agreement has begun. BC Hydro is now focussing on reaching an agreement with PRHP this fall on the approach channel.

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#### Advisor Update

Technical Advisory Board (TAB) meets monthly with the design team; the design work is on schedule and is not holding up construction. Recent geotechnical readings are showing very little movement.

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Amy



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# BC HYDRO ISSUES NOTE

<b>Issue:</b>	<b>SITE C: CLEARING AND DEBRIS MANAGEMENT 2021</b>
<b>Spokesperson:</b>	Dave Conway, Community Relations Manager

## ISSUE SUMMARY

The Site C project is resuming burning activities this fall for in various project areas. About 1,200 to 1,500 piles of wood waste are expected to be burned between November and March 2022.

## BACKGROUND

- During construction of the Site C project, clearing and debris management, including burning, will occur in various project areas.
- Clearing has been occurring in project areas since construction began in July 2015.
- Clearing is required to prepare for project activities, such as river diversion (which was achieved in October 2020), future reservoir filling and the Highway 29 realignment.
- Merchantable trees will be hauled to local mills for harvest; however, this is dependent on the tree size and species, along with road access to the clearing area.
- The remaining wood waste may be chipped, mulched and spread as coarse woody debris or burned at the dam site and the reservoir areas.
- The burning piles consist of waste – non-merchantable trees, branches, leaves and other natural debris – that has been left over from the clearing of trees.
- Burning is expected to begin in early-November and will continue over several months in the following areas:
  - Halfway River drainage
  - Islands in the Peace River
  - South bank of the Peace River between Halfway River and Farrell Creek
- All approvals and permits are in place; stakeholders, including local and regional governments and first responders, will be notified prior to burning.
- Contractors can only burn during weather windows known as “venting windows”.
  - These are periods when the weather is conducive to disperse smoke.
  - Custom venting windows are authorized under provincial regulation, specific for the project.
- Contractors must comply with BC Hydro’s Vegetation Clearing and Debris Management Plan and Smoke Management Plan to ensure wood is managed as effectively as possible, animal sweeps are completed, and wood waste disposal activities are well managed and coordinated.

## KEY MESSAGES

- BC Hydro is committed to safely and responsibly advancing the Site C project.
- We have been clearing trees and vegetation from the future reservoir area and Highway 29 realignment right-of-way.
- When possible, merchantable trees are sent to local mills for harvest.
- Over the next several months, some debris will also be burned in various project areas when conditions allow for it.
- We will notify nearby property owners, local and regional governments, Indigenous groups and first responders before piles are ignited.

## TOP QUESTIONS AND ANSWERS

### 1. When will burning be occurring?

- Burning activities on the project typically takes place between November and March.
- This is the time of year when the weather is most conducive to disperse smoke, which minimizes impacts to people living in the area.

### 2. Where will burning be taking place?

- We are burning in several project areas this fall and winter including:
  - the Halfway River drainage;
  - on islands in the Peace River; and
  - on the south bank of the Peace River between Halfway River and Farrell Creek.

### 3. What are you doing to monitor air quality?

- We have five monitoring stations that track weather and air quality in and around the Site C project area.
- The Province of B.C. also has additional weather and fine particulate monitoring stations in the Fort St. John area.
- Our contractors will also ensure each burn follows our regulatory requirements and project commitments.

### 4. How much burning do you expect to do this season?

- We expect about 1,200 to 1,500 piles of wood waste to be ignited this season.
- Wherever possible, merchantable trees will be sent to local mills for harvest.

### 5. Will residents be notified about burning before it takes place?

- Yes, the project provides advance notice before burning takes place.
- This includes email notifications, Twitter posts, our bi-weekly construction bulletins and on our project website.
- In addition, the contractor typically provides a 24-hour notification to local and regional governments, Indigenous groups, provincial agencies, first responders, health care providers and nearby properties prior to any burning taking place.

October 29, 2021

## **Public advisory: Wood debris burning to resume on Site C project**

BC Hydro will resume its burning program in Site C project areas pending suitable venting and ground conditions.

Crews are clearing vegetation, where safe and practical, from the future reservoir area to help ensure boater safety and reduce impacts to dam operations. Clearing work will continue along the Highway 29 realignment right-of-way.

Any timber that is merchantable is hauled to local mills, and remaining waste wood is mulched, bucked to shorter logs or burned.

From October to March, burning may take place in the following areas:

- Halfway River drainage
- Islands in the Peace River
- South bank of the Peace River between Halfway River and Farrell Creek

The public may encounter increased smoke and lower visibility while burning and wood disposal takes place. The Site C project plans and monitors burning carefully, including the timing, size and location of the wood piles, and the smoke being emitted.

Burning activities will follow the [Site C Smoke Management Plan](#) and will only take place during custom venting windows authorized under provincial regulations, specific to Site C.

If residents see an uncontrolled fire or forest fire, they are asked to immediately contact the BC Wildfire Service at 1 800 663-5555 or \*5555 on a cell phone.

### **Sign up for regular burning notifications**

Email [sitec@bchydro.com](mailto:sitec@bchydro.com) if you'd like to be put on an e-mail mailing list for upcoming burning notifications.

### **Learn more**

- [Clearing and debris management](#)
- [FAQ: Clearing and debris management](#)
- [Site C Smoke Management Plan](#)
- [Information sheet: Clearing and debris management](#)

### **Contact us**

Toll-free: 1 877 217 0777

Email: [sitec@bchydro.com](mailto:sitec@bchydro.com)

Twitter: [@sitecproject](https://twitter.com/sitecproject)

# BC HYDRO ISSUES NOTE

<b>Issue:</b>	Aggregate Resources – Access to Area E
<b>Spokesperson:</b>	Dave Conway, Community Relations Manager

## ISSUE SUMMARY

BC Hydro has issued a Notice to Vendors for the development of Area E to access the materials required to ensure the completion of the Site C project. The Notice to Vendors is posted on the BC Bid website and an RFP will be issued on November 5.

## BACKGROUND

- Construction of the remaining dam works on the Site C project requires an estimated 12 million m<sup>3</sup> of a specific type of granular material called “Zone 3” or “Shell” material.
- BC Hydro is currently obtaining this material from several locations within the dam site area.
  - To date, the project has used about 3.7 million m<sup>3</sup> of Zone 3 material for construction within the dam site.
- The majority of the remaining granular material is expected to be sourced on site within existing work areas.
  - BC Hydro is forecasting that it will require about 2.2 million m<sup>3</sup> of material in 2022 from other sources in order to complete the earthfill dam.
  - These other sources include downstream dredging, within the transmission line right of way and from Area E.
- During the project definition and approval stage, BC Hydro identified Area E as having the highest degree of certainty for volume and suitability of Zone 3 material and evaluated the impacts of using it as a source of material during the Environmental Impact Statement (EIS) stage.
- Area E, and the road leading to it called Ice Bridge Road, is located on the right bank downstream of the dam site and is accessible through Gate C of the dam site area.
- Access to the Area E granular materials via Ice Bridge Road are needed by January 2022 to maintain the project schedule.
  - Portions of Ice Bridge Road have already been upgraded.
  - The portion leading to Area E requires upgrades in order to accommodate two-way truck traffic.
    - The upgrading and haul road was assessed during the EIS stage.
- Site preparation activities – including clearing of Ice Bridge Road and Area E – need to begin in January 2022 and be completed prior to the bird nest season starting in mid-April to prevent construction impacts from bird nesting.

- BC Hydro has submitted a provincial application with the Ministry of Forests, Lands and Natural Resource Operations.
- BC Hydro is seeking direction from the Ministry of Energy, Mines and Low Carbon Innovation on the best approach to obtaining approval to temporarily exclude these areas from the Agricultural Land Reserve.
- BC Hydro has discussed the possibility of using Area E with local Indigenous groups and has conducted ground truthing of the area.
- BC Hydro also provided a briefing to the Peace River Regional District and member communities about the potential use of Area E in September 2021.
- On November 1, BC Hydro issued a notice to vendors (NTV) on BC Bid to invite interested contractors and other prospective proponents to attend a site visit for the Area E road upgrades, pit development and hauling work.
- BC Hydro plans to post a Request for Proposals (RFP) on November 5.

## **KEY MESSAGES**

- BC Hydro is committed to safely and responsibly advancing the Site C project.
- We have posted a Notice to Vendors on BC Bid that's related to the development of Area E so we can access the materials required to complete the earthfill dam.
- Area E was identified as a contingency source in the project's environmental assessment to acquire this type of material.
- We continue to work with Indigenous groups, local and regional governments and regulatory agencies as we work through this process.

## **TOP QUESTIONS AND ANSWERS**

### **1. Why do you need to access Area E and Ice Bridge Road?**

- Construction of the remaining dam works on the Site C project requires about 12 million m<sup>3</sup> of a specific type of granular material called "Zone 3" or "Shell" material.
- We anticipate we will require about 2.2 million m<sup>3</sup> of material in 2022 from other sources in order to complete construction of the earthfill dam.
- We have identified Area E as having the highest degree of certainty for volume and suitability for the type of material that is required for construction.
- We need to access Area E via an upgrade to Ice Bridge Road by January 2022 to maintain our project schedule.
- Using Area E as an aggregate source, upgrading Ice Bridge Road and hauling by truck was included within the project's Environmental Impact Statement phase.

**2. Is access to Area E materials and the Ice Bridge Road a new impact of the Site C Project?**

- No, Area E was identified as a contingency source for this material in the project's environmental assessment.
- In the environmental assessment process, we estimated this area could be used for up to 1 million m<sup>3</sup> of material.
- We are forecasting that we will require about 2 million m<sup>3</sup> of material in 2022 from other sources for the earthfill dam.
- In addition to Area E, other sources for these materials include downstream dredging and within the transmission line right of way.

**3. Have you spoken with First Nations about this plan?**

- Yes, we have discussed the use of Area E with First Nations at two environmental forums earlier this year.
- We have also conducted ground-truthing of Area E and Ice Bridge Road with Blueberry River First Nations and Doig River First Nations.
- Ground-truthing is also planned with Halfway River First Nation.
- We have also shared our draft permit applications with Indigenous Nations for feedback prior to submitting our final applications.

**4. Is Area E in the Agricultural Land Reserve? Do you have the permits you require to access the materials?**

- Yes, Area E is located within the Agricultural Land Reserve.
- We are currently working with provincial agencies and local governments to determine the most appropriate regulatory mechanism for temporarily excluding these areas from the Agricultural Land Reserve.
- We have also submitted all other required permit applications to our regulators.

**5. Will the development of Area E and Ice Bridge Road require an Environmental Assessment amendment?**

- Area E was identified as a contingency source in the project's environmental assessment process.
- In the environmental assessment, it was estimated this area could be used for up to 1 million m<sup>3</sup> of material.
- We continue to work with Indigenous groups, local and regional governments and regulatory agencies as we work through this process.

## **Site C Clean Energy Project**

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### **Quarterly Progress Report No. 21**

**F2021 Fourth Quarter**

**January 1 to March 31, 2021**

**CONTAINS CONFIDENTIAL INFORMATION -  
FOR GOVERNMENT ONLY**

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## 1 Executive Summary

### 1.1 Overview and General Project Status

The Site C Project (**Project**) continues to face significant challenges that have materially impacted Project cost and schedule, as previously discussed in Annual Report No. 5 (January to December 2020).

The most significant challenge continues to be the impacts of the global COVID-19 pandemic, which, during the quarter, included the implementation of health orders to gradually re-start work after the winter holidays in January 2021, managing COVID-19 cases at site, and incremental costs to complete work.

The second significant challenge relates to geotechnical issues on the right bank. By early 2020, BC Hydro had determined that significant foundation enhancements were required to increase the stability under the structures on the right bank, including the powerhouse, spillways and future dam core area. During the quarter, independent dam experts confirmed BC Hydro's proposed foundation enhancements solution is appropriate and sound, and will make the right bank structures safe and serviceable over the long operating life of Site C.

The final significant challenge relates to cost pressures facing the Project. Prior to the onset of the COVID-19 pandemic, the Project was already managing significant financial pressures; the pandemic-related costs and delays and the need for foundation enhancements have added to these cost and schedule pressures.

However, despite the COVID-19 pandemic, the Project achieved significant construction milestones during the quarter, including the completion of the upstream and downstream cofferdams, significant progress on the second 500 kV 75-kilometre-long transmission line, and the first two (of six) turbine runners arrived at site from São Paulo, Brazil.

During the reporting period, the Government of British Columbia (**B.C.**) announced a revised cost estimate to complete the Project of \$16 billion, along with a new expected in-service date of 2025, as a result of the delays and impacts of the pandemic. Subsequent to March 31, 2021, Treasury Board approved the new budget of \$16 billion and the new in-service date of 2025, subject to the risks summarized in this report.

Also, in February, the Government of B.C. also released the Site C Project Review, led by Peter Milburn (**Milburn Review**), which included 17 recommendations aimed at improving oversight, governance, risk management, and construction and claims management.

The sections below discuss the major challenges and successes of the quarter in further detail.

## **1.2 The COVID-19 Pandemic Continues to be a Significant Challenge**

The COVID-19 pandemic continues to impact on-site work activities. To reduce the risk of increased post-winter holiday transmission of COVID-19 at major projects and local communities in the north, B.C.'s Provincial Health Officer issued several public health orders in late December 2020 and early January 2021.

Starting from a reduced number of onsite workers in January 2021, BC Hydro was able to ramp up gradually throughout the first few months of the year. During the reporting period, COVID-19 cases on the Site C Project started to increase, mirroring what was occurring across the province during the pandemic's third wave. Subsequent to the reporting period, on April 28, 2021, Northern Health declared a COVID-19 outbreak at Site C because of an increase of cases at site. This step was taken to ensure the health and safety of employees, contractor workers and members of the public. Work continued on-site and BC Hydro was not directed to shut down the site or stop any work due to the COVID-19 protocols in place.

Throughout the pandemic, BC Hydro has continued to prioritize employee health and safety by implementing measures across site to minimize the risk of transmission at the worker accommodation, all work fronts, and all construction offices by offering vaccination clinics to on-site Site C workers and employees; and working closely with local government, First Nations and health authority stakeholders. Through regular communication, these stakeholders were kept informed about pandemic-related updates on the Project.

### **1.3 Geotechnical Review from Independent Dam Experts Confirmed Foundation Enhancements Proposed Solution**

By early 2020, BC Hydro had determined that significant foundation enhancements were required to increase the stability under the structures on the right bank, including the powerhouse, spillways and future dam core area.

In February 2021, the Government of B.C. released the geotechnical review from two independent, world-leading dam experts. Their review confirmed the foundation enhancements developed to address geotechnical issues on the Project's right bank indicate the Project design continues to meet the highest safety standards and international best practices. The independent dam experts have been retained to provide oversight to BC Hydro while construction of the foundation enhancements is completed.

### **1.4 Revised Cost Estimate and New Expected In-Service Date**

As announced by the Government of B.C. on February 26, 2021, the revised cost estimate to complete Site C is \$16 billion and includes a new expected in-service date of 2025, as a result of the delays and impacts of the COVID-19 pandemic. COVID-19 is the single largest contributor to the cost increase, followed by the additional costs for foundation enhancement measures, and other cost pressures.

Prior to the onset of the COVID-19 pandemic, and since the \$10.7 billion Project budget was approved in February 2018, BC Hydro was managing significant financial pressures due to:

- Amendments to the main civil works contract;
- Additional labour resource requirements;
- First Nations treaty infringement claims and an injunction application;
- Increased costs associated with reservoir clearing, transmission line construction and highway re-alignment work; and
- Additional significant scope and design enhancements to the foundations of the structures on the right bank.

However, prior to the COVID-19 pandemic, the Project remained on schedule for the first generating unit to go into service in late 2023 and a final in-service date in 2024.

The COVID-19 pandemic, along with the need for foundation enhancements on the right bank to deal with unanticipated geotechnical conditions, significantly added to the cost pressures. BC Hydro continues to review the revised cost estimate and key Project risks, further to the recommended actions in the Milburn Review.

The key Project risks that remain and continue to be assessed include the continuation of the COVID-19 pandemic and the potential impacts to on-site construction activities; commercial negotiations with contractors; design finalization for the foundation enhancements and related procurements; the procurements for the balance of plant contracts; and the ability of the Project to attract and retain sufficient skilled workers.

## **1.5 BC Hydro Received and Started to Implement the Milburn Review Recommendations**

In February 2021, the Government of B.C. also released the independent review of the Project by special advisor Peter Milburn. His report included 17 recommendations aimed at improving oversight and governance and strengthening Site C risk reporting and management. The Government of B.C. and BC Hydro have accepted all the recommendations and implementation of all recommendations has started. Mr. Milburn has been retained to provide oversight on the implementation of the recommendations, which include enhancing the independence, mandate and expertise of the Site C Project Assurance Board and strengthening BC Hydro's risk management processes.

## **1.6 Upholding Commitments to the Environment, Indigenous Groups and Local Communities**

During the reporting period, BC Hydro continued to uphold its commitments to the environment, Indigenous groups and local communities.

BC Hydro continued to secure the appropriate permits, authorizations and leaves to commence construction required for the Project. BC Hydro estimates that approximately 600 permits will be required throughout the life of the Project and of these permits, 481 have been received to March 31, 2021, and are actively being managed. The remaining authorizations are anticipated to be received as required to meet the overall Project schedule needs.

In March 2021, BC Hydro submitted a draft Environmental Assessment Certificate amendment request to the Environmental Assessment Office regarding the use of haul trucks on a contingency basis to transport till material from 85th Avenue Industrial Lands to the dam site area. Prior to submitting the final submission in June 2021, BC Hydro engaged with local governments, First Nations and local residents on the proposed activity and responded to concerns. A decision on the amendment is expected in the fall of 2021.



Work advanced in the areas of environmental monitoring and assessment as well as in the Project's fish, wildlife, habitat, vegetation management and heritage programs. During the reporting period, environmental activities focused on responding to and assessing noise, light and air quality concerns within the Hudson's Hope area as well as re-opening the temporary fish passage and establishing contingency trap and haul programs to augment the fish passage.

Throughout the quarter, BC Hydro worked to engage, build relationships and find solutions together on topics that are most important to the First Nations communities affected by Site C.

### **1.7 Despite COVID-19 Pandemic, Construction Progress Continued Over the Winter Season**

Despite the challenges COVID-19 pandemic, the Project achieved significant construction milestones during the quarter, including the completion of the upstream and downstream cofferdams, which needed to be in place in advance of the spring freshet. Completed ahead of schedule, the cofferdams create a dry construction area to continue construction activities with the earthfill dam. Construction on the earthfill dam progressed with excavations in the core trench areas.

Significant progress was also made on the second 500 kV 75-kilometre-long transmission line, with the completion of all foundations, and all towers assembled and installed on the foundations by the end of the quarter.

The first two (out of six) turbine runners arrived at site from São Paulo, Brazil, during the quarter.

### **1.8 Project Status Dashboard for the Quarter**

BC Hydro, with direction from the Project Assurance Board, is committed to delivering the Site C Project without compromising on safety, scope, and quality. To report on Project status, BC Hydro uses a dashboard system where key Site C

Project areas are classified as red (at risk), amber (moderate issues) or green (on target).

The Project Status Dashboard is provided in Table 1 below. Overall Project health as of March 31, 2021, remained “red” due to significant schedule and cost pressures that had not then been reflected in the budget and schedule that was approved by Treasury Board subsequent to the end of the reporting period. In February 2021, the Government of B.C. announced that the Project will continue with a revised cost estimate of \$16 billion and a new expected in service date of 2025. Project health will be reassessed in the next Quarterly Progress Report based on the newly approved budget and revised project schedule.

**Table 1 Project Status Dashboard**

● On Target

● Moderate Issues

● At Risk

Status as of:		March 2021
Overall Project Health	●	<p>Overall Project health remained “red” due to significant schedule and cost pressures. In February 2021, the Government of B.C. announced that the project will continue with a revised cost estimate of \$16 billion and a new expected in service date of 2025. The revised cost estimate was approved by Treasury Board subsequent to the end of the reporting period.</p> <p>The scope status changed from “red” to “amber” as independent experts confirmed the foundation enhancements developed to address geotechnical issues on the Project’s right bank will work and will ensure the Project meets the highest safety standards.</p> <p>Further to the recommended actions in the Milburn Report, BC Hydro continued to review the revised cost estimate, along with Project risks, which are very significant.</p>
Safety	●	<p>Safety remained “amber” during the quarter. Management of COVID-19 transmission for Site C workers and local communities continued to be a priority in the reporting period. To reduce the risk of increased post-winter holiday transmission of COVID-19 at major projects and local communities in the north, B.C.’s Provincial Health Officer issued several public health orders in late December 2020 and early January 2021. One of these orders was the <i>Industrial Projects Restart Order</i>, which required a slow and controlled return of workers to the five major projects in the region, including Site C. BC Hydro worked closely with Northern Health to implement the order and gradually increase worker numbers over the reporting period. From January to March 2021, there were 34 confirmed positive cases of COVID-19 on the Project, with 25 cases linked to five controlled, onsite clusters. Subsequent to the reporting period, on April 28, 2021, Northern Health declared a COVID-19 outbreak at Site C because of an increase in cases at Site. During the reporting period, there were five serious safety incidents consisting of four near misses that had the potential to be a serious injury and one serious injury that required medical attention. To encourage active learning from safety incidents across all work fronts and contractors, the Project held 22 Safety Incident Reviews in this quarter.</p>
Scope	●	<p>Scope changed from “red” to “amber” during the quarter as independent experts confirmed BC Hydro’s proposed foundation enhancements solution is appropriate and sound, and will make the right bank structures safe and serviceable over the long operating life of Site C. The independent dam experts have been retained to provide oversight to BC Hydro while construction of the foundation enhancements is completed. Scope remains “amber” as certain designs are still being finalized.</p>
Schedule	●	<p>Schedule remained “red” during the quarter. The revised cost estimate and schedule include a one-year delay to 2025 for the project in-service date, as a result of the delays and impacts of the COVID-19 pandemic. BC Hydro continues to refine its updated schedule. The revised cost estimate and schedule were not yet approved by Government during the reporting period. The schedule status will be updated when the revised cost estimate and schedule are approved.</p>

Status as of:		March 2021
<b>Cost</b>	●	<p>Cost remained “red” during the quarter. The Government of B.C. announced the project will continue with a revised cost estimate of \$16 billion. Prior to the onset of the COVID-19 pandemic, BC Hydro had identified in previous progress reports dating back to 2019 that the Project was already managing significant cost pressures, and these were being assessed, monitored and managed to the best extent possible. The COVID-19 pandemic, along with the need for foundation enhancements on the right bank to deal with unanticipated geotechnical conditions, significantly added to those cost pressures. The revised cost estimate based on an in service date of 2025 was not yet approved by Government during the reporting period. The cost status will be updated when the revised cost estimate is approved.</p> <p>Significant cost risks remain, including the continuation of the COVID-19 pandemic, the continuation of commercial negotiations with contractors, procurements for the remaining work fronts and equipment, and the availability of skilled workers. BC Hydro continues to review the revised cost estimate, along with risks, further to recommendations provided by Peter Milburn.</p>
<b>Quality</b>	●	<p>The overall quality rating for the Project continued to be good during the reporting period, indicating that the work generally conforms to the requirements of the drawings and specifications. For the main civil works, BC Hydro focused its quality assurance efforts on the foundation drilling and grouting for the main dam. For the generating station and spillways civil works, BC Hydro focused its quality assurance efforts on the wet curing, thermal control and strength of concrete for the generation station, spillways and intake structures. For offsite manufacturing, BC Hydro continues to meet weekly with the quality management teams of key suppliers in COVID-19 affected areas to discuss impacts, plan upcoming inspections and to coordinate with our local quality assurance representatives to ensure quality requirements are satisfied prior to components being shipped.</p>
<b>Regulatory, Permits and Tenures</b>	●	<p>As at March 31, 2021, BC Hydro estimates that approximately 600 permits will be required throughout the life of the Project. Of these permits, 481 have been received to March 31, 2021, and are actively being managed. The remaining authorizations are anticipated to be received as required to meet the overall Project schedule needs.</p> <p>In March 2021, BC Hydro submitted a draft Environmental Assessment Certificate amendment request to the Environmental Assessment Office regarding the use of haul trucks on a contingency basis to transport till material from 85th Avenue Industrial Lands to the dam site area.</p>
<b>Environment</b>	●	<p>During the reporting period, the focus of the environmental work was responding to and assessing noise, light and air quality concerns within the Hudson’s Hope area as well as re-opening the temporary fish passage and establishing contingency trap and haul programs to augment the fish passage. Environment Canada initiated an investigation on October 10, 2018, with regards to a rainfall event in September 2018. BC Hydro has subsequently increased the system capacity along with other actions to reduce the potential of future similar events. This investigation is still ongoing. Focus remains on minimizing sediment and erosion across the dam site, care of water, hydrocarbon management, wildlife attractant management and invasive weed control.</p>
<b>Procurement</b>	●	<p>The balance of plant contract has been split into six packages and will be procured in 2021. The balance of plant mechanical request for proposals was posted on January 22, 2021 and closed on April 21, 2021. The closing date of the balance of plant electrical request for proposals is scheduled to close in June 2021.</p>

Status as of:		March 2021
<b>Indigenous Relations</b>	●	Seven of 10 agreements are fully executed and in implementation. West Moberly First Nations withdrew from confidential discussions to seek alternatives to litigation related to Site C in August 2019 and filed an amended Notice of Civil Claim in September 2019. British Columbia and BC Hydro concluded an agreement with Prophet River First Nation in 2020.
<b>Litigation</b>	●	The treaty infringement claim filed by West Moberly First Nations in January 2018 remains active. An amended Notice of Civil Claim filed by West Moberly First Nations in September 2019, among other things, expanded their original treaty infringement action, shifting the focus to all three Peace River facilities, not just Site C, and their alleged cumulative impacts. BC Hydro is preparing for the trial, which is scheduled to commence in March 2022.
<b>Stakeholder Engagement</b>	●	BC Hydro continues to work with the communities, regional district and stakeholder groups on the implementation of various community agreements. Throughout the reporting period, BC Hydro continued sharing recurring COVID-19 updates (through calls and emails) with local community representatives and Northern Health, as well as engaged with stakeholders and residents about the Environmental Assessment Certificate amendment regarding the use of haul trucks on a contingency basis to transport till material from 85th Avenue Industrial Lands to the dam site area. Additionally, BC Hydro continues to receive, respond to and resolve Project-related complaints.

## 1.9 Significant Project Updates for the Quarter

Significant Project updates that occurred between January 1 and March 31, 2021 include the following:

- On December 29, 2020 the Provincial Health Officer posted the *Industrial Projects Restart Order* limiting the number of workers at five industrial camps in Northern B.C., including Site C. BC Hydro complied with the *Industrial Projects Restart Order* issued by the Provincial Health Officer throughout the reporting period. Refer to section [3.1.1](#) and section [11.2](#) for more information.
- Two turbine runners were shipped from São Paulo, Brazil, and arrived at the Port of Prince Rupert in late 2020. One turbine runner was shipped to site in January 2021 and the second turbine runner was shipped to site in early February 2021. Refer to section [2.1.5](#) for more information.
- The upstream cofferdam was completed to full height (elevation 433.9 metres) in February 2021, two months ahead of schedule. The downstream cofferdam

interlocking steel pile wall was completed in January 2021 followed by the completion of the downstream cofferdam to full height (elevation 414 metres) in March 2021. Refer to section [2.1.1](#) for more information.

- The area between the upstream and downstream cofferdams was dewatered to allow for commencement of the excavation of the centre section of the earthfill dam core trench. The dewatering was completed in February 2021. Refer to section [2.1.1](#) for more information.
- On February 26, 2021, the Government of B.C. announced the revised cost estimate to complete Site C is \$16 billion and includes a new expected in-service date of 2025, as a result of the delays and impacts of the COVID-19 pandemic. Refer to section [5.2](#) for more information.
- The Government of B.C. released the geotechnical review from two independent, world-leading dam experts. Their review confirmed the foundation enhancements developed to address geotechnical issues on the Project's right bank indicate the Project design continues to meet the highest safety standards and international best practices. Refer to section [2.2.2](#), section [2.2.6](#) and [Appendix E](#) for more information.
- Preparation of in-river infrastructure began in February 2021 to manage water-borne wood debris for the 2021 season. Refer to section [2.1.2](#) for more information.
- On March 16, 2021, BC Hydro submitted an Environmental Assessment Certificate amendment request to the Environmental Assessment Office regarding the use of haul trucks on a contingency basis to transport till material from 85th Avenue Industrial Lands to the dam site area. Prior to submitting the request, BC Hydro engaged with local governments, First Nations and local residents on the proposed activity and responded to concerns in the final amendment submission. Refer to section [9.4](#) for further information.

- By the end of March 2021, crews installed the last of the 205 transmission tower foundations for the second, 75-kilometre-long, 500 kV transmission line that connects Site C to the Peace Canyon Generating Station. All the towers for the second transmission line were also assembled and installed on the foundations. The tower foundations are constructed using helical piles and anchors. Refer to section [2.2.4](#) for more information.
- Powerhouse construction continued throughout the reporting period, including concrete placements at the powerhouse, intakes and spillways; installation of penstock segments; and construction of the steel super-structure for the powerhouse. Refer to section [2.1.3](#) for more information.
- In March 2021, there were 4,321 total workers on the Site C Project. Of the total workers, 3,134 (73 per cent) were from British Columbia, and there were 900 workers on site from the Peace River Regional District (25 per cent of the construction and non-construction contractors' workforce). Refer to section [11.3](#) for further information.
- During the reporting period, BC Hydro was notified of 34 positive cases of COVID-19 related to people working on the project. Refer to section [3.1.1](#) for further information.

Refer to [Appendix A](#) for site construction photos for the quarter and refer to [Appendix B](#) for a list of work completed since the project commenced in 2015.

## **2 Construction and Engineering Major Accomplishments, Challenges and Work Completed,**

### **2.1 Construction**

The COVID-19 pandemic continued to have a significant impact on dam-site construction activities in the first quarter of 2021. On December 29, 2020, the Provincial Health Officer posted the *Industrial Projects Restart Order*, limiting the number of workers at five industrial camps in northern B.C., including Site C. Refer to section [3.1.1](#) and section [11.2](#) for further information. The Order primarily impacted the generating station and spillways civil contractor, discussed further in section [2.1.3](#) below.

BC Hydro continues to work closely with contractors to understand the costs and schedule impacts due to COVID-19.

#### **2.1.1 Main Civil Works**

The scope of the main civil works contract includes the construction of the following major components:

- Diversion works, including two concrete-lined, 10.8-metre-diameter tunnels. Tunnel No. 1 is 700 metres in length and Tunnel No. 2 is 790 metres in length;
- Diversion tunnel inlet and outlet portals, and approach channels;
- Excavation and bank stabilization;
- Relocation of surplus excavated materials (including management of discharges);
- Dams and cofferdams (including a zoned earth embankment dam 1,050 metres long and 60 metres above the present riverbed, and stage 1 and 2 cofferdams);



- Roller-compacted concrete (including a powerhouse, spillways and dam buttress approximately 800 metres long made up of approximately 1.7 million cubic metres of concrete); and
- Haul roads.

An update on construction activities currently underway or completed during the reporting period are described below under four main areas: (1) left bank, (2) right bank, (3) river diversion, and (4) earthfill dam. Refer to the Earthfill Dam section for updates on the right and left bank earthfill dam core trench excavation.

### **Left Bank**

The significant work activities on the left bank for the quarter were focused on the left bank drainage adit. During the quarter, the 454-metre-long left bank drainage adit tunnel was completed and approximately 50 per cent of the finishing concrete work, which includes the placement of slabs, was completed.

### **Right Bank**

The right bank scope of work includes the excavation of the powerhouse, spillways and dam, and placing roller-compacted concrete for the foundations to support the powerhouse, dam and spillway structures.

The activities currently underway or completed for the quarter ending March 31, 2021 on the right bank include:

#### *Right Bank Drainage Tunnel*

Remediation work is continuing in the right bank drainage tunnel. In 2019, some shotcrete on the wall of the tunnel was damaged, which limited access into the tunnel. Work has continued to advance in the first quarter of 2021. As of March 31, 2021, 84 per cent of the tunnel was remediated and had been completed to its final state. The contractor is continuing to progress the work to remediate the tunnel.

*Spillway Roller-Compacted Concrete (Dam/Core Buttress)*

Roller-compacted concrete for the dam/core buttress was expected to be complete in fall 2020. Due to the necessary reduction in the number of workers in the worker accommodation lodge because of the COVID-19 pandemic, only 30 per cent of the original planned placements of roller-compacted concrete for the dam/core buttress was achieved in 2020. The remainder of the roller-compacted concrete placements are planned to occur during the summer construction season of 2021. No roller-compacted concrete was placed in the first quarter of 2021 as the construction season had not yet begun due to low winter temperatures.

**River Diversion**

After years of preparations, the Peace River was diverted on October 3, 2020.

Activities to support diversion of the Peace River will continue until reservoir filling is complete, at which time the diversion facilities will be permanently de-commissioned.

*Upstream and downstream Cofferdam Construction<sup>1</sup>*

Construction on the upstream and downstream cofferdams commenced in the summer of 2020 as part of the river diversion process and were completed in the first quarter of 2021. The upstream cofferdam was completed to full height (elevation 433.9 metres) in February 2021, two months ahead of schedule. The downstream cofferdam interlocking steel pile wall was completed in January 2021 followed by the completion of the downstream cofferdam to full height (elevation 414 metres) in March 2021. The completion of both the upstream and downstream cofferdams allows for the creation of a dry area to continue construction activities with the earthfill dam.

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<sup>1</sup> This section was previously referred to as "In River Work".

## **Earthfill Dam**

Work to resume material placements for the earthfill dam was planned in spring 2020, when temperatures are conducive to earthfill dam material placements; however, due to the necessary reduction in the number of workers in the worker accommodation lodge because of the COVID-19 pandemic, the start date was impacted, as the work areas associated with the earthfill dam construction were scaled down. Due to the ramp down, placements of the material in the 2020 season did not occur and first placements of materials took place one year later, in April 2021.

### *Core Trench Excavation*

The area between the upstream and downstream cofferdams was dewatered to allow for commencement of the excavation of the centre section of the earthfill dam core trench. The dewatering was completed in February 2021.

Excavation of the earthfill dam core trench continued and, as of March 31, 2021, the class 1 (soil) excavation of the entire core trench (left, right, and centre sections) was 78 per cent complete, and the class 2 excavation (bedrock) was 74 per cent complete.

Grouting on the left bank core trench floor is complete. The remaining grouting on the left slope of the core trench will recommence once the dam material placements has reached elevation of 410 metres and above to provide access to the remaining sections of the slope.

Grouting on the right bank core trench floor was completed prior to March 31, 2021, allowing for the dam core material to progress once the summer construction season begins. As of March 31, 2021, the contractor had completed 64 out of 76 grouting holes on the slope. Subsequent to the reporting period, the remaining holes were completed to allow for the roller-compacted concrete program to begin with the construction season.

### *Conveyor Belt System*

Upgrades to the conveyor system were completed by March 31, 2021 and works to complete tests on the system in advance of the production season were completed during the reporting period.

## **2.1.2 Infrastructure and Site Operations**

The infrastructure and site operations include construction and operations updates for the quarter for the worker accommodation, debris management on the rivers, and temporary fish passage operations.

### **Worker Accommodation**

The total capacity of the worker accommodation, including camp operations staff, is 2,350.

Since January 2020, BC Hydro and the camp operator have implemented numerous measures to protect employees, contractors and facilities as a result of the COVID-19 pandemic. The changes made at the worker accommodation lodge to increase cleaning and physical distancing continued through the quarter.

Prior to workers boarding flights, all workers continue to be required to complete the B.C. Ministry of Health self-assessment and confirm their results with their employer.

Additionally, every person accessing the site is screened and their temperature is scanned daily at the gate before entering the work site. BC Hydro and its contractors also set up thermal scanners at various exit and entry points in the worker accommodation lodge that are used before workers board crew buses or leave camp to go to other Project work sites. This supports the employers and employees with the required daily self-assessment before reporting to work each day.

BC Hydro continues to implement the protocols mandated by the Provincial Health Authority and the British Columbia Centre for Disease Control for the worker accommodation lodge. The on-site health clinic remained well stocked during the

reporting period with the supplies needed to protect workers in the event of an outbreak.

On December 29, 2020, the Provincial Health Officer posted the *Industrial Projects Restart Order*, limiting the number of workers at five industrial camps in northern B.C., including Site C. Refer to section [3.1.1](#) and section [11.2](#) for further information. BC Hydro prioritized the available camp bed nights while maintaining the operation of the worker accommodation facility to the extent possible, in compliance with the Order.

### **Debris Management**

There are four debris retention structures on the Moberly and Peace Rivers that provide coverage for all head pond elevations to capture and prevent debris from entering the diversion tunnels. Debris management is seasonal with activities from approximately April to November each year and no activities over the winter season (approximately December to March).

During the quarter, there was no active debris management given the winter season. The debris management contractor returned to site at the end of March 2021 to begin debris management. The contractor performed maintenance on the BC Hydro Peace River boom prior to returning it to service for the season, and subsequent to the reporting period in early April 2021, strung the boom across the Peace River.

### **Temporary Fish Passage**

The temporary fish passage facility is a trap-and-haul facility located on the right bank of the Peace River diversion tunnel outlet channel and provides safe and efficient fish passage from the outlet channel to upstream release locations during the construction of the Project. The operational season for the temporary fish passage is approximately April to October each year and the facility is winterized for the period of October to March. The facility is re-commissioned annually following spring freshet for the duration of the diversion of the Peace River. After reservoir

inundation, fish passage operations will be transferred to the permanent fish passage facility that will be constructed.

In February 2021, work commenced to re-commission and start-up the facility for operations in April 2021.

### **2.1.3 Generating Station and Spillways**

The generating station and spillways scope of work includes the construction of the following major components:

- Generating station and spillways civil works, including:
  - ▶ Powerhouse: Concrete placements, installation of structural steel, and installing hydraulic gates;
  - ▶ Inlet headworks: Concrete placements, construction of the penstocks, and installing hydraulic gates; and
  - ▶ Spillways: Concrete placements and installing hydraulic gates.
- Cranes, which includes the supply and commissioning of the powerhouse cranes, tailrace gantry crane, and headworks gantry crane; and
- Hydromechanical equipment, including the supply of all gates.

Construction progress is taking place in the generating station and spillways civil works, cranes and hydromechanical equipment as described below.

#### **Generating Station and Spillways Civil Works**

The generating station and spillways civil works contract include the delivery of civil works associated with the powerhouse, intakes, penstocks, and spillways. During the quarter, the contractor was impacted by the *Industrial Projects Restart Order*, issued in late December 2020, which required a slow and controlled return of workers to work projects and communities in the north after the holiday period. Refer to section [3.1.1](#) and section [11.2](#) for further information. The contractor has

proposed a schedule to recover the most significant contract milestones. Despite the challenges posed by the COVID-19 pandemic, the contractor started to recover the schedule and exceeded production targets in March 2021. Concrete for the generating station and spillways civil works project is 40 per cent complete.

### *Powerhouse*

Powerhouse concrete is 75 per cent complete. The first stage concrete (the formed concrete foundation of the powerhouse), will be largely complete by May 2021. The second stage concrete (concrete that embeds the turbines and forms the floors) is advancing at a pace to match the turbine and generators contractor's schedule. In May 2021, the contractor will start to remove its infrastructure from the downstream adjacent area (the tail race) to enable the foundation work to proceed on schedule.

### *Intakes Headworks*

Intakes concrete is 50 per cent complete. Intakes 1 and 3 are largely complete. Construction of intakes 2 and 6 are proceeding. Construction of intake 5 will start in April 2021. During the winter, production of the intakes was falling behind plan, but production in April and May 2021 is expected to increase with increased staffing and warmer weather. There is some float in the schedule for the intakes.

### *Penstocks*

As of March 31, 2021, the generating station and spillways contractor has completed 58 per cent of the penstock steel. The steel for penstocks 1 and 2 is complete. penstocks 3 and 6 are proceeding on schedule.

### *Spillways*

The contractor has completed 24 per cent of the spillways concrete and has met the planned production rates through the winter. The concrete work in the spillways stilling basins has been postponed until the foundation enhancement work is

complete in late 2021. The spillway headworks is on the critical path for the generating station and spillways civil works project.

### **Cranes**

Powerhouse bridge cranes were initially commissioned in August 2020. The cranes continue to be commissioned over the length of the powerhouse as the work progresses.

### **Hydromechanical Equipment**

Draft tube gates, intake operating gates, and intake maintenance gates started shipping from Italy in 2020. All of the gates are expected to be at the site by summer of 2021.

#### **2.1.4 Balance of Plant**

The balance of plant procurement has been split into six contract packages and the schedule for the balance of plant work is being aligned with the turbine and generators schedule. The six contract packages include: mechanical, electrical, architectural, heating, ventilation, and air conditioning (**HVAC**) and fire protection. The sixth package is a general contract for the other buildings on the site including the fishway. The mechanical request for proposals was posted to BC Bid on January 22, 2021 and the electrical request for proposals was posted on BC bid on March 19, 2021. Subsequent to the reporting period, BC Hydro received four proposals for the mechanical contract on April 21, 2021. Proposals for the electrical package are expected to be received in June 2021. The remaining four requests for proposals will be posted through 2021.

#### **2.1.5 Turbines and Generators**

The scope of work for turbines and generators includes the complete design, supply, installation, testing and commissioning of six turbines, generators, governors and



exciters. Overall, the design, procurement and manufacturing for the turbines and generators are on schedule.

During the quarter, the contractor's work to assemble and weld embedded turbine components in its temporary manufacturing facility continued and was completed subsequent to the period in April 2021.

The contractor's São Paulo, Brazil, factory will supply most of the turbine and generator components. There are some impacts due to the COVID-19 pandemic, but work is continuing. Meetings regarding manufacturing progress of the turbine and generator components in the São Paulo, Brazil factory are continuing and have been held concurrently with visits by BC Hydro's subcontracted inspection agencies to many of the contractor's subcontractors in the São Paulo area and Europe.

Two turbine runners were shipped from São Paulo, Brazil, and arrived at the Port of Prince Rupert in late 2020. One turbine runner was shipped to site in January 2021 and the second turbine runner was shipped to site in early February 2021.

#### **2.1.6 Transmission and Substation**

The transmission sub-project connects the Site C Project to the BC Hydro transmission system. The scope of work includes the following major components:

- Two 75-kilometre-long, 500 kV transmission lines from the Site C substation to the Peace Canyon generating station;
- Three one-kilometre-long, 500 kV transmission lines from the Site C generating station to the Site C substation;
- A new 500 kV Site C substation; and
- Expansion of the existing Peace Canyon 500 kV Gas Insulated Switchgear to incorporate the two new 500 kV transmission line terminals.

Progress continued on the transmission lines during this reporting period.

The COVID-19 pandemic impacted the transmission and substation activities but work generally continued as planned during this reporting period. The following reflects progress to March 31, 2021.

## **Transmission Towers and Lines**

### *Transmission Lines*

Construction of the second 500 kV transmission line continues and as of the end of March 2021, all 205 of 205 foundations had been completed, 205 of 205 towers had been assembled, and 205 of 205 towers had been installed on foundations.

Stringing of conductors is expected to begin in the summer of 2021.

In total, 405 towers will support the two new 500 kV transmission lines that will connect the Site C substation to the Peace Canyon generating station, over a distance of 75 kilometres.

### **2.1.7 Highway 29 and Hudson's Hope Shoreline Protection Berm**

The creation of the Site C reservoir requires realignment of six segments of Highway 29 totalling approximately 32 kilometres. The scope of the highway realignment includes relocation of existing 25 kV distribution lines adjacent to the highway and the decommissioning of the existing highway. BC Hydro is working with the Ministry of Transportation and Infrastructure on Highway 29 construction. The Highway 29 sub-project also includes the construction of a shoreline protection berm within the District of Hudson's Hope to protect against bank erosion due to reservoir wind waves and water table rise, and the development and operation of the Portage Mountain Quarry, which will supply riprap and filter materials for highway and berm construction. The permanent highway realignment is planned to be completed by spring 2023 to ensure the highway remains accessible once the reservoir is inundated and the dam is operational.

The Highway 29 sub-project is divided into the following components:

- Cache Creek highway realignment and bridge;
- Halfway River highway realignment and bridge;
- Farrell Creek East highway realignment;
- Farrell Creek highway realignment and bridge;
- Dry Creek highway realignment and bridge;
- Lynx Creek highway realignment and bridge;
- Portage Mountain Quarry development and operation; and
- Hudson's Hope shoreline protection berm.

The following reflects progress to March 31, 2021.

### **Cache Creek**

Construction continued on the Cache Creek East segment during the reporting period. Activities included the site preparation for bridge foundations, clearing and stripping of the highway alignment, the diversion of Cache Creek around the future bridge piers, construction of a temporary detour bridge in the event that the existing bridge is impacted by the diversion head pond, and the installation of piles for the bridge foundations.

### **Halfway River**

The Halfway River segment includes the realignment of 3.7 kilometres of highway and the construction of a new one-kilometre long bridge crossing the Halfway River, approximately 500 metres north of the current structure.

The construction of the 1,042-metre-long bridge at Halfway River started in January 2020 and includes the operation of a concrete batch plant, aggregate plant, aggregate pit development, construction of bridge abutments and hauling and stockpiling of materials.

At the end of the reporting period, the contractor had completed the highway grading to 85 per cent, the bridge substructure to 99 per cent and the bridge superstructure to 63 per cent. This included the installation of all 81 bridge steel girders and 264 of 638 pre-cast concrete deck panels.

### **Farrell Creek East**

The Farrell Creek East segment includes the realignment of 8.4 kilometres of highway. Geotechnical studies in 2019 concluded that 5.7 kilometres of this segment could be removed from the scope of work and monitored following the creation of the Site C reservoir, reducing the length of Farrell Creek East realignment work to 2.7 kilometres.

The contractor mobilized clearing equipment to site and completed the clearing of trees and vegetation from the highway right-of-way. Temporary fencing was also installed.

### **Farrell Creek**

The Farrell Creek segment includes the realignment of 1.9 kilometres of highway, including the construction of a new 411-metre-long bridge.

At the end of the reporting period the contractor had cleared the site, including reservoir clearing in the Farrell Creek drainage, established borrow and disposal sites for grading works, installed bridge berms for the bridge foundations, diverted the Farrell Creek around the future bridge piers, and installed 89 per cent of the foundation piles.

### **Dry Creek**

The Dry Creek segment includes the realignment of 1.4 kilometres of highway, including the construction of a new 192-metre-long bridge.

There was no work completed during the reporting period.

### **Lynx Creek**

The Lynx Creek segment includes the realignment of 9.1 kilometres of highway and the construction of a 169-metre-long bridge.

At the end of the reporting period the Lynx Creek contractor had completed all clearing works and had substantially completed the pre-load structure for the bridge causeway. Stripping of the east and west bridge approaches was completed as well as a significant portion of the new highway alignment. Gravel extraction, hauling and placement along the highway alignment was approximately 10 per cent complete.

### **Portage Mountain Quarry**

Portage Mountain Quarry supplies riprap and berm filter materials for various segments of the Highway 29 realignment and construction of the shoreline protection berm in the District of Hudson's Hope.

The quarry contractor completed the construction of a new stockpile area just outside the quarry, which will be used to store material that does not meet specifications.

Blasting operations will resume on May 16, 2021.

### **Hudson's Hope shoreline protection berm**

The Hudson's Hope berm is a 2.6-kilometre shoreline protection berm that will protect the slopes adjacent to the reservoir from erosion.

As of the end of the reporting period, the contractor had completed 55 per cent of the construction of the toe berm, which forms the base of the berm. Activities on site also included stripping and vegetation clearing as well as the crushing and stockpiling of berm fill material.

### 2.1.8 Reservoir<sup>2</sup>

The following reflects progress to March 31, 2021.

#### **Reservoir Clearing**

The reservoir clearing scope of work is divided into two main regions:

- Lower reservoir, Moberly River drainage and eastern reservoir including Cache Creek drainage; and
- Middle reservoir, Halfway River drainage and western reservoir.

Clearing in the lower reservoir, Moberly River drainage, eastern reservoir and middle reservoir up to Halfway River was required to support river diversion. All other clearing is scheduled for completion prior to reservoir inundation.

#### *Lower Reservoir, Moberly River Drainage and Eastern Reservoir including Cache Creek Drainage*

Clearing activities including waste wood disposal occurred in the Moberly River drainage, north and south banks of the eastern reservoir and Cache Creek area over the winter. All clearing and burning activities are now substantially complete for these areas except for some road deactivation works on the south bank of the eastern reservoir and some waste disposal in the Moberly River drainage.

#### *Middle Reservoir, Halfway River Drainage and Western Reservoir*

Clearing activities include burning of waste wood continued between Cache Creek and Halfway River drainage over the fall and winter. By March 31, 2021, clearing was substantially complete though some tree removal, waste wood disposal and road deactivation activities remained on the south bank of the middle reservoir. Some burn piles also remain at the Halfway and Peace rivers confluence. These activities are planned to be completed next winter.

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<sup>2</sup> This section was previously referred to as "Reservoir Clearing".

All clearing activities were completed in the middle and western reservoirs, Halfway River drainage, and an area between Halfway River and Farrell Creek by the end of the reporting period except for some trees that were left for wildlife buffers and on an island near Farrell Creek that had restricted access due to high water flows. Clearing activities will resume in summer 2021 to clear the remaining areas as well as further westward when road conditions are suitable.

### **Other Reservoir Work**

The scope of other reservoir work includes infrastructure relocations and reinforcements as well as environmental mitigation and enhancements works, which are required as part of reservoir filling.

BC Hydro's existing 1L364 transmission line crossing of the Halfway River drainage needs to be relocated prior to inundation. Detailed design work continued over the winter and procurement was initiated for the supply of the steel poles. The procurement for the foundation installation will occur in summer 2021 with construction works planned for next winter.

Preferred locations for fisheries enhancements sites were identified in the eastern and western reservoirs and design work advanced during this reporting period.

Existing oil and gas wells may be impacted by reservoir filling. Assessment on individual well sites continued over the winter and this work is anticipated to continue in the coming months. Consultation with regulatory bodies is occurring.

## **2.2 Engineering**

The Engineering team provides technical support to all aspects of the Project. Through the reporting period, substantial effort was given to support the achievement of the contractor's schedule for both the main civil works and the generating station and spillways civil works contracts, as well as advancing the

selection and design of required foundation enhancements to the structures on the right bank.

### **2.2.1 Main Civil Works**

Support for the main civil works contract continued during the reporting period supporting excavations, grouting and instrumentation of the main dam foundations in preparation for the placement of dam fills in 2021.

Detailed geological mapping of the excavations and instrumentation monitoring continues during construction. This information is used to update the design parameters for the site geology and foundations.

### **2.2.2 Foundation Enhancements**

During the reporting period, value engineering activities continued in support of advancing the design of the foundation enhancement measures required to increase the stability below the powerhouse and spillways.

Value engineering, coupled with cost and schedule optimization analysis, resulted in finalizing the total number of piles required to be installed within the foundation of the spillways and powerhouse. A total of 96 piles are required, which corresponds to 48 piles within the foundation of each structure. The vertical steel and concrete piles are 2.4 metres in diameter and vary in length ranging from 30 to 40 metres.

The piles will extend the function of the spillways and powerhouse buttress roller-compacted concrete shear key a further 15 to 25 metres into the bedrock, to an elevation below the deepest bedding plane where movements have been measured. The depth of the piles assures adequate stability even if weaker planes exist below the level identified; and the fixed nature of the piles will provide added resistance to both the spillways and the powerhouse in the event of a low probability, extreme or unusual event.



Value engineering work continued on the enhancements to improve the water-tightness of the approach channel. Work included optimizing the approach channel's shape, the location and design of the channel's grout curtain and the design of the approach channel's liner. In addition, advancements in value engineering continued for the design of the drainage enhancements required below the approach channel's foundation.

BC Hydro continued to engage the independent dam experts, Technical Advisory Board and other subject matter experts to provide oversight of value engineering activities associated with the design of the foundation enhancements. Refer to section [2.2.6](#) for a summary of Technical Advisory Board meetings and [Appendix E](#) for the reports issued by the independent dam experts and Technical Advisory Board during the first quarter.

### **2.2.3 Large Cranes, Hydromechanical and Turbines and Generators**

Engineering support to construction and manufacturing, as well as vendor submittal review and integration, continued throughout the reporting period for the large cranes, hydromechanical equipment and turbines and generators contracts.

### **Generating Station and Spillways, Balance of Plant and Equipment Supply**

During the reporting period, work focused on the production of record drawings for the powerhouse, along with supporting construction with review of submittals for the powerhouse, intakes, penstocks, and spillways.

For the balance of plant scope of work, engineering focused on preparation and issuance of the technical specifications and issued for proposal drawings for the balance of plant mechanical and electrical request for proposals packages which were both issued to BC Bid in early 2021. The team continues to support the procurement process for the mechanical and electrical request for proposal packages through responding to requests for information, reviewing proposals and other BC Hydro requests. Work also continued on preparation of the technical

specifications and issued for proposal drawings for the four-remaining balance of plant request for proposals packages. The balance of plant team also continued to support the review of the technical submittals and design drawings, factory acceptance testing, and virtual factory visits for the nine equipment supply contracts including the generator terminal equipment, generator circuit breakers, generator step-up transformers, AC station service, DC station service, 500 kV motor operated disconnects, diesel generators, large valves and compressed air receivers contracts.

Engineering design continued to be advanced on the protection and control systems and is on schedule with various protection and control panels now under construction.

Overall, the detailed engineering on the generating station and spillways is complete. This excludes the foundation enhancements design, for which the detailed engineering is approximately 50 per cent complete.

#### **2.2.4 Transmission and Substation**

During the reporting period, engineering support was provided to complete construction of the second 500 kV transmission line foundations and tower installations.

#### **2.2.5 Highway 29**

The 100 per cent detailed design was completed for the Farrell Creek East segment B. The design will be provided to the Ministry of Transportation and Infrastructure for use in the event that impacts are caused by the future Site C reservoir. Engineering support is being provided to the various highway segments and the Hudson's Hope berm as required to progress construction activities.

Design was initiated for the construction of an intersection for a boat launch at Halfway River.

### **2.2.6 Technical Advisory Board**

A series of video conferences occurred from January to March 2021 to review the design and construction of the earthfill dam and foundation enhancements. A report was issued from the Technical Advisory Board in January 2021 on the overall status of the design and provides context for the foundation enhancements. In addition, three reports were issued by the independent experts.

Refer to [Appendix E](#) for the reports issued by the Technical Advisory Board and the independent experts during the reporting period.

## **2.3 Quality Management**

The Project has a quality management plan that outlines activities to ensure materials, equipment and the constructed works meet contract quality requirements. The plan identifies resources and procedures necessary for achieving the quality objectives, roles and responsibilities, and is the framework document for the quality management program.

During the reporting period, the Project team continued its activities to support the Project quality plan, including:

1. Ongoing meetings with the quality management teams of key manufacturers in countries affected by COVID-19;
2. Ongoing meetings with the quality management teams of the site contractors to address quality issues; and
3. Continuing with monthly quality performance indicator assessments for the engineering, manufacturing and construction activities across each sub-project.

The Project team continues to track and manage quality nonconformances. [Table 2](#) summarizes quality nonconformity instances during the reporting period.

**Table 2      Quality Management Nonconformity  
Report (NCRs) Metrics Reporting Period  
– January 2021 to March 2021**

Contract	NCRs Reported January 1, 2021 to March 31, 2021	NCRs Closed January 1, 2021 to March 31, 2021	NCRs Reported to Date	NCRs Closed to Date	NCRs Open as of March 31, 2021
Main Civil Works	17	37	1,826	1,810	16
Turbines and Generators	69 (52+17)	38 (22+16)	442 (406+36)	324 (307+17)	118 (99+19)
Generating Station and Spillways Civil Works	76	73	640	575	65
Large Cranes	3	5	26	26	0
Hydromechanical Equipment	12	12	30	30	0
Transmission	0	0	115	114	1

BC Hydro's ability to travel to participate in equipment inspections and final acceptance tests continues to be restricted due to the COVID-19 pandemic. In order to mitigate the quality risks associated with these restrictions, BC Hydro continues to meet virtually with contractors in affected areas, including the turbines and generators contractor (Brazil) and the hydromechanical equipment contractor (Italy) on a weekly basis to plan upcoming inspections and to coordinate with local quality assurance representatives. For critical components, BC Hydro's local inspectors maintain a full-time equivalent presence in order to monitor the progress and quality of the manufacturing. For selected factory acceptance tests, for example the exciter transformer, BC Hydro participated remotely via video conferencing and data file sharing with the equipment manufacturer. With the implementation of these measures, BC Hydro continues to ensure that quality requirements are satisfied prior to components being shipped.

During the reporting period, the main civil works contractor continued drilling and grouting the main dam foundation. The contractor focussed its efforts on heating and hoarding the foundation in order to maintain the specified ground-temperature parameters for the grouting. BC Hydro and the contractor continue to meet weekly to discuss and resolve open nonconformity reports as well as discuss broader topics related to the contractor's quality performance. BC Hydro continues to work with the contractor to ensure the operational readiness of its on-site materials testing laboratory in advance of the resumption of roller-compacted concrete placement and commencement of materials processing for the main dam.

The quality of the constructed works in the generating station and spillways and intake structures continues to be good. During the reporting period, the contractor focussed its efforts on adjusting the concrete mix design to ensure that the 56-day requirement for compressive strength is achieved, as well as maintaining the heating and hoarding structures over the concrete placements to ensure that the thermal control and wet-curing requirements are achieved during winter conditions.

For the turbines and generators contract, the quality of the components manufactured to date continues to be good. BC Hydro continues to meet with the contractor on a weekly basis to discuss upcoming inspections, quality issues and the overall quality assurance program.

### **3 Safety and Security**

Managing COVID-19 issues in ways that allowed construction activities to continue safely remained a primary focus during this reporting period.

#### **3.1.1 Industrial Projects Restart Order and COVID-19 at Site**

To reduce the risk of increased post-winter holiday transmission of COVID-19 at major projects and local communities in the north, B.C. Provincial Health Officer issued several public health orders in late December 2020 and early January 2021.

one of these orders was the *Industrial Projects Restart Order*, which required a slow and controlled return of workers, and specifically applied to the five major projects in the region, including Site C.

Starting from a reduced baseline number of onsite workers, BC Hydro was asked to submit a Restart Plan that set out how the project would increase worker numbers while managing the risk of COVID-19 transmission. The Site C Restart Plan was submitted in late January 2021 and BC Hydro was able to ramp up gradually throughout late winter and into early spring.

From January to March 2021, the medical clinic saw 453 initial clinic visits for respiratory and gastrointestinal symptoms, and 313 (69 per cent) resulted in the workers being isolated. A total of 221 COVID-19 tests were administered by the onsite clinic. There were 34 confirmed positive cases of COVID-19 on the Project with 25 cases linked to five controlled, onsite clusters.

Subsequent to the reporting period, on April 28, 2021, Northern Health declared an outbreak of COVID-19 at Site C because of an increase in cases at site. This step was taken to ensure the health and safety of employees, contractor workers and members of the public. Work continued on-site and BC Hydro was not directed to shut down the site or stop any work due to the COVID-19 protocols in place.

### **3.1.2 Site C COVID-19 Vaccinations**

In early March 2021, Northern Health launched an industrial projects vaccination initiative and provided the major projects with AstraZeneca / Covishield vaccines. Working with the onsite medical clinic, Site C launched a mass vaccination program on March 19, 2021 and vaccinated 1,430 workers in 10 days before the vaccination program was temporary halted due to federal reviews of the AstraZeneca / Covishield vaccines.

Subsequent to the reporting period, in late May 2021, Northern Health authorized the Site C vaccination program to restart.

### **3.1.3 Security**

Gate C is now fully automated and operational. Permanent security fencing has been installed along with an automated sliding gate. Pedestals with proximity access readers have been installed and control access to workers with a valid site access card. The original security office now houses automated COVID-19 screening equipment and security technologies to enable 24/7 monitoring and alerting.

Working collaboratively with the Site C security services contractor, BC Hydro introduced a new set of service expectations and key performance indicators for the security on the Project. These key performance indicators are relevant and achievable, designed to improve security outcomes and better utilize the security workforce.

### **3.1.4 Summary of Safety and Regulatory Performance Metrics**

From July 2015 through March 2021, all work fronts across the Project had completed almost 32 million work hours, with no fatalities and one permanent partial disabling injury in 2017. In this reporting period, there were five serious safety incidents consisting of four near misses that had the potential to be a serious injury and one serious injury that required medical attention. There were 194 non-serious incidents reported including 48 near misses and 146 low grade injuries that may have required first aid and/or medical attention treatment. A near miss is defined as an incident that could have resulted in an injury but did not because of effective hazard barriers or the person was out of harm's way/missed. BC Hydro considers near miss reporting as indicative of a strong and improving safety culture and is strongly encouraging all Site C contractors and employees to report near misses.

To encourage active learning from safety incidents across all work fronts and contractors, the Project held 22 Safety Incident Reviews in this quarter. Two of the more serious safety incident investigations and corrective actions were reviewed by BC Hydro and contractor senior leaders. Site C construction management and

safety teams reviewed another 20 less-serious incidents as well as safety trends observed in the incidents (e.g., working at heights).

Table 3 below reflects safety and regulatory performance results for the Project, including all contractors and all sub-projects.

**Table 3 Summary of Site C Safety and Regulatory Metrics**

	Reported January 1, 2021 to March 31, 2021 <sup>3</sup>	Reported Since Inception (July 27, 2015 to March 31, 2021) <sup>3</sup>
Fatality <sup>4</sup> Error! Bookmark not defined.	0	0
Permanently Disabling Injury <sup>5</sup>	0	1 <sup>6</sup>
Serious Incidents <sup>7</sup>	5	80
Lost Time Injuries <sup>8</sup>	1	34
All-Injury Incidents <sup>9</sup> (Lost Time Injuries <sup>8</sup> and Medical Attention requiring Treatment <sup>10</sup> )	12	216

<sup>3</sup> Numbers are subject to change due to timing of when data is retrieved and when injury is categorized.

<sup>4</sup> Excludes any non-occupational incidents.

<sup>5</sup> A permanently disabling injury is one in which someone suffers a probable permanent disability.

<sup>6</sup> In June 2018, an injured worker received a permanent partial disability award from WorkSafeBC due to a lost time injury incident in August 2017. The worker was attempting to unload a light plant (tower) from a flatbed truck. The worker stepped on the light plant (tower) outrigger to gain enough height to reach the lifting attachment when the worker lost balance and fell approximately 7.5 feet to the ground. BC Hydro reclassified this incident as a permanent disabling injury after receiving an update on the WorkSafeBC award in June 2018. The incident is identified as a serious injury in the BC Hydro Incident Management System.

<sup>7</sup> Serious incidents are any injury or near miss with a potential for a fatality or serious injury.

<sup>8</sup> Lost time injuries are those where a worker (employee or contractor) misses their next shift (or any subsequent shift) due to a work-related injury / illness. If a worker only misses work on the day of the injury, it is not considered a lost time injury.

<sup>9</sup> All-Injury incidents are work-related medical attention requiring treatment, lost time injuries, and fatalities.

<sup>10</sup> Medical attention requiring treatment is where a medical practitioner has rendered services beyond the level defined as "diagnostic or first aid" and the worker (employee or contractor) was not absent from work after the day of the injury. Services beyond diagnostic / first aid include (but are not limited to) receiving stitches, a prescription, or any treatment plan such as physiotherapy or chiropractic.



There was one lost time injury between January and March 2021, which occurred in poor winter conditions when a worker slipped on ice and injured their foot. This is down from five lost time injuries from the same quarter last year (quarter ending March 31, 2020). There was also a 48 per cent decline of all-injury incidents compared to the same quarter last year. These declines are due in part to a reduction in the workforce due to the *Industrial Projects Restart Order*.

### **3.1.5 Safety Verifications**

In this reporting period, the Site C safety team completed a total of 183 formal, planned safety verifications for the Project (on dam-site and off dam-site) – an average of 61 per month. The closure rate for these 2020 verifications (indicating the number of identified nonconformances addressed) was 94.9 per cent; a continued strong collaboration between the BC Hydro construction and safety teams. Of these 183 safety verifications, 27 per cent were clean sheet verifications, where no nonconformances were found during the verification. Further, 87 per cent of all the safety verifications conducted during the reporting period identified good safety practices even if there were some nonconformances.

### **3.1.6 Regulatory Inspections and Orders**

WorkSafeBC, under the authority of the *Worker's Compensation Act*, is the primary regulator with jurisdiction over safety for the Project. WorkSafeBC oversees all worker safety (employee and contractor) for the Project, both on the dam site and off the dam site. The Ministry of Energy, Mines and Low Carbon Innovation is the regulatory authority for worker safety on any work fronts subject to the *Mines Act*, specifically West Pine Quarry, Portage Mountain Quarry, and Wuthrich Quarry.

From January to March 2021, WorkSafeBC issued 10 regulatory inspection reports and four regulatory orders. The Ministry of Energy, Mines and Low Carbon Innovation did not conduct any regulatory inspections during this period.

Of the 10 inspection reports, seven were 'clean sheets' with no orders. Two of the clean sheets were related to COVID-19. This is a slight improvement from the quarter ended March 31, 2020. Refer to [Appendix B](#), for a list of safety regulatory inspections and orders received from January to March 2021.

In March 2021, the generating station and spillways contractor received an administrative penalty from WorkSafeBC, for the maximum allowed under regulation. This penalty was in response to an incident where a worker was injured after falling about 12.2 metres (40 feet) from a formwork shoring deck in November 2020. Holes had been cut out of the deck to accommodate the installation of future shoring tower components, which had not yet been covered. The worker, who was wearing a fall protection harness but was not connected to a lifeline, was returning from lunch and stepped through one of the unguarded holes. WorkSafeBC observed a number of worker safety high risk violations.

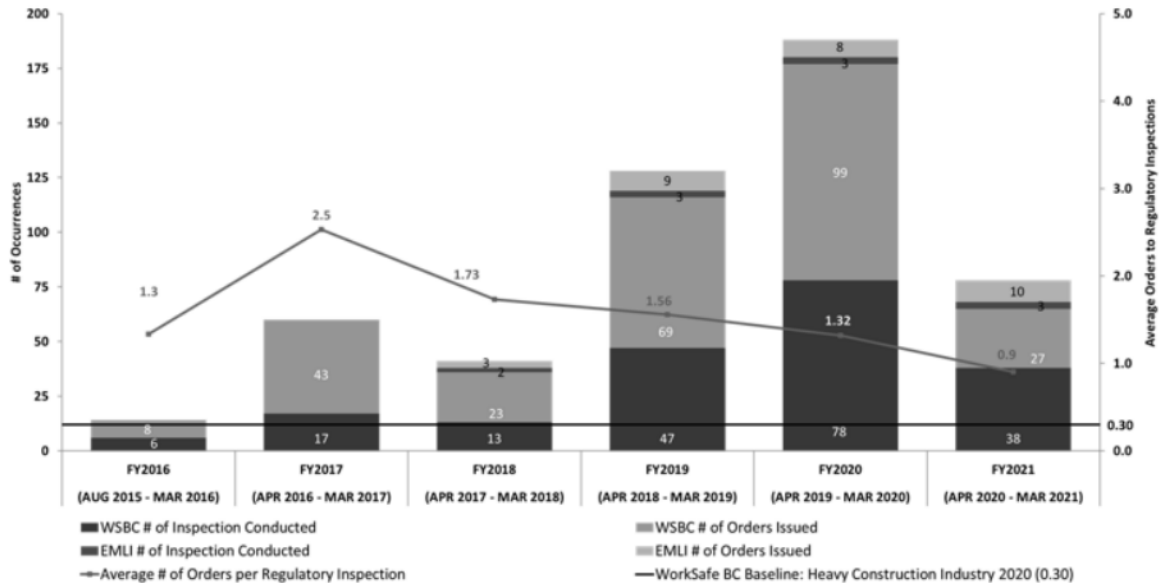
The Project monitors an additional metric – average number of orders per regulatory inspection. Between April 2020 and March 2021, the average number of orders per inspection is 0.90, an improvement from 1.32 orders per inspection in the previous year.

**Table 4                      Safety Regulatory Inspection and Orders**

	<b>Reported January 1, 2021 to March 31, 2021<sup>11</sup></b>	<b>Reported Since Inception (July 27, 2015 to March 31, 2021)</b>
Regulatory Inspections	10	211
Regulatory Orders	4	299

<sup>11</sup> Numbers are subject to change due to timing of when data is retrieved and when injury is categorized.

**Figure 1** Number of Orders to Regulatory Inspections, August 2015 to March 2021



## 4 Project Schedule

### 4.1 Project In-Service Dates

Work to re-baseline the Project began in July 2020. As announced by the Government of B.C. on February 26, 2021, the revised cost estimate to complete Site C is \$16 billion and includes a new expected in-service date of 2025, as a result of the delays and impacts of the COVID-19 pandemic. BC Hydro continues to review the schedule, work closely with contractors to understand the costs and schedule impacts due to COVID-19, and review risks as part of the recommended actions in the Milburn Review. During the quarter, BC Hydro and Site C contractors continued to explore ways in which the work delayed by the COVID-19 pandemic could potentially be accelerated, which, if successful, could result in an earlier in-service date.

Table 5 shows the status of key Project milestones in relation to the new expected in-service date of 2025. The Project schedule continued to be reviewed during the reporting period.

**Table 5 In-Service Dates**

Description	In-Service Dates based on Announcement from Government of B.C. <sup>12</sup>	Status
5L5 500 kV Transmission Line	October 2020	Complete
Site C substation	November 2020	Complete
5L6 500 kV transmission line	July 2023	On track
Unit 1 (first power)	December 2024	On track
Unit 2	February 2025	On track
Unit 3	May 2025	On track
Unit 4	July 2025	On track
Unit 5	September 2025	On track
Unit 6	November 2025	On track

## 5 Project Governance, Costs and Financing, and Risk

### 5.1 Project Governance

On February 26, 2021, the Government of B.C. announced that construction on Site C will continue at a revised estimated cost of \$16 billion and a new expected in-service date of 2025. At the same time, the Government of B.C. released the independent review of the Project by Mr. Milburn resulting in seven recommendations related to Project governance. Measures to improve Project governance during the reporting period include:

- Significant progress has been made on all of Mr. Milburn's recommendations and BC Hydro is working closely with Government to complete their implementation

<sup>12</sup> In-service dates based on Government of British Columbia announcement on February 26, 2021.

including the seven recommendations related to the Project Assurance Board (**PAB**) in areas of composition, skills matrix, meeting structure and time commitments, orientation process and terms of reference;

- EY Canada continues to provide independent oversight for the Project including budget oversight, schedule and commercial management evaluation and risk assessment analysis. BC Hydro and EY Canada are working collaboratively on implementing identified opportunities for improvement;
- BC Hydro completed a cost risk analysis and schedule risk analysis in the first quarter of 2021. During these analyses, BC Hydro worked collaboratively with EY Canada and continues to implement enhancements identified by both EY Canada and Mr. Milburn;
- An Independent Construction Advisor retained by the Project Assurance Board continued to provide advice and opinions on construction planning by major contractors at the dam site;
- The two independent dam experts commissioned by the Site C Project Assurance Board completed their initial assessment of the right bank foundation enhancements and earthfill dam during the quarter, and concluded the right bank foundation enhancements solutions are appropriate and sound, will make the right bank structures safe and serviceable over the long operating life of Site C, and that the earthfill dam can be built safely and meet all Canadian Dam Association dam safety and reliability guidelines. The independent dam safety experts, along with the Technical Advisory Board, will continue to monitor the design and construction of the right bank foundation enhancements and earthfill dam as the work evolves; and
- BC Hydro continued to increase the number of on-site representatives to effectively manage the construction contracts.

## 5.2 Project Budget Summary

In January 2018, the Government of B.C. approved a revised total Project budget of \$10.7 billion, comprised of a \$9.992 billion base budget and \$708 million in Project reserve.

Prior to the COVID-19 pandemic, and since the \$10.7 billion Project budget was approved in February 2018, the Project was managing significant financial pressures due to:

- Amendments to the main civil works contract;
- Additional labour resource requirements;
- First Nations treaty infringement claims and an injunction application;
- Increased costs associated with reservoir clearing, transmission line construction and highway re-alignment work; and
- Additional significant scope and design enhancements to the foundations of the structures on the right bank.

In addition to the above noted financial pressures, an identified Project geological risk materialized on the right bank. BC Hydro identified by early 2020 that significant foundation enhancements were required to increase the stability under the structures on the right bank, including the powerhouse, spillways and future dam core area.

However, prior to the COVID-19 pandemic, the Project remained on schedule for the first generating unit to go into service in late 2023 and a final in-service date in 2024.

The COVID-19 pandemic has created significant pressures on the Project budget and schedule. This is primarily due to the Project not being able to restart and accelerate certain work that was restricted due to the pandemic. In response to the increasing escalation of provincial measures to manage the COVID-19 pandemic, in

March 2020, BC Hydro substantially reduced the number of workers in the worker accommodation lodge, which resulted in fewer workers travelling to and from Fort St. John and the Peace Region. This impacted construction activities on Site C as the work on the construction site was scaled back to only those activities that were critical to achieve river diversion and essential services, such as site safety and security and environmental protection. This decision resulted in a reduction of the work force staying at site by about 50 per cent. In May 2020, BC Hydro began safely increasing camp capacity and consequent construction activities at Site C in a gradual phased approach. In December 2020 and January 2021, several public health orders were issued to limit the number of onsite workers in January 2021 to reduce the risk of increased post-winter holiday transmission of COVID-19.

BC Hydro commenced work to re-baseline the Project budget starting in July 2020. This process included completing a detailed review of base budgets, remaining work and risks and included the review and input from the independent oversight advisor, EY Canada.

As announced on February 26, 2021 by the Government of B.C., the revised Project cost estimate is \$16 billion. BC Hydro continues to review the revised cost estimate, along with risks, further to the recommended actions in the Milburn Review. The revised project cost estimate was not yet approved by Government during the reporting period.

Table 6 below provides a comparison between the previous Project budget to the revised cost estimate of \$16 billion.

**Table 6      Previous Project Budget compared to  
Revised Project Cost Estimate (\$ million)**

Description	Previous Budget	Revised Project Cost Estimate	Change
Dam, Power Facilities and Associated Structures and Transmission (Note 1)	4,548	8,258	3,710
Offsite Works, Direct Construction Supervision and Site Services (Note 2)	1,845	2,895	1,050
<b>Total Direct Construction Cost</b>	<b>6,393</b>	<b>11,153</b>	<b>4,760</b>
Indirect Costs (Note 3)	1,456	2,082	626
<b>Total Construction and Indirect Costs</b>	<b>7,849</b>	<b>13,235</b>	<b>5,386</b>
Interest During Construction	1,285	2,028	743
Contingency / Reserve	1,566	737	(829)
<b>Total</b>	<b>10,700</b>	<b>16,000</b>	<b>5,300</b>

Note 1: Key items included are river diversion infrastructure, earthfill dam and related works, spillways, powerhouse, generation equipment and transmission and substation work.

Note 2: Key items included are highway re-alignment and reservoir related work, direct construction supervision, and site services such as workers accommodation.

Note 3: Key items included are mitigation and compensation programs, development and regulatory costs, project management, engineering and other support services such as project controls, contracts management, environmental, and Indigenous relations.

The one-year delay due to the COVID-19 pandemic and other costs associated with COVID-19 are the single largest driver to the increase in the cost estimate followed by the additional costs for the foundation enhancement measures. In addition, prior to COVID-19, the Project was managing significant financial pressures due to amendments to the main civil works contract; additional labour resource requirements; increased costs associated with reservoir clearing, transmission line construction and highway re-alignment work.

The key project risks that remain and continue to be assessed include the continuation of the COVID-19 pandemic and the potential impacts to on-site construction activities; commercial negotiations with contractors; design finalization for the foundation enhancements and related procurements; the procurement for the



balance of plant contracts; and the ability of the Project to attract and retain sufficient skilled workers.

### 5.3 Project Expenditure Summary

As of March 31, 2021, the life-to-date expenditures on the Project was \$6.867 billion. [Table 7](#) below provides a summary of the 2020/21 to 2022/23 Service Plan Project expenditures for Fiscal 2021, the actual Project expenditures for Fiscal 2021 and the related variance.

**Table 7**      **Actual Fiscal 2021 Project Expenditures  
Compared to 2021/22 to 2023/24 Service  
Plan (\$ million Nominal)**

Description	2021/22 to 2023/24 Service Plan March 2021 YTD	Actual Expenditures March 2021 YTD	Variance
Total Project	1,646	1,740	(94)

Details of the variances between actual and plan are in [Appendix H](#).

### 5.4 Internal Project Financing versus External Borrowings to Date

To date, all Project funding has been from internal borrowings and there has been no Site C Project-specific debt issued. As part of BC Hydro's debt management strategy, BC Hydro's exposure to variable debt is managed within a board approved range of 5 per cent to 25 per cent and a target of 15 per cent.

## 5.5 Material Project Risks

Material Project risks are identified and reviewed on an ongoing basis. As the Project progresses through implementation phase, the material Project risks will evolve to reflect the current risks facing the Project.

During the reporting period and in response to recommendations from the Milburn Review, the criteria for selecting those risks for inclusion in internal and external reporting were updated. The criteria include both objective and subjective measures, and these criteria have been utilized to select the risks included in the list below.

Refer to [Table 8](#) below for a list of the material Project risks as of March 31, 2021.

**Table 8 Material Project Risks**

Risk Description	Impact and Response Plan Summary
Risk that COVID-19 event impacts continuation of construction activities at site or in Vancouver.	<p><b>Impact:</b> BC Hydro and contractors do not have access to the required labour for daily construction and project management activities. BC Hydro and contractor costs increase to respond to COVID-19 and schedule delay impacts; camp capacity reduction and/or shutdown due to COVID-19 outbreaks.</p> <p><b>Response:</b> Minimize non-essential travel to site. Screen workers before they travel to site and at site before entry; implement camp mitigation measures (additional cleaning, closed cafeteria self serve stations, establish isolation wings); put in place BC Hydro and contractor worker protection exposure protocols and plans.</p>
Risk that union raiding, organizing, or other union conflicts impact site work.	<p><b>Impact:</b> Schedule delay, low productivity and morale, and increased legal fees.</p> <p><b>Responses:</b> Implement labour stability terms in commercial contracts; execute security plans if on site disruption occurs</p>
Risk that the Project cannot attract and retain sufficient skilled workers.	<p><b>Impact:</b> Contractors may not be able to adequately source, supply, attract, and retain sufficient project labour due to workforce demographics, increased competition for labour from other major projects, the requirement for specialized workers, and the effects of COVID-19. This may result in potential impacts to schedule, safety, productivity and cost.</p> <p><b>Response:</b> Contractors provide labour sourcing and supply plans, provide advance notice of foreign workers, and participate in local job fairs. BC Hydro encourages and facilitates capacity building initiatives and monitors employee turnover rates and labour conditions on other projects.</p>

Risk Description	Impact and Response Plan Summary
Risk that increased interest rates and changes in expenditure timing increases borrowing costs.	<p><b>Impact:</b> Rising interest rates and changes in expenditure timing result in an increase to the Project's interest costs above the amount budgeted.</p> <p><b>Response:</b> Implement interest rate hedging program for future debt placements to reduce the potential impact of rising interest rates. Monitor changes to expenditure timing.</p>
Risk of contractor claims.	<p><b>Impact:</b> Increased construction management and contract management effort required to respond and investigate claims; settlement of claims may result in increased costs.</p> <p><b>Response:</b> Ensure sufficient commercial management resources in place, proactively resolve claims as received, and ensure commercial management procedures are in place.</p>
Risk of a safety incident resulting in a fatality or disabling injury.	<p><b>Impact:</b> Serious worker injury or fatality; project delays and associated costs.</p> <p><b>Response:</b> Continue with BC Hydro and contractor safety steering committee to address shared safety issues and opportunities; BC Hydro and contractors have implemented safety cultural leadership training; increase BC Hydro executive involvement and engagement with site safety leadership; regularly hold on site safety conferences; continue to include safety in BC Hydro and contractor on boarding orientations; and continue to promote a strong safety culture.</p>
Risk of earthfill dam construction delays due to instrumentation installations.	<p><b>Impact:</b> Earthfill dam construction is delayed awaiting the installation of instruments; Instruments are non-functional and/or damaged.</p> <p><b>Response:</b> Close oversight of the main civil works contractor's current effort to self perform work; main civil works contractor refining/training personnel and drilling techniques/equipment; communicating to main civil works contractor the importance of instrumentation and scheduling to mitigate delays.</p>
Risk of a slope failure on transmission right-of-way above the Site C substation.	<p><b>Impact:</b> Slope failure on the transmission line right-of-way above the substation. Costs to repair transmission lines and substation.</p> <p><b>Response:</b> Conduct geotechnical investigations, install additional instrumentation, and implement recommended slope failure mitigation measures.</p>
Risk of erosion of the outlet riprap material.	<p><b>Impact:</b> Cost of remediation; schedule delay and potential generation flow restriction on G.M. Shrum and Peace Canyon generation stations.</p> <p><b>Response:</b> Complete both temporary and permanent solutions to prevent erosion. Monitor outlet area for any signs of erosion.</p>
Risk of procurement uncertainty for the right bank foundation enhancement work.	<p><b>Impact:</b> Existing contractors' scope of work and schedule impacted by potential new right bank foundation enhancement contractor interfaces.</p> <p><b>Response:</b> Rely on change schedule terms of existing contracts to proceed with change orders for the right bank foundation enhancement work scope, and if agreement can't be reached, proceed with an open procurement process.</p>

Risk Description	Impact and Response Plan Summary
Risk of lack of access to intake deck impacts transmission lines from generating station to substation.	<p><b>Impact:</b> Delays to transmission lines in-service date and turbine-generator unit 1 in-service date</p> <p><b>Response:</b> Work with interface management and construction management to update the schedule to ensure the transmission lines are available when required. Develop plan to complete the work and resolve any potential lack of access to the intake deck.</p>

### 5.5.1 Safety Performance Frequency Metrics

To assess safety performance over time, the Project considers key safety metrics in the context of the total amount of hours worked (frequency) which corrects for the volume of work. [Table 9](#) below summarizes these key safety frequencies by quarter for a rolling 12-month average.

**Table 9** Summary of Safety Performance Frequency Metrics

	Fiscal 2020 April 2019 – March 2020 (Rolling 12-Month Average)				Fiscal 2021 April 2020 – March 2021 (Rolling 12-Month Average)			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Serious Incident Frequency	0.43	0.39	0.53	0.53	0.55	0.62	0.48	0.48
Lost Time Injury Frequency	0.23	0.18	0.14	0.22	0.23	0.21	0.21	0.12
All Injury Frequency	1.03	1.44	1.68	1.93	1.92	1.46	1.33	1.14

Fiscal 2021 Q4 will be updated when information is available.

Comparing results from the quarter ended March 31, 2020 to the quarter ended March 31, 2021, indicates all safety performance frequencies (serious incident, lost time injury and all-injury) have decreased. These declines are due in part to a reduction in the workforce due to the *Industrial Projects Restart Order* (reduced workforce during this reporting period).

The serious incident frequency for January to March 2021 is 0.48, a slight but not significant decrease compared to 0.53 for the same period in 2020. Lost time injury

frequency this quarter is 0.12, a significant decrease compared to 0.22 from the same quarter last year. Finally, all-injury frequency is at 1.14 this quarter, a 41 per cent decrease compared to 1.92 for the same quarter last year; the decrease was in medical attention injuries.

## 6 Key Procurement and Contract Developments

### 6.1 Key Procurement

The procurement approach was approved by the board of directors in June 2012 for the construction of the Project. The procurement approach defined the scope of the major contracts and their delivery models. The remaining procurements on the Project are summarized in Table 10 below.

**Table 10 Remaining Major Project Contracts and Delivery Models**

Component	Contract	Procurement Model	Anticipated Timing
Reservoir/ Transmission Clearing	Multiple reservoir clearing contracts to be awarded over seven to eight years	Design-Bid-Build	Fifteen contracts completed (reservoir 13, transmission two). Three reservoir access and clearing contract packages remain to be procured; the final number will depend on the scope of each package.
Generating Station and Spillways	Balance of Plant – Mechanical contract	Design-Bid-Build	Request for proposals closed in April 2021
	Balance of Plant – Electrical contract	Design-Bid-Build	Request for proposals was posted in March 2021
	Balance of Plant – Architectural contract	Design-Bid-Build	Request for proposals scheduled to be posted in June 2021
	Balance of Plant – Permanent upstream fishway and other out structures	Design-Bid-Build	Request for proposals scheduled to be posted in July 2021
	Balance of Plant – Fire detection and protection contract	Design-Build	Request for proposals scheduled to be posted in August 2021

Component	Contract	Procurement Model	Anticipated Timing
	Balance of Plant – Heating, ventilation and air conditioning contract	Design-Build	Request for proposals scheduled to be posted in September 2021

## 6.2 Major Construction Contracts Exceeding \$50 million

Since inception of the Project, 10 major construction contracts have been awarded that exceed \$50 million in value, as shown in [Table 11](#).

All of the construction contracts have been procured and awarded as per BC Hydro procurement policies.

**Table 11 Major Project Contracts Awarded**

Work Package	Contract Value at March 31, 2021 <sup>13</sup> (\$ million)	Contract Execution Date
Site Preparation: North Bank	60	July 2015
Worker Accommodation	551	September 2015
Main Civil Works	2,671	December 2015
Turbines and Generators	464	March 2016
Transmission and Clearing	80	October 2016
Quarry and Clearing	101	February 2017
Generating Station and Spillways Civil Works	1,809	March 2018
Hydromechanical Equipment	70	April 2018
Transmission Line Construction	137	May 2018
Highway 29	377	October 2019

## 6.3 Contracts Exceeding \$10 million

For open contracts procured and awarded in excess of \$10 million, refer to [Appendix F](#).

<sup>13</sup> Contract value reflects the current value including executed change orders to the end of the reporting period.

## **6.4 Contract Management**

### **6.4.1 Material Changes to the Major Contracts**

The main civil works contract is a unit price contract and as such variations in quantities and design are expected over the term of the contract. Since contract award in December 2015, the main civil works contract value has increased by \$924 million to reflect approved changes to March 31, 2021. This increase in contract value is primarily the result of a number of contract amendments since contract award in 2015 including two larger contract amendments, one in 2018 and the second in March 2020.

The generating station and spillways contract is also a unit price contract and as such variations in quantities and design are expected over the term of the contract. Since contract award in March 2018, the generating station and spillways contract value has increased by \$205 million to reflect approved changes to March 31, 2021.

## **7 First Nations Consultation**

Pursuant to the Environmental Assessment Certificate and Federal Decision Statement, BC Hydro is required to consult with 13 Indigenous groups with respect to the construction stage of the Project. This consultation includes provision of information on construction activities, support for the permit review process, and review and implementation of mitigation, monitoring and management plans, and permit conditions.

Accommodation offers were originally extended to 10 First Nations communities. Seven agreements have been fully executed and are in various stages of implementation. In February 2019, the Government of B.C., BC Hydro, West Moberly First Nations and Prophet River First Nation agreed to enter into confidential discussions to seek alternatives to litigation related to the Site C Project. West Moberly First Nations withdrew from the discussions in August 2019 and filed an amended Notice of Civil Claim in September 2019. The Government of B.C. and

BC Hydro have since negotiated an agreement with Prophet River First Nation to settle this litigation, which was publicly announced in August 2020. To date, Impact Benefits Agreements with McLeod Lake Indian Band, Doig River, Halfway River, Prophet River, and Saulteau First Nations, and Project Agreements with Dene Tha' and Duncan's First Nations have been publicly announced.

Diversion readiness, headpond, Highway 29, mitigation, and monitoring engagement activities were adapted in light of the COVID-19 pandemic, including continuation of the Environment Forum and the Culture and Heritage Resources Committee, primarily by video conference. Modified community engagement events were organized for several Nations. Most of the Nations have also participated in COVID-19 modified site tours. Additional communication materials, including videos and social media, have also been developed to support ongoing information sharing. Consultation is ongoing with impacted First Nations regarding options and site-specific plans for identified burial and cultural sites impacted by reservoir inundation, in particular in the Halfway River and Cache Creek Bear Flats areas. The cultural monitoring program continues with First Nations monitors observing Project construction at Highway 29 locations as well as environmental enhancement and mitigation programs. Due to the B.C.'s Provincial Health Officer public health order restricting numbers at the dam site, the cultural monitors will not be on the dam site until further notice.

In October 2020, in collaboration with the Project's Cultural and Heritage Resources Committee, BC Hydro launched a new interactive travelling exhibit that tells the story of Indigenous peoples in the Peace Region. During the reporting period, the exhibit was set up at the Fort St. John museum and the Site C camp and will resume travel to communities once COVID-19 health orders are lifted.

The exhibit describes past use of the Peace Valley area, tells stories from various communities, and commemorates sites that will be lost to inundation from the future



Site C reservoir. It includes important archaeological evidence uncovered from the Site C construction area, which spans from 12,500 years ago until the recent past.

s.13; s.16

## 8 Litigation

The details of open proceedings as of March 31, 2021 are summarized in [Table 12](#) below.

**Table 12 Litigation Status Summary**

Description		Date
<b>B.C. Supreme Court: Treaty Infringement Claim</b>		
West Moberly First Nations	Civil claim filed	January 15, 2018
	Injunction application filed	January 31, 2018
	Injunction hearing date	July 23 to August 3, 2018 and September 4 to 7, 2018
	Injunction denied (no appeal filed)	October 24, 2018
	Amended civil claim filed	September 25, 2019
	Scheduled trial date	March 2022
<b>B.C. Supreme Court: Civil Claims</b>		
Building and Construction Trades Council	Civil claim filed	March 2, 2015
	Response to claim filed	April 10, 2015
	No steps have been taken in litigation that require a response from BC Hydro.	
Michael Acko, etal	Civil claim filed	January 18, 2021
(residents of Old Fort community)	Claim is being reviewed by legal counsel and a response will be filed in due course.	

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Description		Date
Allianz Global Risks US Insurance Company, et al	Civil claim filed  Claim was filed by BC Hydro to preserve BC Hydro's rights to claim under the Site C property insurance policy.	February 5, 2021
<b>B.C. Supreme Court: Civil Claims – Expropriation Act</b>		
Joy Ross	Notices of claim filed to keep open plaintiffs' rights to claim further compensation under the <i>Expropriation Act</i> .  Further appraisal and other reports are required prior to commencing settlement negotiations in all but one claim, where a further appraisal has been completed and settlement negotiations commenced.  No requirement for BC Hydro to file responses at this time.	July 22, 2019
Chipmunk Holding Ltd., et al		July 22, 2019
Sam and Judy Mahood		July 22, 2019
Gordon and Heather Kelly		May 13, 2020
Derrek Beam		September 22, 2020
Ken and Arlene Boon		January 15, 2021
Caroline Bentley		January 15, 2021
Dale and Clara London		January 15, 2021
Carla Salmond		January 15, 2021
Lloyd Bentley, et al		January 15, 2021
Hudson's Hope Historical Society		March 18, 2021
Hudson's Hope Holdings Ltd.		March 26, 2021
Beverley and Bob Bach		March 26, 2021

## **9 Permits and Government Agency Approvals**

### **9.1 Background**

Before the Site C Project could start construction, an extensive environmental assessment process was undertaken which resulted in the issuance of the Provincial Environmental Assessment Certificate and the Federal Decision Statement in support of the Project. In addition, the Project is required to apply for multiple provincial permits, water licences, leaves to commence construction and federal authorizations. Timing of the application for these permits and authorizations is staged and aligned with the construction schedule, availability of detailed design information, and by Project component. Permitting approaches and requirements are also determined through regular meetings with regulatory agencies and are subject to change throughout the Project. As at March 31, 2021, BC Hydro estimates that approximately 600 permits will be required throughout the life of the Project. Of these permits, 481 have been received and are actively being managed.

Multiple conditions are attached to each permit or authorization, which cover subjects such as air quality, water quality, fish and aquatics, wildlife, heritage, health and safety, construction environmental management and First Nations consultation. As of March 31, 2021, all required conditions and submissions have been met in accordance with the schedule and requirements of the conditions.

### **9.2 Federal Authorizations**

Federal authorizations are required under the *Fisheries Act* (Fisheries and Oceans Canada) and the *Navigation Protection Act* (Transport Canada). All major federal authorizations for construction and operation of the Site C dam and reservoir were received in July 2016. As of March 31, 2021, one additional *Fisheries Act* authorizations is anticipated for the temporary placement of fill material immediately downstream of the downstream cofferdam. Additional *Canadian Navigable Waters Act* (formerly *Navigation Protection Act*) approvals for discrete works in the reservoir

(e.g., shoreline works, debris booms and Highway 29 bridges) are anticipated to be issued at the regional level. As of March 31, 2021, a total of 95 federal approvals have been received and are actively being managed. Thirty future approvals are planned.

### **9.3 Provincial Permits**

Site C requires provincial permits primarily under the *Land Act*, *Water Sustainability Act*, *Forest Act*, *Wildlife Act*, *Heritage Conservation Act*, and *Mines Act*. These permits include investigative permits, licences to occupy land, water licence approvals, leaves to commence construction and leaves to construct, and licences to cut vegetation, among others.

Approximately 475 provincial permits and approvals will be required throughout the life of the Project. As of March 31, 2021, 386 permits have been obtained and are actively being managed. These include permits for the dam site, worker accommodation, Highway 29 realignment, transmission line and eastern and middle reservoir clearing. Future provincial permits are being planned for western reservoir clearing and the remainder of the generating station construction, reservoir filling and operations. All future permits are anticipated to be issued in accordance with the Project construction schedule.

### **9.4 Environmental Assessment Certificate**

Compliance with the Project conditions in the Environmental Assessment Certificate is regularly monitored, and evidence is collected by various federal and provincial regulatory agencies, the Independent Environmental Monitor, BC Hydro and contractors.

On March 16, 2021, BC Hydro submitted a draft Environmental Assessment Certificate amendment request to the Environmental Assessment Office regarding the use of haul trucks on a contingency basis to transport till material from 85<sup>th</sup> Avenue Industrial Lands to the dam site area. Prior to submitting the final

submission in June 2021, BC Hydro engaged with local governments, First Nations and local residents on the proposed activity and responded to concerns. A decision is expected in the fall of 2021. Hauling will comply with all requirements for the use of public roadways.

All amendments and amendment requests are posted on the Environmental Assessment Office website.

As with any large construction project, refinements to the design are expected. There are no material impacts to the cost of the Project as a result of the proposed amendment requests.

## **9.5 Permitting Improvement**

To efficiently and effectively manage the large volume of permits required for the Project, BC Hydro continues to engage with regulators, Indigenous groups, and contractors to share information, seek feedback, and identify process improvements. Process improvements implemented in the quarter ending March 31, 2021 include the following:

- BC Hydro continues to facilitate meetings with the Ministry of Forests, Lands, Natural Resource Operations and Rural Development, the Comptroller of Water Rights, the Department of Fisheries and Oceans and contractors to ensure permit applications are coordinated, timely and sufficient;
- BC Hydro has implemented a coordinated Indigenous groups consultation process with the Ministry of Forest, Lands, Natural Resource Operations and Rural Development to assist with the government permit workload; and
- Regular permitting forums are being held with Indigenous groups to share information on upcoming permit applications and to seek feedback before applications are submitted to regulators. Given progress on provincial permit applications, smaller bundles of permits may also be reviewed with Indigenous

groups at Environmental Forums. Permits were discussed at two environmental forums held during this quarter: January 18, 2021 and March 9, 2021.

## **10 Environment**

### **10.1 Mitigation, Monitoring and Management Plans**

The Environmental Assessment Certificate and Federal Decision Statement conditions require the development of environmental management, mitigation and monitoring plans, as well as the submission of annual reports on some of these plans.

Focus remains on minimizing sediment and erosion across the dam site, care of water, hydrocarbon management and invasive weed control. Given the size of the Project and the length of construction, wildlife is becoming less wary of the site. As such, wildlife attractant management continues to be a focus.

On the left bank, all care-of-water systems performed well during spring melt, re-vegetation is established in many areas of the site, and the temporary fish passage facility was opened for the season as well as a contingency “trap and haul” program established.

On the right bank, the water treatment plant and holding ponds to treat potentially acid generating rock contact water were fully operational throughout the reporting period.

Throughout the winter, wildlife installations were paused and will resume this coming season. Wildlife sweeps of the area for any potential project interactions with burn piles and active construction continue regularly and appropriate mitigation or avoidance practices established. Burn piles with wildlife denning established are not ignited and will be addressed in the next burn season. A beaver radio telemetry study to track beavers affected by the winter 2020/21 head pond was completed with reporting of results expected in the next reporting period.

The Wildlife and Vegetation and Technical Committee has agreed that BC Hydro can use rehabilitation of aging wetlands as part of the overall wetland compensation program.

Air quality, water, noise and light monitoring were undertaken within the Hudson's Hope area related to works within the berm and along the truck haul route. Air quality overall for the region was observed to be problematic at times. However, point monitoring at the roadways and along the berm did not identify air quality exceedances coming from the Site C works. Additionally, noise monitoring along the roadways determined that Project related traffic noise was similar to ambient traffic noise. Environmental staff continue to monitor the area and work with inspectors from the Environmental Assessment Office.

Care-of-water systems within the till conveyor performed well over the reporting period.

## **10.2 Environmental Compliance Inspections and Enforcement**

During the reporting period, the Project was inspected by the Independent Environmental Monitor and provincial regulators from the B.C. Environmental Assessment Office, who performed more than 430 hours of inspections.

Throughout the course of the onsite inspections, environmental compliance was focused on the following areas:

- Equipment spill/leak monitoring. BC Hydro continues to promptly identify the presence of leaks and spills on equipment and report the findings in daily logs. Further actions to address issues include continuing to utilize spill pads and drip trays, and monitoring of equipment with appropriate storage and disposal;
- Erosion prevention and sediment control along the River Road ditch line and a former main civil works contractor access road. Repairs have been completed along the River Road ditch line and temporary measures are being put in place

for the access road. BC Hydro continues to monitor and apply appropriate erosion and sediment control measures;

- Dust control and prevention within the Hudson Hope berm and Portage Mountain Quarry areas. BC Hydro continues to work with contractors regarding dust mitigation/monitoring and assessment of dust-generating activities. Such measures, currently in place, include usage of 'skeleton' buckets, water trucks, and the dispatch of a consulting occupational health and safety inspector to use a handheld device to measure dust; and
- Noise monitoring and control within the Hudson Hope berm area. BC Hydro has continued to work with the surrounding community regarding site specific details and have addressed any related issues.

BC Hydro completed over 9,000 environmental compliance inspections in the reporting period, with a compliant or partial compliant result of 99 per cent across all contractors and works areas.

Site C Project staff continues to meet with provincial regulators to ensure ongoing focus and attention to the areas of most importance and concern for the regulators, and to proactively address any environmental or regulatory issues that may arise.

Additionally, the Project has engaged both an Independent Environmental Monitor and an Independent Engineer that report directly to provincial regulators. The Independent Environmental Monitor provides weekly reports that have also demonstrated substantial compliance across the Project while continuing to identify areas of focus for sediment and erosion control, water management and spill prevention. The Independent Engineer works directly with site staff to proactively identify design issues that may impact the environment and develop mitigation plans to avoid or minimize impacts.



### **10.3 Heritage**

In accordance with Environmental Assessment Certificate and Federal Decision Statement conditions, the Site C Heritage Resources Management Plan addresses the measures that will be used to mitigate the adverse effects of the Project on heritage resources.

In the period January to March 2021, the heritage program focused on reporting associated with the past year's activities, including field work that met regulatory requirements for pre-construction archaeological impact assessments and systematic data recovery at selected archaeological sites, as well as providing Project construction support.

Heritage reporting included the submittal of 10 archaeological interim reports and two archaeological annual reports for 2020 work to the B.C. Archaeology Branch and Indigenous groups in accordance with *Heritage Conservation Act* permit terms and conditions. One palaeontological chance find report for 2020 was submitted to the B.C. Archaeology Branch and the B.C. Heritage Branch. In addition, the Heritage Resources Management Plan 2020 Annual Report was submitted to regulators in accordance with Environmental Assessment Certificate and Federal Decision Statement conditions.

Heritage reviews of contract documents, contractor environmental plans and construction readiness plans, as well as construction-related field inspections at archaeological sites were performed to ensure compliance. Additionally, two heritage chance finds with significance were reported.

### **10.4 Agricultural Mitigation and Compensation Plan Framework**

As part of the Site C Agricultural Mitigation and Compensation Plan, BC Hydro has established a \$20 million BC Hydro Peace Agricultural Compensation Fund to support agricultural production and related economic activity in the Peace Region. The fund is governed by a regional decision-making board made up of

representatives from five regional agricultural organizations, the Peace River Regional District, three agricultural producer members-at-large and one Peace River Valley agricultural producer. Northern Development Initiative Trust is the fund administrator and manages the investment of the funds.

As of March 2021, \$771,319 in funding has been approved for 33 projects. The Board established a grant budget of \$750,000 for 2021. A second grant intake is planned for early fall.

## 11 Employment and Training Initiatives and Building Capacity Initiatives

### 11.1 Labour

To date, unions that have participated in the construction of Site C are listed in [Table 13](#) below.

**Table 13 Participating Unions**

Union
Construction Maintenance and Allied Workers (CMAW)
Christian Labour Association of Canada (CLAC), local 68
Canada West Construction Union (CWU)
Construction and Specialized workers Union (CSWU), local 1611
International Union of Operating Engineers (IUOE), local 115
Millwrights Union local 2736
Ironworkers, local 97
International Brotherhood of Electrical Workers (IBEW)
MoveUP, local 378
Pile Drivers 2402
Boilermakers, lodge 359
United Association of Journeymen & Apprentices of the Plumbing & Pipefitting Industry of the U.S. & Canada, local 170
Teamsters, local 213

In addition, unions affiliated with the BC Building Trades will be working on the installation of the turbines and generators.

The labour approach for the Site C balance of plant contracts will be for the contractors to retain the Construction Labour Relations Association to enter into an agreement, with the Bargaining Council of B.C. Building Trades Unions or another consortium of Building Trades Unions that covers an agreed set of labour requirements.

### **11.2 Labour Update on Scaled Back Activities at Dam Site due to COVID-19 Pandemic**

BC Hydro continues to provide updates to key project unions on site regarding information that is being shared with workers, the latest number of people in camp in isolation, and the status of COVID-19 testing results.

In late December 2020, the Provincial Health Officer posted the *Industrial Projects Restart Order* for several large-scale industrial camps to help slow down the number of workers returning to work following the holiday season.

For Site C, the maximum number of people that could be physically working at site in late January 2021 (both at camp and locally) was approximately 1,500 people.

In early January 2021, the Provincial Health Officer updated the *Industrial Projects Restart Order* to include the requirement for camp workers to remain in camp during their shift rotation. BC Hydro and its contractors are working with the workforce to implement this order. Exemptions are granted for work-related reasons, medical emergencies and critical appointments.

### **11.3 Employment**

Contractors submit monthly workforce data electronically to BC Hydro. [Table 14](#) presents the monthly number of construction contractors, non-construction contractors, engineers, and Project team workers for this period. As with any

construction project, the number of workers – and the proportion from any particular location – will vary month-to-month and also reflects the seasonal nature of construction work.

**Table 14 Site C Jobs Snapshot Reporting Period –  
January 2021 to March 2021**

Month	Number of B.C. Primary Residents <sup>14</sup>	Total Number of Workers <sup>15</sup>
January 2021	2,862	3,852
February 2021	2,840	3,877
March 2021	3,134	4,321

In March 2021, there were 4,321 total workers on the Site C project.

Seventy-three per cent (3,134 workers) of the workforce was made up of residents of British Columbia, while 25 per cent (900 workers) of the workforce lived in the Peace River Regional District. The on-site contractor workforce number also includes 13 per cent women (474 workers) and 143 workers who are working for various contractors as apprentice carpenters, electricians, millwrights, ironworkers, mechanics, boilermakers and heavy equipment operators.

Figure 2 below shows the monthly Site C workforce over the period March 2020 to March 2021 and illustrates the impact of the COVID-19 pandemic on the workforce. The initial reduction of the workforce at site occurred in mid-March 2020 and the slow ramp up of the workforce started at the end of May 2020. The *Industrial Projects Restart Order*, which limited workers returning to site in January and

<sup>14</sup> Employment numbers provided by Site C contractors and consultants are subject to revision. Data not received by the Project deadline may not be included in the above numbers. Employment numbers are direct only and do not capture indirect or induced employment.

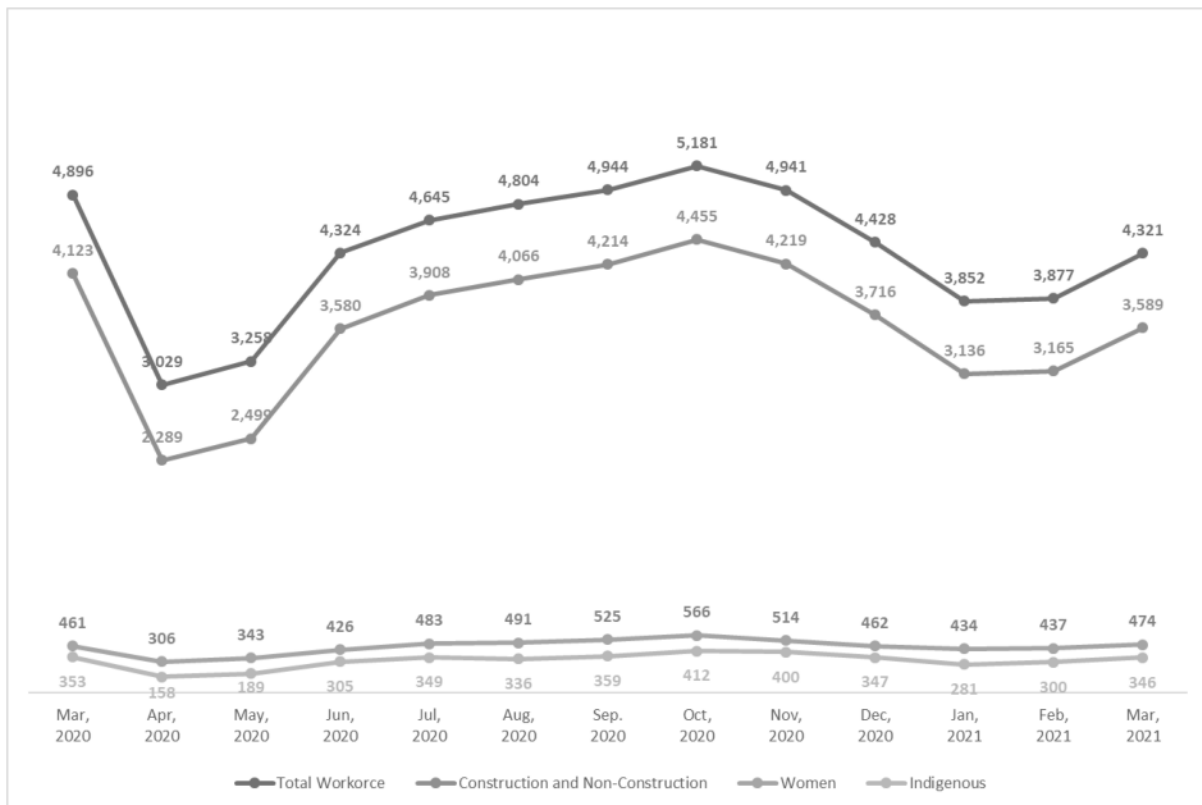
<sup>15</sup> Total workers include:

- Construction and non-construction contractors performing work on Site C dam site, transmission corridor, reservoir clearing area, public roadwork, worker accommodation and services.
- Engineers and Project team that is comprised of both on-site and off-site workers.
- The Project team, which includes, BC Hydro construction management and other offsite Site C Project staff. An estimate is provided where possible if primary residence is not given.

February 2021, impacted the construction and non-construction workforce during the reporting period (January to March 2021).

Prior to COVID-19, BC Hydro had anticipated that 2020 would be one of the Project's peak workforce years. For the most important work months for the project (April to October), BC Hydro projected a total workforce of about 5,000 people for each of those months.

**Figure 2 Site C Workforce March 2020 to March 2021**



Note 1: The Indigenous and women numbers are a subset of the construction and non-construction contractors workforce number.

In October 2020, the total workforce peaked at 5,181, the highest number to date since the start of construction. With reduced occupancy in the worker accommodation due to COVID-19, Project contractors continue to maximize the

local workforce. In October 2020, there were 1,144 workers reported from the Peace River Regional District (26 per cent of the workforce), which is a peak number for the Project.

#### **11.4 Training and Capacity Building Initiatives**

In September 2017, the Contractors Labour Committee agreed to establish an Indigenous labour subcommittee. The purpose of the subcommittee is to support Indigenous training, labour and employment on Site C through communication, consultation, coordination and cooperation among contractors on the Project.

The committee meets quarterly, or on an as-needed basis. All major Site C construction contractors currently attend this meeting.

BC Hydro has included apprentice targets in the generating station and spillways civil works contract, the transmission lines and the substation contracts, the balance of plant contracts and the Highway 29 work to be procured by BC Hydro, as appropriate.

In August 2013, Northern Lights College Foundation started distributing the BC Hydro Trades and Skilled Training Bursary Awards. As of March 2021, a total of 274 students had received bursaries, including 122 Indigenous students who have benefitted from the bursary in programs such as electrical, welding, millwright, cooking, social work, and many others. BC Hydro has worked with the Northern Lights College Foundation to extend the bursary timeline and reserve a portion of bursary amounts for trades programs directly needed for Project work. Part of this agreement was to set aside funds for the BC Hydro and Northern Lights College pre-carpentry skills pilot program for Site C as well as other joint pre-skills programs. In March 2021, BC Hydro provided funds to the Northern Lights College Foundation to continue the bursary for an additional year.

BC Hydro continues to work with local employment agencies to ensure that as job opportunities become available, they are posted on the WorkBC website as well as on the Fort St. John Employment Connections website.

In February 2021, BC Hydro and key Site C contractors signed the BC Construction Association's Builders Code Pledge for an acceptable worksite. Signing this pledge jointly demonstrates the Project's commitment and belief that everyone has a right to be safe and protected at the worksite. This initiative between BC Hydro and Site C contractors demonstrates that inclusion, diversity and respectful workplace behavior is jointly valued on the Project.

#### *Contractor Indigenous Employment and Training information Session*

In February 2021, BC Hydro facilitated the sixth bi-annual Indigenous Employment and Information session with Site C contractors and employment and training representatives from the Treaty 8 First Nations (the session was held virtually due to COVID-19). In attendance were six site contractors, and representatives from seven different nations, as well as the North East Native Advancing Society and BC Hydro. The purpose of these meetings is to assist in building relationships between employment and training professionals from the Indigenous communities and key Site C contractors, as well as to share employment and training opportunities. Representatives from the Indigenous communities, BC Hydro and Site C contractors wanted to proceed with this forum even though they could not meet in person this year due to COVID-19.

Site C contractors have noted that certain trades will continue to be in high demand during peak Project construction periods. As such, in early 2020, major on-site contractors started exploring opportunities for apprentice and other training to take place on-site. Further in 2020, BC Hydro worked with Northern Lights College and Site C contractors to develop three on-site pilot programs. The programs included a new program with Northern Lights College designed for local Indigenous candidates

interested in becoming heavy equipment operators on the Site C Project, a re-launch of the Pre-Carpentry Skills Program with Northern Lights College, and a Fish Monitoring Program.

Both the pre-heavy equipment operator skills program and pre-carpentry skills program were postponed due to COVID-19. BC Hydro continues to monitor the situation for an appropriate time to proceed with these programs as well as looking at restructured options for smaller groups and online options. The BC Hydro and Northern Lights College Fish Monitoring Program was restructured and delivered off-site with additional COVID-19 safety protocols, was launched in August 2020, and is planned to be delivered again in 2021.

- **Fish Monitoring Program**

This pilot program was scheduled to commence in late spring 2020 but was restructured to an off-site program and with additional training offered online. This was successfully delivery in August 2020, with eight participants completing the program. The program included workforce training certifications in preparation for employment opportunities on the Project.

- **Pre-Carpentry Skills Pilot Program at Site C**

This pilot program was successfully delivered in April 2019 by BC Hydro and Northern Lights College. In 2019, seven Indigenous students from this program were hired for Project work by contractors on the Project, with two students entering an apprentice program to become journeyperson carpenters. Funding for this program was also provided through the North East Native Advancing Society and donations from the Construction Maintenance and Allied Workers. The intent of this program is to provide an overview of the skills required for the carpentry trade (essential skills training), general employment knowledge (employment readiness), overview of job requirements for carpenters,



knowledge of B.C.'s apprenticeship system, and Site C Project-specific knowledge.

- **Pre-Heavy Equipment Operator Skills Pilot Program at Site C**

This course focuses on preparing individuals who have prior heavy equipment operator training for employment opportunities on BC Hydro's Site C Project with its contractors. Funding for this program was to be provided through the North East Native Advancing Society and donations from the Christian Labour Association of Canada (**CLAC**), local 68. Both the carpentry and the pre-heavy equipment operator programs were designed as 14-day programs for local new workers or workers new to the trade with preference given to local Indigenous candidates. The courses were to be partly run at the worker accommodation lodge and the 14 days were intended to reflect a typical Site C schedule.

## **12 Community Engagement and Communication**

### **12.1 Local Government Liaison**

There are a number of Environmental Assessment Certificate conditions that are relevant to local communities in the vicinity of the Project. BC Hydro is implementing some of these conditions through community agreements offered to five local governments. Through these agreements and discussions, BC Hydro has, in some instances, agreed to additional measures to address concerns about local community impacts from construction and operation of the Project. BC Hydro provided update emails at a frequency agreed upon with the Regional Community Liaison Committee regarding actions taken to respond to the pandemic and, in 2020, launched a Site C COVID-19 website for public information. Biweekly calls continued through the reporting period with the Regional Community Liaison Committee to continue to engage with local governments and Indigenous groups in partnership with Northern Health and Emergency Management B.C.

BC Hydro has concluded four community agreements with respect to the Project: The District of Taylor (2013), the District of Chetwynd (2013), the City of Fort St. John (2016) and the District of Hudson's Hope (2017). BC Hydro and the City of Fort St. John established a Community Agreement Monitoring Committee to jointly oversee implementation of the community agreement. BC Hydro and the Peace River Regional District advanced negotiations through exchanging supporting information during this period and staff have worked to implement some of the mitigation measures for the Charlie Lake Wastewater outfall. Subsequent to the reporting period, BC Hydro provided a comprehensive response to the Peace River Regional District on April 9, 2021, addressing all the issues raised by the Peace River Regional District in 2020 and early 2021. There is a significant gap between the payments proposed by the Peace River Regional District and what BC Hydro has offered based on an analysis of direct specific impacts due to Site C and the existing environmental assessment certificate conditions.

The Regional Community Liaison Committee, which is comprised of local elected officials and local First Nations communities, most recently met virtually on March 17, 2021. Eight local governments and four local First Nations communities (McLeod Lake Indian Band, Doig River First Nations, Saulteau First Nations and Blueberry River First Nations) as well as the two MLAs for Peace River North and Peace River South, are invited to participate as committee members.

Representatives from the Project's major contractors may also attend the meetings as invited guests.

As part of the Site C Project, BC Hydro is working with communities to provide lasting benefits for residents of the Peace Region. In 2016, BC Hydro launched the GO Fund, an \$800,000 fund to support Peace Region non-profit organizations. The GO Fund is being distributed over an eight-year period to organizations that provide services to vulnerable populations including children, families and seniors.

The GO Fund is administered by Northern Development Initiative Trust on behalf of BC Hydro. During this reporting period, BC Hydro distributed \$10,000 to one non-profit organization in the Peace Region and as of March 31, 2021, nearly \$505,000 had been distributed to 57 projects since the fund was launched in 2016.

## **12.2 Business Liaison and Outreach**

BC Hydro continued to implement its Site C Business Participation Plan, which supports local and regional business participation in the project. The Project team sent out four procurement notifications to the Site C business directory in the first quarter of the year.

### **12.2.1 Community Relations and Construction Communications**

Throughout the reporting period, BC Hydro continued to implement its construction communications program. The program includes updating and maintaining the Project website ([www.sitecproject.com](http://www.sitecproject.com)) with current information, and photos and

videos of construction activities, as well as providing information to local and regional stakeholders as required.

Due to COVID-19 restrictions, the Site C community relations team has not hosted any external site tours since before the beginning of the pandemic.

### **Construction Bulletins**

Bi-weekly construction bulletins continued to be issued throughout the reporting period. These bulletins are posted on the Project website and sent by email to the web-subscriber list. There were six construction bulletins and one quarterly construction notification letters issued in the first quarter of 2021.

### **Public Enquiries**

In total, BC Hydro received 236 public enquiries between January 1 and March 31, 2021. The majority of these enquiries continued to be about business and job opportunities, with limited construction impact concerns from local residents.

Table 15 shows the breakdown of some of the most common enquiry types.

In total, BC Hydro has received more than 12,700 enquiries since August 2015.

**Table 15      Public Enquiries Breakdown**

<b>Enquiry Type<sup>16</sup></b>	<b>January 1 to March 31, 2021</b>
Job Opportunities	75
Business Opportunities	41
General Information	53
Construction Impacts <sup>17</sup>	32
Other <sup>18</sup>	35
<b>Total</b>	<b>236</b>

<sup>16</sup> This table is a sample of enquiry types and does not include all enquiry types received.

<sup>17</sup> The nature of the construction impact inquiries is primarily air quality, noise and traffic conditions.

<sup>18</sup> "Other" accounts for enquiries related to a variety of other topics, such recreation access near construction sites, property owner correspondence, or requests for site tours.

## **12.2.2 Communications Activities**

Based on a search using the media database Infomart, there were 370 stories about the Site C Project in B.C. news media between January 1 and March 31, 2021.

## **12.3 Labour and Training Plan**

In accordance with an Environmental Assessment Certificate condition, a Labour and Training Plan was developed and submitted to the Environmental Assessment Office on June 5, 2015. This plan, as well as Environmental Assessment Certificate Condition 45, includes reporting requirements to support educational institutions in planning their training programs to support potential workers in obtaining Project jobs in the future. This report was issued to the appropriate training institutions in the northeast region of B.C. in July 2016, July 2017, July 2018, July 2019 and September 2020. The next report will be issued in summer/fall 2021.

## **12.4 Human Health**

### **12.4.1 Health Care Services Plan and Emergency Service Plan**

The Project health clinic is contracted by BC Hydro with Halfway River International SOS Medical Ltd., a partnership between Halfway River First Nation and International SOS. The clinic continues to operate in its permanent location within the Two Rivers Lodge and based on camp occupancy was staffed 24/7 during this period with a nurse practitioner and advanced care paramedics. BC Hydro and the clinic operator continue to liaise with the local health care community.

The clinic provides workers with access to primary and preventative health care and work-related injury evaluation and treatment services and is currently open seven days a week, 24 hours a day. Since opening the health clinic, there have been a total of 23,541 patient interactions. During the first quarter of 2021, there were 1,938 patient interactions, of which 225 were occupational and 1,713 non-occupational. Several preventive health themes were promoted to workers including smoking awareness; influenza, cancer, the stress and

transmission of the COVID-19 virus, COVID-19 variants and vaccination and aftercare.

## **12.5 Property Acquisitions**

In spring of 2021, BC Hydro secured the last of the remaining land rights required for the remaining highway re-alignment segments (Lynx Creek and Farrell Creek East). BC Hydro also successfully negotiated several land acquisitions for other Project components to enable reservoir clearing and inundation.

## **13 Plans During Next Six Months**

As announced by the Government of B.C. on February 26, 2021, the revised cost estimate to complete Site C is \$16 billion and includes a new expected in-service date of 2025, as a result of the delays and impacts of the pandemic. BC Hydro continues to review the schedule, work closely with contractors to understand the costs and schedule impacts due to COVID-19, and review risks consistent with the recommended actions in the Milburn Review. Based on the current expected schedule, [Table 16](#) below shows the key milestones for activities planned during the next six months, April 2021 to September 2021.

**Table 16 Key Milestones for Activities Planned  
During the Next Six Months (April 2021 to  
September 2021)**

Milestone	Current Expected Schedule <sup>19</sup>
<b>Generating Station and Spillways</b>	
Unit 4 – Unit bay superstructure complete and powerhouse bridge crane ready	April 2021 (complete)
Unit 5 – Unit bay superstructure complete and powerhouse bridge crane ready	June 2021
Contract Award – Balance of plant mechanical	July 2021
Unit 6 – Unit bay superstructure complete and powerhouse bridge crane ready	August 2021
Contract Award – Balance of plant electrical	September 2021
<b>Main Civil Works</b>	
Complete all the work for the closure section of the upstream cofferdam to elevation 433.9 m	April 2021 (complete in March 2021)
Roller-compacted concrete buttress complete	September 2021
<b>Turbines and Generators</b>	
Unit 1 – Stay ring and spiral case assembled and handover of generator embedded parts	June 2021
Unit 2 – Stay ring and spiral case assembled and handover of generator embedded parts	September 2021
<b>Right Bank Foundation Enhancements</b>	
Commence pile installation at the spillway	August 2021

## 14 Impacts on Other BC Hydro Operations

During the reporting period, the operation of system storage at Williston Reservoir (including GM Shrum and Peace Canyon powerplants) was planned to meet flow releases necessary for Site C construction, and this operation continues. Water releases from Peace Canyon Generating Station were maintained at or below the levels necessary for Project construction. BC Hydro maintained adequate vacant

<sup>19</sup> Once the current expected schedule is finalized and approved, BC Hydro will report on the performance measurement baseline, control budget, forecast and current status.

storage in Williston Reservoir to protect Site C construction works from flows that could otherwise exceed the capacity of the diversion works.



## **Site C Clean Energy Project**

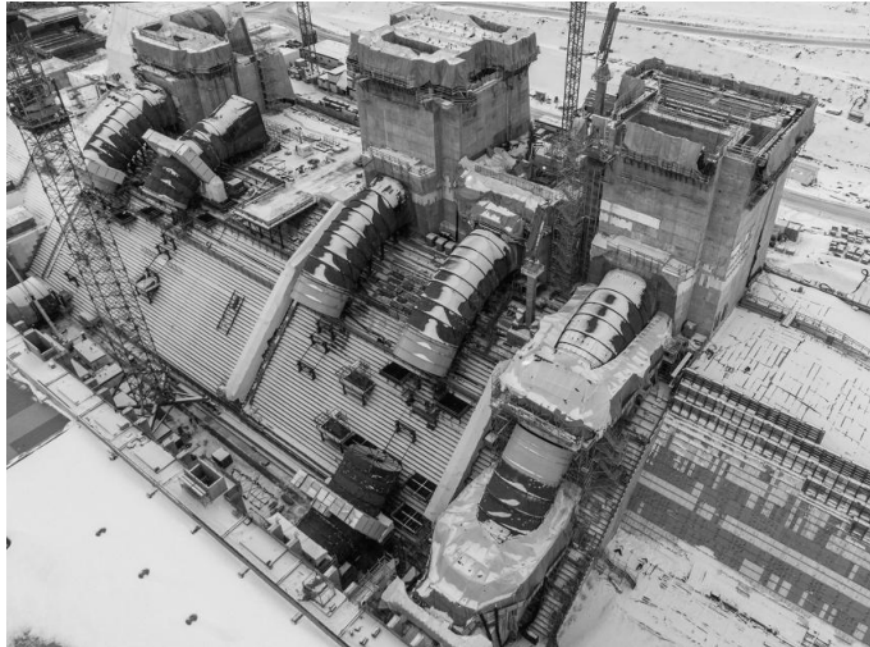
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### **Quarterly Progress Report No. 21**

#### **Appendix A**

#### **Site Photographs**

**Figure A-1** An aerial view of the Site C penstocks and intakes under construction (January 2021)



**Figure A-2** Halfway River bridge construction where the final girders will connect pier 12 to the eastern bridge abutment (January 2021)



**Figure A-3** Unit 1 turbine runner arrives at Site C after travelling from Sao Paulo, Brazil, by ship to Prince Rupert, and transported on a customized truck to the project site (January 2021)



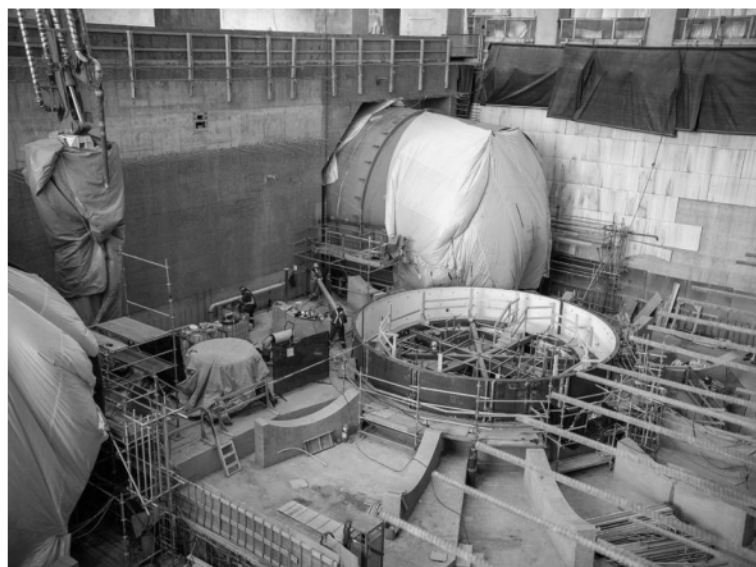
**Figure A-4** Construction of the shoreline protection at Hudson's Hope (January 2021)



**Figure A-5** Powerhouse steel superstructure construction. The powerhouse construction also includes concrete placements at the powerhouse, intakes and spillways, and the installation of penstock segments. (February 2021)



**Figure A-6** Crews have commenced installation of the turbine-embedded components for Units 1 and 2 inside the powerhouse. The Unit 1 draft tube cone and thrust ring are being prepared for installation (February 2021)



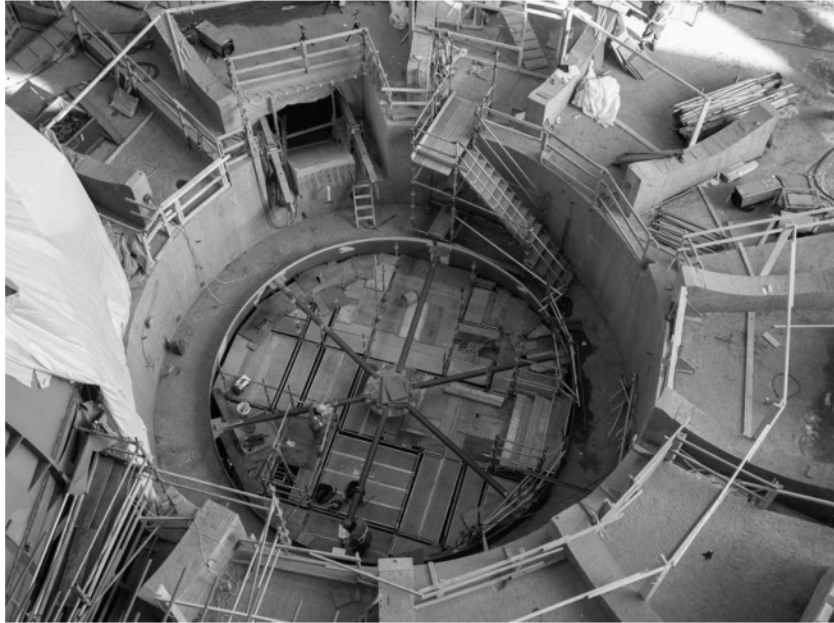
**Figure A-7** The upstream and downstream cofferdams, which divert the Peace River through the two diversion tunnels (February 2021)



**Figure A-8** Intake Units 1 and 3 are nearing completion as part of the ongoing powerhouse construction (February 2021)



**Figure A-9** Crews install the Unit 2 turbine pit elbow liner (March 2021)



**Figure A-10** Girder installation is complete, and workers remove scaffolding from the Halfway River bridge (March 2021)



**Figure A-11 Main service bay and operations building (March 2021)**



**Figure A-12 The last of 205 transmission towers on the second transmission line was completed at the end of March – eight months ahead of schedule (March 2021)**



## **Site C Clean Energy Project**

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### **Quarterly Progress Report No. 21**

#### **Appendix B**

#### **Work Completed Since Project Commencement in 2015**



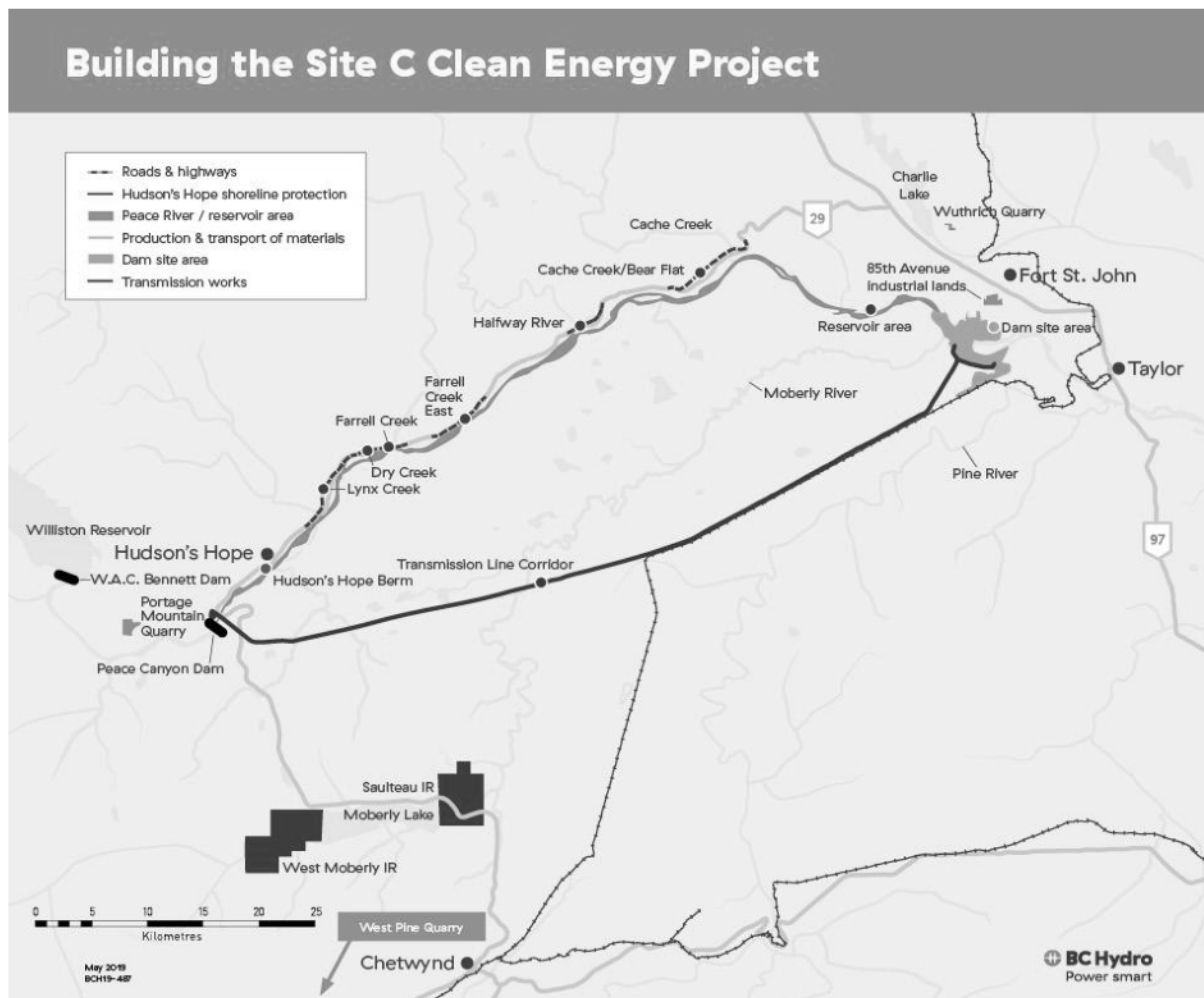
## **Appendix B: Work Completed Since Project Commencement in 2015**

Construction began on July 27, 2015 and is ongoing. Since the commencement of construction, the following work has been completed:

- Site preparation, including on-site access roads;
- Clearing of the left and right banks at the dam site and clearing of the lower reservoir area;
- Construction of the worker accommodation lodge and Peace River construction bridge;
- Powerhouse excavation, and placement of 414,000 cubic metres of roller-compacted concrete in the powerhouse buttress;
- Spillways excavation, and the placement of 586,000 cubic metres of roller-compacted concrete in the spillways buttress;
- Construction of dam site access public roads;
- Construction of the Site C viewpoint;
- Excavation of the diversion tunnel inlet (upstream) and outlet (downstream) portals, allowing for the commencement of diversion tunnel excavations;
- Excavation of the right bank drainage tunnel, which will be used to monitor and drain the water from within the foundation under the powerhouse, spillways and dam buttresses and will eventually be connected to services within the powerhouse;
- Completion of two river diversion tunnels, which are used to reroute a short section of the Peace River to allow for the construction of the main earthfill dam;

- Completion of the upstream and downstream cofferdams;
- Construction and commissioning of the temporary fish passage facility;
- Diversion of the Peace River around the Site C construction site;
- Completion of the Peace Canyon 500 kV gas-insulated switchgear expansion to enable connection of Site C to the BC Hydro electrical system;
- The completion of the Site C substation and first of two new 500 kV transmission lines;
- Clearing activities in the lower reservoir;
- Fish habitat enhancements downstream of the dam site; and
- The completion of 50 affordable housing units in Fort St. John.

**Figure B-1 Site C Project Components**



## **Site C Clean Energy Project**

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### **Quarterly Progress Report No. 21**

#### **Appendix C**

#### **Safety and Security**

The following safety incidents occurred during the quarter from January 1, 2021 to March 31, 2021:

**Serious Safety Incidents**

The five serious incidents that occurred during this reporting period include:

1. Cord reel fell from the overhead door in the main service bay area;
2. A worker was observed standing inside an operating conveyor hopper;
3. A worker slipped, fell and fractured their tibia, resulting in a lost time incident due to the need for surgery;
4. While a guyed transmission tower was being lifted, a 7.7 kg wedge block fell within the work area zone from 18 metres above; and
5. A ventilation system failure within the left bank drainage adit, resulted in silica exposure to exceed occupational exposure limits. Workers who may have exposed to higher levels of silica were encouraged to record the incident with WorkSafeBC for possible future claims.

**All Injury Incidents**

The 12 injury incidents that occurred during this reporting period include one lost-time injury and 11 medical attention requiring treatment injuries. Note that serious incidents resulting in an injury will be listed in both the list of serious incidents and the list of All Injury Incidents.

Lost time injury:

1. A worker slipped, fell and fractured their tibia resulting in lost time due to required surgery.

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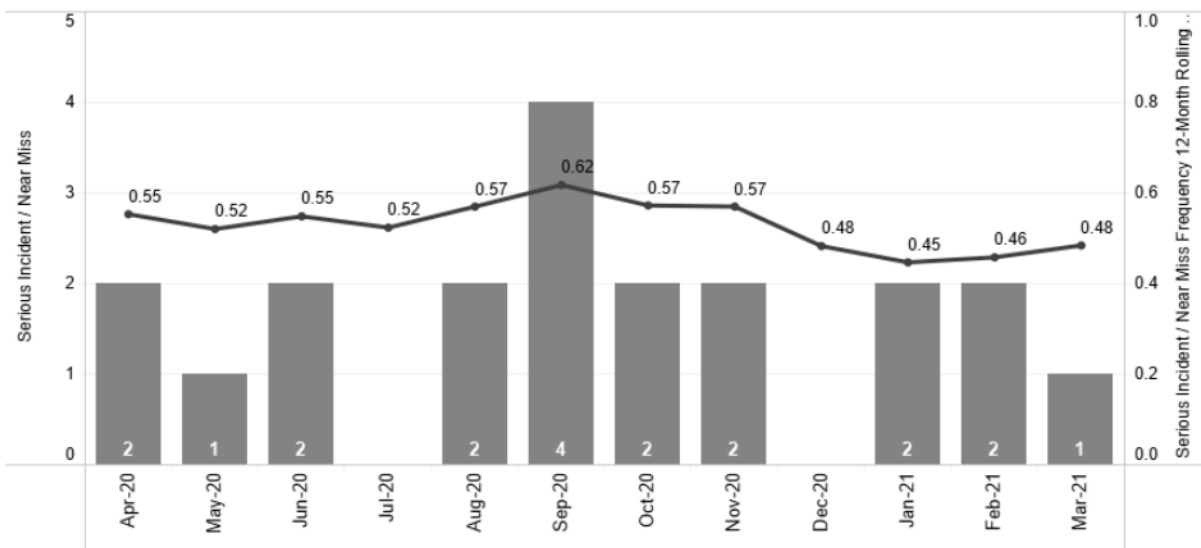
Medical attention requiring treatment injuries:

1. A worker pinched their finger when a tool slipped. The worker suffered a laceration;
2. A worker pinched their finger when a tool slipped. The worker suffered a laceration;
3. A worker slipped and their head contacted the blade of a grader. The worker suffered a laceration;
4. A worker accidentally triggered the pressure water hose and suffered a laceration to their shin;
5. A worker lost their footing on rebar then fell and suffered a laceration to their hand;
6. A worker slipped on ice and their knee contacted the running board of a light duty truck. The worker suffered a laceration;
7. A worker slipped while descending on scaffold stairs and dislocated their shoulder;
8. A worker pinched their finger between two panels. The worker suffered a laceration;
9. A worker's tool slipped and cut their hand;
10. A worker's hand got caught between a seat band and wheel hub and the worker suffered an injury to their finger;
11. A worker was pulling nails from a piece of lumber punctured their finger by a tie wire; and
12. A metal dumpster lid suddenly closed and worker fractured their hand.

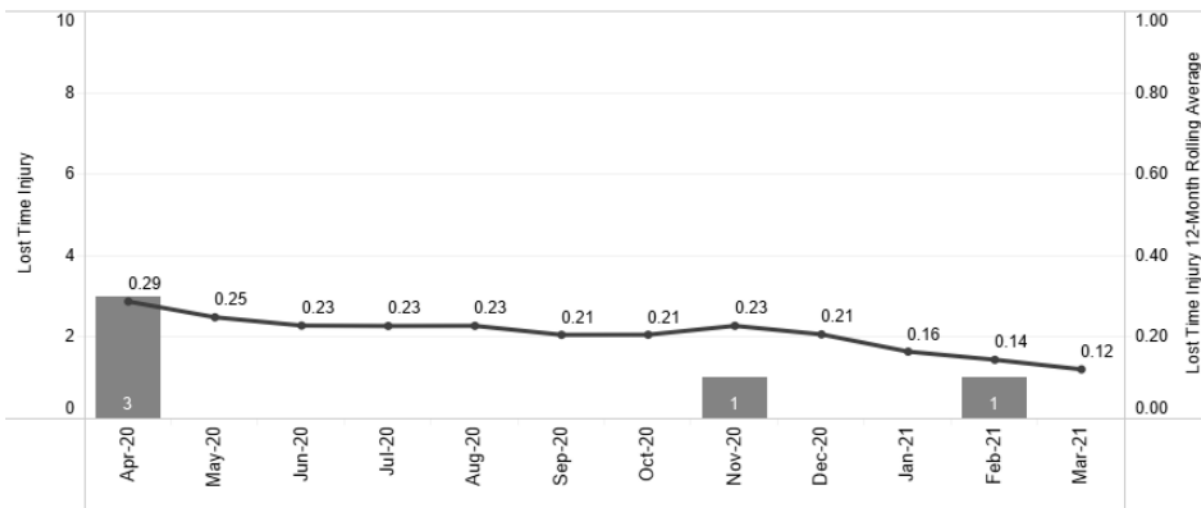
Figure C-1 below provides information on employee and contractor serious incidents/near miss frequency, lost time injury frequency and all-injury frequency from January 1, 2021 to March 31, 2021.

**Figure C-1 Employee and Contractor Serious Incidents/Near Miss Frequency, Lost Time Injury Frequency and All-injury Frequency**

**Employee & Contractor Serious Incident / Near Miss Frequency**



**Employee & Contractor Lost Time Injury Frequency**



Employee & Contractor All-Injury Frequency

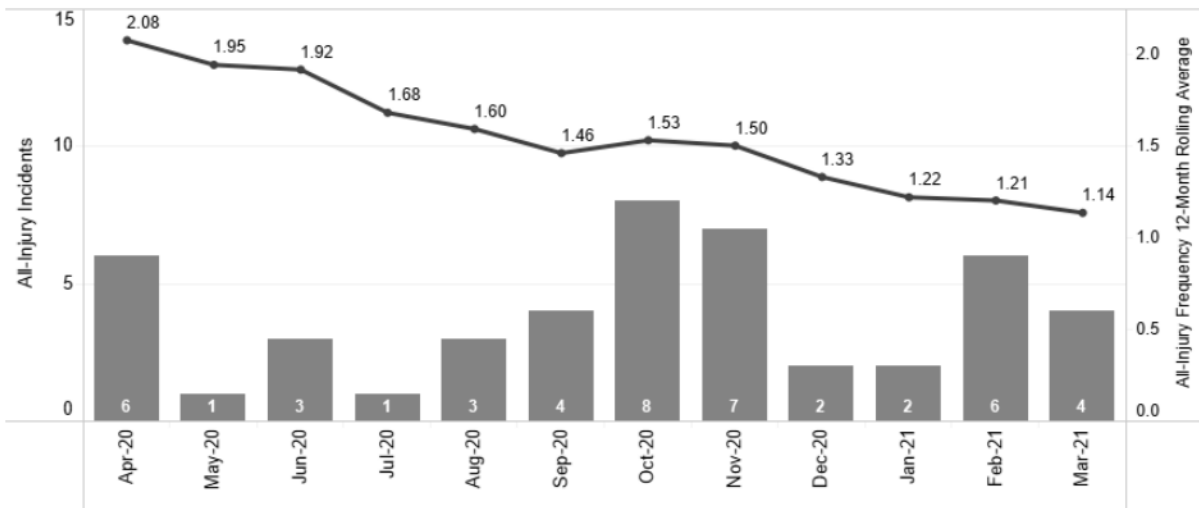


Table C-1 lists the safety regulatory inspections and orders received from January 2021 to March 2021.

**Table C-1 Safety Regulatory Inspections and Orders**

**WorkSafeBC**

Risk Level	Theme	Inspection Reports and Orders Received	Date of Inspection
<p><b>Inspection #1:</b> WorkSafeBC conducted an inspection on the washroom facilities provided by the general contractor for the generating station and spillways structural works of the hydroelectric dam construction project.</p> <p>Washroom facilities: the temporary washroom facility (wash cart) provided at the intake work location was subject to a freeze cycle resulting in an overflow condition. It was stated that the exterior water line froze and backed-up water into the interior portion of the wash cart. The employers service department conducted the necessary repairs, performed initial clean-up, and sanitized the wash cart. There wasn't any septic and/or effluent involved in the overflow condition. Further, clean-up/sanitation of the wash cart was provided by a third-party contractor.</p> <p>It was also noted that the sites additional temporary washroom facilities located at various locations are to be continually monitored and maintained during the extreme cold temperatures (-30 C to -45 C) that were being experienced in the region at the time.</p>			
		<b>No Orders</b>	February 16, 2021



Risk Level	Theme	Inspection Reports and Orders Received	Date of Inspection
<b>Inspection #2:</b> WorkSafeBC conducted an inspection as part of the 2021-2023 Construction High Risk Strategy. WorkSafeBC's primary goal is prevention of injuries and prevention of serious/fatal injuries in the construction industry. The Construction High Risk Strategy will focus on four risk areas: <ol style="list-style-type: none"> <li>1. Falls from elevation inspections will focus on adequate controls to prevent falls from elevation.</li> <li>2. Struck by inspections will focus on mechanism of injury as related to mobile equipment work activities.</li> <li>3. Contact with electricity high voltage limits of approach inspections will focus on hierarchy of controls, 30M33 assurance in writing, worker education and training, work arrangements and procedures.</li> <li>4. Musculoskeletal injury inspections will focus on high potential for time-loss injuries from some repetitive, poorly planned out tasks (material handling), employer must identify potential for musculoskeletal injury inspections (risk assessment), controls to mitigate risk, over exertion and repetitive strain injury.</li> </ol>			
		<b>No Orders</b>	February 16, 2021
<b>Inspection #3:</b> WorkSafeBC contacted the contractor via telephone as a result of a reported incident. The incident resulted in the inadvertent slip and fall to the same elevation, resulting in contact with the ground surface. Minor injury was reported.			
		<b>No Orders</b>	February 23, 2021
<b>Inspection #4:</b> WorkSafeBC contacted the contractor via telephone as a result of a reported incident. The incident involved injury of a worker. A worker who was operating an excavator exited the cab to assist a mechanic conducting repairs to the bucket, accessed onto a frozen compacted snow-covered area, and slipped resulting in a fall to the ground.			
Low risk	Accident Reporting and Investigation	<b>Order #1 - WCA68(1)(a):</b> The contractor failed to immediately notify the board of the slip and fall accident that resulted in a serious injury to a worker.	February 23, 2021
<b>Inspection #5:</b> WorkSafeBC conducted an inspection on the general work activities taking place at the time of the inspection which included tower/mobile crane operation, mobile equipment uses, formwork assembly, steel erection, reinforcing steel installation, concrete preparation / placement, and scaffold erection.  During the inspection, health and safety items were discussed, including access and egress, indoor air quality, hazardous substances and processes, fall protection systems, first aid facilities and equipment and general.			
		<b>No Orders</b>	February 24, 2021

Risk Level	Theme	Inspection Reports and Orders Received	Date of Inspection
<p><b>Inspection #6:</b> WorkSafeBC conducted an inspection to review the contractor's response to the current COVID-19 pandemic in relation to worker health and safety at the workplace.</p> <p>To date, the contractor has implemented the following controls at the workplace to prevent and/or mitigate the risk of contracting COVID-19:</p> <ul style="list-style-type: none"> <li>• Project and site-specific access screening temperature/questionnaire</li> <li>• A detailed COVID-19 safety plan</li> <li>• Digital touchless sign in procedures and practices via phone app</li> <li>• Daily health check incorporated, with workers required to self-monitor for COVID-19 symptoms, and report symptoms or possible exposure of a suspected or confirmed case to their supervisor</li> <li>• Plexiglass dividers at the reception area to protect workers when social distancing cannot be maintained</li> <li>• Masks are mandatory at all times for workers and visitors on the Project</li> <li>• Hand sanitizer stations and additional wash carts are available at access points throughout the Project</li> <li>• Custom built cubicles incorporated physical barriers to create separation in lunchroom</li> <li>• Additional space for personal items to hang prior to entering lunchroom</li> <li>• Custom exterior phone booth type separation dividers available for workers</li> <li>• COVID-19 physical distancing signage, markers are posted throughout the project</li> <li>• COVID-19 measures are communicated to workers and supervisors</li> <li>• Enhanced cleaning protocols in place</li> </ul>			
		<b>No Orders</b>	February 24, 2021
<p><b>Inspection #7:</b> WorkSafeBC attended the workplace as a result of an incident that involved the release of a large quantity of vermiculite insulation.</p> <p>The employer stated that a garbage truck contacted the outside wall of the building causing a cinder block wall to release vermiculite insulation. The employer removed all staff from the area and contacted an abatement contractor to remove and safely contain any remaining vermiculite.</p> <p>The employer has taken steps to properly address this hazardous material and is being given two directive orders to ensure the health and safety of its staff.</p>			
Low Risk	Procedures	<b>Order #1 – OHS6.8(1):</b> BC Hydro is directed to ensure that the vermiculite is removed and further contained in accordance with procedures developed by a qualified person and implemented by a qualified contractor.	February 26, 2021

Risk Level	Theme	Inspection Reports and Orders Received	Date of Inspection
Low Risk	Hazard materials	<b>Order #2 - OHS20.112(8):</b> BC Hydro is directed to have an assurance in writing completed to verify that the vermiculite has been properly removed and contained and ensure that asbestos fibres are below the allowable limit.	
<p><b>Inspection #8:</b> WorkSafeBC contacted the contractor as a result of a reported COVID-19 transmission to workers at the Project.</p> <p>The Provincial Health Officer (Northern Health Authority) representatives, BC Hydro and worker accommodation contractor were notified of a reported COVID-19 transmission to workers at the Project and conducted a joint review with the contractor. Conditions and/or gaps with the employer's COVID-19 response plan were reviewed to determine findings that may be deficient with the Provincial Health Officer orders and/or contractor's practices at this time.</p> <p>The contractor continues to undertake a full investigation to determine the cause or causes, identify any conditions, acts or procedures that significantly contributed to the transmission, and if gaps and conditions, acts or procedures are identified, determine the corrective action necessary to prevent the recurrence of similar transmission.</p>			
		<b>No Orders</b>	March 23, 2021
<p><b>Inspection #9:</b> WorkSafeBC conducted an inspection on March 26, 2021 following a reported crane incident involving a described minor contact between a tower crane and mobile crane in the spillway area.</p> <p>The preliminary causation is when the tower crane slewed into the overlap zone resulting in the tower crane jib trolley sheave to contact and sever the mobile crane's communications lines affixed to the extended boom.</p>			
Low Risk	Certification following incident	<b>Order #1 - OHS14.16(2):</b> The contractor failed to remove the tower crane from service until a professional engineer had certified it was safe for use, following the incident.	March 26, 2021
<p><b>Inspection #10:</b> WorkSafeBC responded a report from the contractor as a result of an incident that involved the potential for a serious injury to a worker.</p>			
		<b>No Orders</b>	March 31, 2021

## **Site C Clean Energy Project**

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### **Quarterly Progress Report No. 21**

#### **Appendix D**

#### **Workforce Overview**

**Table D-1 Current Site C Jobs Snapshot  
(January 2021 – March 2021<sup>20</sup>)**

	<b>Number of B.C. Workers and Total Workers</b>	<b>Construction and Non-construction Contractors<sup>21</sup> (including some Subcontractors). Excludes Work Performed outside of B.C. (e.g., Manufacturing)</b>	<b>Engineers and Project Team<sup>22</sup></b>	<b>Total</b>
January 2021	BC Workers	2,197	665	2,862
	Total Workers	3,136	716	3,852
February 2021	BC Workers	2,181	659	2,840
	Total Workers	3,165	712	3,877
March 2021	BC Workers	2,457	677	3,134
	Total Workers	3,589	732	4,321

Employment numbers provided by Site C contractors are subject to revision. Data not received by the project deadline may not be included in the above numbers.

BC Hydro has contracted companies for major contracts, such as main civil works, who have substantial global expertise. During the month of March 2021, there was one worker in a specialized position working for Site C construction and non-construction contractors, which were subject to the Labour Market Impact Assessment process under the Federal Temporary Foreign Worker Program. Additionally, there were 28 management and professionals working for Site C construction and non-construction contractors through the Federal International Mobility Program.

<sup>20</sup> Employment numbers are direct only and do not capture indirect or induced employment.

<sup>21</sup> Construction and non-construction contractors total workforce employment number includes work performed on the Site C dam site, transmission corridor, reservoir clearing area, public roadwork, worker accommodation and services.

<sup>22</sup> Engineers and Project team are comprised of both on-site and off-site workers. The Project team includes BC Hydro construction management and other off-site Site C project staff. An estimate is provided where possible if primary residence is not given.

**Table D-2 Preliminary Site C Apprentices Snapshot  
(January 2021 to March 2021)**

Month	Number of Apprentices
January 2021	100
February 2021	123
March 2021	143

Data is subject to change based on revisions received from the contractors.

**Table D-3 Current Site C Job Classification Groupings**

Biologists and laboratory	Carpenters	Inspectors	Construction managers/supervisors	Crane operators	Electricians	Engineers
Foresters	Health care workers	Heavy equipment operators	Housing staff	Heating, ventilation, and air conditioning	Kitchen staff	Labourers
Mechanics	Millwrights	Office staff	Pipefitters	Plumbers	Sheet metal workers	Truck drivers
Underground mining	Welders	Surveyors	Security guards	Boilermakers	Cement Masons	Crane Operators
Ironworkers						

**Table D-4 Indigenous Inclusion Snapshot  
(January 2021 to March 2021)**

Month	Number of Indigenous Workers
January 2021	281
February 2021	300
March 2021	346

The information shown has been provided by BC Hydro's on-site<sup>23</sup> construction and non-construction contractors and their subcontractors that have a contractual requirement to report on Indigenous inclusion in their workforce.

<sup>23</sup> On-site includes work performed on Site C dam site, transmission corridor, reservoir clearing area, public roadwork, worker accommodation and services.

Employees voluntarily self-declare their Indigenous status to their employer and there may be Indigenous employees that have chosen not to do so; therefore, the number of Indigenous employees may be higher than shown in the above table.

As with any construction project, the number of workers, and the proportion from any particular location will vary month-to-month and reflects the seasonal nature of construction work. The number of workers will also vary as a contract's scope of work is completed by the contractor.

### *Women*

In March 2021, there were 474 women working for Site C construction and non-construction contractors. The number of women was provided by on-Site construction and non-construction contractors and engineers that have a contractual requirement to report on the number of women in their workforce.

## **Site C Clean Energy Project**

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### **Quarterly Progress Report No. 21**

#### **Appendix E**

#### **Technical Advisory Board and Technical Review Panel Reports**

**CONTAINS CONFIDENTIAL INFORMATION -  
FOR GOVERNMENT ONLY**



**CONTAINS CONFIDENTIAL INFORMATION - FOR GOVERNMENT ONLY**  
**Appendix E**

~~Site C Technical Review Panel~~  
~~John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, PhD~~  
REPORT NO. 1  
January 22, 2021

## EXECUTIVE SUMMARY

The Project Team has, with the support of the independent Technical Advisory Board, decided on the installation of drilled piles downstream of the powerhouse and spillway structures as the preferred right bank foundation enhancement approach. In our opinion, the proposed approach is sound and capable of making the right bank structures both safe and serviceable, however, several details still need to be addressed in the analysis and design. The Project Team is currently progressing the analyses and designs to address these details, and we look forward to reviewing the work as it progresses.

Significant investigations of the right abutment at Site C were completed during the pre-design and design phases of the project, and additional investigations have been completed after the observation of unexpected movements in the right abutment during excavation. The additional investigations showed that there are low strength, persistent bedding planes even deeper in the foundation than anticipated. The investigations, analyses, and evaluations have been and are being completed following current best professional practice methods. In our opinion, the available information, in combination with information being developed from on-going investigations and evaluations, provides adequate data for the design of the foundation enhancements.

Drilled piles were selected as the preferred foundation enhancement after consideration of a range of possible options and completion of a multiple accounts analysis to compare alternatives. We are not aware of any appropriate structural foundation enhancement alternatives that were not considered in this evaluation, and the selection of the drilled pile alternative is reasonable and well supported.

As part of the design development for the foundation enhancement, the final pile system configuration will be optimized, after final selection of design and performance criteria. We look forward to reviewing the optimization work.

## INTRODUCTION

Data from geotechnical instrumentation for the Site C Project has indicated that the right bank foundation has lower strengths and stability than anticipated in the original design, and that remedial measures are required.

Hydroelectric projects are considered low risk – high consequence structures. BC Hydro has concluded that the subsurface movements, and related potential instabilities, that have been

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identified on the right bank pose undue risks. Certain foundation enhancements have been proposed by the Project Team to address these risks.

The Technical Advisory Board (TAB) for the project has been involved in the development of the remedial measures. Nevertheless, given the scope, cost and schedule implications of the proposed remedial measures, the Project Assurance Board (PAB) has decided to have an additional Third-Party Due Diligence Review undertaken of the proposed remedial measures. That review is being completed by a Technical Review Panel (Panel) composed of two individuals: ~~Mr. John W. France~~ of the United States and ~~Dr. Kaare Hoeg~~ of Norway. The Panel has been tasked with reviewing the following aspects of the work being completed by the Project Team:

- The characterization of the rock and the properties of the rock mass, bedding planes, shears, etc.
- The design of the seepage control measures in and under the approach channel.
- The water loads assumed in the rock given the seepage control measures.
- The multiple accounts evaluation leading to the selection of piles as the preferred enhancement.
- The results of the field trials to determine the lateral pile load/deflection characteristics.
- The methods of analysis being used to estimate the behaviour of the completed works on the right bank, including stability and deformations under the range of expected normal loads to extreme loads, and unanticipated performance of the seepage control measures.
- The acceptance criteria proposed for normal and extreme loads, including target factor of safety and displacement thresholds.
- The methods used to translate the results of the factor of safety based geotechnical analyses to the structural requirements for the piles, considering applicable limit states and structural codes.
- The process to be used for optimization of the number, size, and spacing of the piles and the resulting optimized configuration.

BC Hydro further asked the Panel to address the following six questions:

1. Do the geotechnical investigations completed to date, coupled with the information from the geotechnical instrumentation at the site and the proposed field-testing program, provide adequate data on which to base the design of the foundation enhancements?
2. Is the proposed approach to the right bank foundation enhancements capable of making the right bank structures:

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- a) safe – i.e. meet the Canadian Dam Association Dam Safety Guidelines and stability requirements set out in the Project Design Basis<sup>1</sup> provided by BC Hydro?
- b) serviceable – i.e. displacements and deformations within the limits set out in the Project Design provided by BC Hydro?
3. Is the proposed approach to optimization of the right bank foundation enhancements (number, size and spacing of piles) capable of resulting in a cost-effective solution that can accommodate any reasonably foreseeable geological conditions encountered during construction? Are there any value engineering considerations that could be included in the design program?
4. Is the proposed approach to estimating, scheduling and procuring the enhancements reasonable? Are there other things that could be considered that would increase the level of confidence in the cost estimate prepared by BC Hydro?
5. Were the engineering attributes considered in the multiple accounts evaluation thorough?
6. Are there any other foundation enhancement measures that could have been considered?

Work completed by the Panel to date includes participation in introductory Project Team briefings to the Panel, participation in web-based Project Team briefings to the TAB, participation in web-based discussion sessions with the Project Team, review of documents provided to the Panel by the Project Team, Panel Team discussions, and preparation of this report.

## **FINDINGS**

The analysis and design work related to the planned foundation enhancements for the right abutment of Site C is still in progress at the time of preparation of this report. In the remainder of this section, the Panel provides its initial responses to the six questions posed by BC Hydro based on the information that has been presented to the Panel to date. The Panel's responses to the six questions will be updated in future reports based on further work to be done by the Project Team.

<sup>1</sup> As amended to:

1. Update foundation properties based on recent investigations, including lateral pile tests.
2. Update the sliding stability analysis for the right bank including geological model, load cases, method, and criteria.
3. Specify design approach and acceptance criteria.

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1. *Do the geotechnical investigations completed to date, coupled with the information from the geotechnical instrumentation at the site and the proposed field-testing program, provide adequate data on which to base the design of the foundation enhancements?*

In our opinion, yes, the available information, in combination with information being developed from on-going investigations and evaluations, provides adequate data for the design of the foundation enhancements.

Significant investigations of the right abutment at Site C were completed during the pre-design and design phases of the project, and additional investigations have been completed after the observation of unexpected movements in the right abutment during excavation. The investigations have included geologic mapping of surface exposures and exploratory adits, small and large diameter drill holes, geophysical surveys, and advanced field and laboratory testing.

Field instrumentation was installed to monitor the buttress slopes during excavation and to update the geological model and geotechnical shear strength and deformation parameters (following the "observational method"). Experts with previous experience with similar shale foundation conditions have participated in the geotechnical evaluations.

After the unexpected right bank slope movements, back analyses were completed to evaluate the movements, and additional investigations were undertaken to provide input for design of the foundation enhancements. It was found that persistent bedding planes with low shear strength exist even deeper in the foundation than previously anticipated, which has significant impact on the foundation enhancement measures considered and designed.

The work completed at the site has allowed for a very good characterization of the geological, geotechnical, and engineering conditions in the right abutment, including the rock mass, rock stratification, bedding planes, relaxation joints and shears. Analyses and evaluations have been completed following current best professional practice methods.

Some of the key conclusions that have been reached in the analyses and evaluations are:

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1. An active wedge has not developed in the rock mass behind the roller compacted concrete (RCC) buttress; the rock mass consists of strata of intact rock between numerous, nearly horizontal bedding planes, with only limited shears between bedding planes.
2. Close to the excavation face, steeply dipping relaxation joints likely are present, as observed in other locations along the river.
3. Shear strengths on the bedding planes have likely been reduced to near their residual values. Persistent bedding planes with low shear strength exist even deeper than anticipated under the RCC buttress shear key.
4. A release plane does not appear to have been developed in the passive resistance zone (break-out zone) downstream of the powerhouse and spillway structures.

Based on the information provided to us, these conclusions appear to be well supported by the available data, the analyses, and the evaluations performed.

2. *Is the proposed approach to the right bank foundation enhancements capable of making the right bank structures:*
  - c) *safe – i.e. meet the Canadian Dam Association Dam Safety Guidelines and stability requirements set out in the Project Design Basis provided by BC Hydro?*
  - d) *serviceable – i.e. displacements and deformations within the limits set out in the Project Design provided by BC Hydro?*

The Project Team has, with the support of the independent Technical Advisory Board, decided on the installation of drilled piles downstream of the powerhouse and spillway structures as the preferred right bank foundation enhancement approach and concept. In our opinion, the proposed approach is sound and capable of making the right bank structures both safe and serviceable, however, several details still need to be addressed.

The Project Team is currently developing the specific design basis criteria that will be used to design the pile foundation enhancement. The principal design criterion will be to limit the deformations in the foundation to provide both safety and serviceability. The Panel agrees with this approach. Limiting the foundation deformations will provide for safety by preventing the development of an active wedge in the rock behind the RCC buttress and preventing rupture of the lining system to be installed in the approach channel. To address serviceability, the foundation deformations must be limited so that deformations of powerhouse

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components and spillway gate systems remain within acceptable limits. Stability of the foundations (factors of safety) is being checked to demonstrate compliance with CDA safety guidelines and project design basis requirements.

Some aspects of the planned deformation and stability analyses are currently being developed and finalized. However, with proper application of available characterization information, the resulting design should appropriately address safety and serviceability.

3. *Is the proposed approach to optimization of the right bank foundation enhancements (number, size and spacing of piles) capable of resulting in a cost-effective solution that can accommodate any reasonably foreseeable geological conditions encountered during construction? Are there any value engineering considerations that could be included in the design program?*

The optimization of the pile design is currently in process. The Project Team is considering alternate pile configurations (e.g. diameters, steel configuration, etc.) as part of the process. The initial estimates of the number of required piles were based on stability analyses that considered the possible presence of or development of an active wedge behind the RCC buttress. Currently, stability analyses are being completed based on a sliding block model, bounded on the upstream side by either a single, full-height relaxation joint or a sliding plane along the rock mass-buttress interface. For both cases, the required numbers of piles are significantly less than originally estimated with the active wedge model.

Value engineering considerations were included in the multiple accounts analyses (MAA) commented on below.

A number of details must be worked out for the pile optimization, but we are confident that a pile design can be developed that is cost-effective and capable of accommodating reasonably foreseeable geological conditions encountered during construction.

4. *Is the proposed approach to estimating, scheduling and procuring the enhancements reasonable? Are there other things that could be considered that would increase the level of confidence in the cost estimate prepared by BC Hydro?*

The approach to estimating, scheduling, and procuring the enhancements is awaiting finalization, or at least further development, of the designs of the piles. Our comments on this question will be provided after further development and specifications of the design.

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5. *Were the engineering attributes considered in the multiple accounts analysis thorough?*

Based on a review of the information provided to us concerning the multiple accounts analysis of the potential foundation enhancement alternatives, the engineering attributes considered appear to have been systematic, thorough, and reasonable.

6. *Are there any other foundation enhancement measures that could have been considered?*

We are not aware of any other structural foundation enhancement alternatives that could have been considered.

Additional drainage measures may be used to reduce lateral water pressures and uplift forces under the RCC buttresses. At this time, such additional measures do not appear to be required. If water pressures during the lifetime of the structures rise to values higher than anticipated during design, suitable mitigating drainage measures may be implemented without making any structural changes. Recognition of possible changes in drainage conditions over time and the inclusion of design measures to accommodate drainage mitigation measures are not unusual in current dam design practice.

**STATEMENT OF LIMITATIONS**

The Panel functioned as independent reviewers of the methodologies used by the Project Team for analysis and design of the proposed enhancements, based on information provided by the Project Team. Given the large amount of work being completed by the Project Team and the associated documentation, it was not possible for the Panel to perform a detailed review of all of the material in the available time. In particular, the Panel has not performed detailed checks of calculations and designs completed by the Project Team. Such detailed checks are provided by the quality control/quality assurance programs for the project. The Panel provides its opinions concerning the methods and approaches being used based on information provided by the Project Team. However, the ultimate decisions and responsibilities for the designs remains with the BC Hydro.

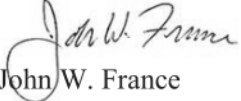
Our review services were performed within the limits prescribed by BC Hydro in a manner consistent with the level of care and skill normally exercised in the current standard of professional engineering practice. No other representation to BC Hydro, expressed or implied, and no warranty or guarantee is included or intended.

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Respectfully submitted,

  
John W. France

  
Kaare Hoeg

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**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, PhD**  
**REPORT NO. 2**  
**February 15, 2021**

**EXECUTIVE SUMMARY**

Additional analyses of the earthfill dam are still in progress, in light of performance observed on the right abutment. However, based on the studies that have been completed to date, we are confident that a safe earthfill dam structure can be constructed at Site C meeting the Canadian Dam Association (CDA) Dam Safety Guidelines. Further, it is our opinion that the earthfill dam type is a particularly appropriate choice for the foundation conditions at Site C, because of 1) the ability to accommodate the low strength foundation bedding planes with flatter earthfill dam slopes, as necessary to provide stability and 2) the earthfill dam's tolerance of deformations, particularly when designed with wide core, filter, and transition zones, as is the case for the Site C earthfill dam design.

The available analyses indicate that for long term steady state conditions, after construction-generated pore water pressures have dissipated, the current earthfill design meets CDA stability guidelines for both the Most Likely Case (MLC) and the Reasonably Worst Case (RWC), both of which we believe have been reasonably estimated. Analyses completed to date also indicate that, for construction conditions including estimated pore water pressure generation and dissipation during construction activities, the CDA stability guidelines can be met with the current earthfill dam design for the MLC and with the addition of a relatively modest amount of stabilizing fill at the downstream slope and toe for the RWC. Further, analyses have indicated that increases of up to 20 percent in factor of safety can be achieved by readily constructible additional berm and toe fill configurations if that should be needed.

In our opinion, the Project Team's estimates of construction-generated pore water pressures are reasonable based on available data. However, the construction-generated pore water pressures constitute one of the greatest uncertainties in the analysis, which must be and are being recognized in evaluating dam safety and the construction schedule/cost risks.

It is our understanding that the additional berm and toe fill configurations referenced above which could increase construction phase stability beyond that required for the RWC are within the Project Team's current budgetary proposal. Part of the Project Team's mitigation strategy to reduce the risk of impacting the schedule during construction is a plan for placement of additional fill downstream of the downstream cofferdam to create a staging area and provide additional stability during construction. The additional staging area fill is sufficient to meet CDA guidelines for the RWC.

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In the very unlikely, but not impossible, event that observed deviation from expected performance is greater than expected (deviates from the RWC), such deviations could still be safely addressed by additional downstream fill placements or temporarily pausing fill placement to allow construction-generated pore water pressures to dissipate. However, such measures could further impact cost and schedule.

In our opinion, the available geotechnical and geological data are satisfactory to characterize foundation conditions for purposes of the earthfill dam design, and the planned observational approach and instrumentation program for the earthfill dam is reasonable and appropriate for monitoring and responding to construction-generated pore water pressures and movements during construction so that adequate stability and safety can be maintained.

## INTRODUCTION

The Technical Review Panel's (Panel's) original assignment did not include review of the Site C earthfill dam design and construction, but BC Hydro subsequently asked the Panel to expand its assignment to include review of this structure and the Panel agreed.

The geotechnical investigations for the Project did not include the portion of the earthfill dam foundation beneath the main river channel, as it was not considered safe to use barge mounted equipment due to the river currents.

Portions of the earthfill dam core trench have been excavated on the left and right banks. The exposed bedrock at the base of the core trench in these locations has been mapped and foundation grouting is being performed.

Mapping and grouting of the right bank portion of the core trench identified shears that affected the stability of the right bank section of the earthfill dam. A shear key has been added to improve stability and reduce dam displacements for the right bank section of the earthfill dam, and a three-dimensional analysis has been undertaken to verify that acceptance criteria will be met.

Installation of piles in the cutoffs of the upstream and downstream cofferdams and the associated investigations have provided more information on the foundation across the main river channel.

After completion of the upstream and downstream cofferdams, the remainder of the core trench will be excavated, mapped, and grouted. Until this work has been completed and assessed, there is uncertainty about the foundation conditions for the earthfill dam and whether the current design will meet the acceptance criteria or whether some further enhancements will be required.

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There are also uncertainties concerning the piezometric response of both the bedding planes in the foundation and the till core and the strengths of discontinuities (bedding planes and shears) in the foundation.

In Report 21A the Technical Advisory Board (TAB) introduced the concepts of the Most Likely Case (MLC) and the Reasonably Worst Case (RWC) and how these concepts should be considered in the design.

The observational approach is planned to verify the design of the earthfill dam during construction. The geotechnical instrumentation will directly measure the piezometric responses in the core and on the foundation bedding planes and inclinometers will indirectly indicate the strength of the foundation. If the observations indicate that the RWC is developing, design modifications would be implemented to meet acceptance criteria.

The TAB for the Project has been involved in the development of the design for the earthfill dam. Nevertheless, given the possibility of required design changes and the experience with unexpected performance during right abutment excavations, the Project Assurance Board (PAB) has decided to have an additional Third-Party Due Diligence Review completed for the earthfill dam design by this Technical Review Panel. The Panel has been tasked with reviewing the following aspects of the work being completed by the Project Team:

- The geotechnical investigations for the earthfill dam completed to date and the geotechnical instrumentation for the earthfill dam and cofferdams.
- The characterization of the rock and the properties of the rock mass, bedding planes, shears, etc. that control the stability of the earthfill dam and its foundations.
- Pore pressure assumptions during and at the end of construction.
- Adaptations of the design and stability analysis that have been identified to date in consideration of experience on the right abutment.
- Strategies to be adopted to further adapt the design, if necessary, based on mapping of the core trench across the riverbed and/or information obtained from geotechnical instrumentation during construction.

Work completed by the Panel to date related to the earthfill dam includes participation in three web-based Project Team briefings/discussion sessions with the Team, participation in web-based Project Team briefings to the TAB, review of documents provided to the Panel by the Project Team, and preparation of this report.

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## FINDINGS

Updates to the Site C earthfill dam design in light of the right abutment experience are still in progress at the time of preparation of this report. In particular, the Project Team is completing three-dimensional stability and deformation analyses for the earthfill dam. The Panel has been briefed on the foundation geology and earlier analyses, which have included parametric studies evaluating ranges of estimates for shear strengths and pore water pressure generation during dam construction. In the remainder of this section, the Panel provides initial findings based on the information that has been presented to the Panel to date. The Panel's findings will be updated in future reports based on further work to be completed by the Project Team.

Based on the information that has been presented, the Panel provides initial findings regarding earthfill dam safety, construction schedule/cost risks, geotechnical/geological investigations, and the observational approach and instrumentation.

### Earthfill Dam Safety

The available analyses indicate that for long term steady state conditions, after construction generated pore water pressures have dissipated, the current earthfill design meets CDA stability guidelines for both the Most Likely Case (MLC) and the Reasonably Worst Case (RWC).

The Project Team has estimated pore water pressures that will be generated during construction in the earthfill dam core and in the foundation bedding planes for the MLC and RWC. The estimated construction pore water pressures are consistent with pore water pressures measured to date during construction of the upstream cofferdam and the Relocated Surplus Excavated Material (RSEM) sites, and these estimated pore water pressures seem reasonable. However, the construction-generated pore water pressures constitute one of the greatest uncertainties in the analysis, which must be and are being recognized in evaluating dam safety and the construction schedule/cost risks.

Analyses completed to date indicate that, for the estimated construction pore water pressure generation and dissipation, the CDA stability guidelines can be met with the current earthfill dam design for the MLC and with the addition of a relatively modest amount of stabilizing fill at the downstream slope and toe for the RWC. Analyses have indicated that increases of up to 20 percent in factor of safety can be achieved by readily constructible berm and toe fill configurations, if that should be needed.

Based on the range of parametric studies that have been completed, we are confident that a safe earthfill dam structure can be constructed at Site C meeting the Canadian Dam Association (CDA) Dam Safety Guidelines.

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In our opinion, the earthfill dam type is a particularly appropriate choice for the foundation conditions at Site C. The slopes of an earthfill dam can be flattened as necessary to provide stability even with the low strength foundation bedding planes. In addition, an earthfill dam is tolerant of deformations, particularly when designed with wide core, filter, and transition zones, as is the case for the Site C earthfill dam design.

### **Construction Schedule/Cost Risks**

The Project Team is well aware of potential impacts to schedule and cost that could result from higher than expected construction-generated pore water pressures or other unexpected foundation and earthfill dam performance, and strategies are being developed to limit the impacts of such occurrences.

Based on the completed analyses, downstream toe berm and fill placements within the currently planned contingencies will most likely address any observations. As noted above, readily constructible berms and fills, which we understand would be within the current budgetary proposal, could increase factors of safety by up to 20 percent, according to the completed analyses. The challenge would be to implement any required changes in a manner that does not adversely affect schedule and cost.

The Project is planning for placement of additional fill downstream of the downstream cofferdam to create a staging area and provide additional stability during construction. The additional staging area fill is sufficient to meet CDA guidelines for the RWC. This additional stability is part of a mitigation strategy to reduce the risk of impacting the schedule during construction, if higher than anticipated pore water pressures are encountered.

Although we believe that it is very likely that any observed unexpected performance could be addressed within the current budgetary proposal, the possibility of deviations from expected behavior greater than the RWC cannot be entirely ruled out. Such greater deviation from expectations could still be safely addressed by additional downstream fill placements or temporarily pausing fill placement to allow construction-generated pore water pressures to dissipate. However, such measures could further impact cost and schedule.

### **Geotechnical/Geological Investigations**

Although geotechnical and geological investigations have been limited to areas outside of the riverbed, we believe that the available data from the earthfill dam investigations and the construction of cofferdams, combined with knowledge of the rock formations obtained from the right abutment investigations, is satisfactory to characterize foundation conditions for purposes of the earthfill dam design.

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February 15, 2021

### Observational Approach and Instrumentation

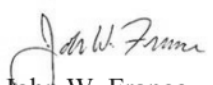
In our opinion, the planned observational approach and instrumentation program for the earthfill dam are reasonable and appropriate. After the experience on the right abutment, the Project Team has added instruments to the originally planned three earthfill dam instrumentation sections and added two more earthfill dam instrumentation sections. The planned instruments should be sufficient to monitor the construction-generated pore water pressures and movements during construction so that adequate stability can be maintained.

### STATEMENT OF LIMITATIONS

The Panel functioned as independent reviewers of the methodologies used by the Project Team for analysis and design of the earthfill dam, based on information provided by the Project Team. Given the large amount of work being completed by the Project Team and the associated voluminous documentation, it was not possible for the Panel to perform a detailed review of all of the material in the available time. In particular, the Panel has not performed detailed checks of calculations and designs completed by the Project Team. Such detailed checks are provided by the quality control/quality assurance programs for the Project. The Panel provides its opinions concerning the methods and approaches being used based on information provided by the Project Team. However, the ultimate decisions and responsibilities for the designs remains with BC Hydro.

Our review services were performed within the limits prescribed by BC Hydro in a manner consistent with the level of care and skill normally exercised in the current standard of professional engineering practice. No other representation to BC Hydro, expressed or implied, and no warranty or guarantee is included or intended.

Respectfully submitted,

  
John W. France

  
Kaare Hoeg

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in  
PUBLIC  
VERSION

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**Appendix E**

~~Site C Technical Review Panel~~  
~~John W. France, P.E., D.GE., D.WRE and Kaare Hoeg, ScD, NAE~~  
**REPORT NO. 3**  
**April 6, 2021**

## EXECUTIVE SUMMARY

This report presents an update to the Technical Review Panel's (Panel's) findings subsequent to Panel Reports Nos. 1 and 2, issued on January 22, 2021 and February 15, 2021, respectively.

In the Panel's opinion, the Engineering Design Team (EDT) has been proceeding well with the design of the right bank enhancements. The principal focus of the recent work has been on analyses to define the number, size, and depth of the pile system, so that the steel for the piles can be ordered. The Panel agrees with this focus, since ordering the steel for the piles soon is required to limit schedule and cost risks.

The optimization work has resulted in a recommended pile system consisting of:

1. A total of 96 concrete-filled steel pipe piles.
2. Each pile will be installed in a 2.4-m diameter drilled shaft.
3. Each pile will include 2.0-m diameter steel casing with 38mm thick wall.
4. This configuration results in a 200-mm thick, concrete-filled annulus outside the steel wall.
5. 50% of the piles will extend to 350-m Elevation and the other 50% of the piles will extend to 360-m Elevation.

The recommended pile system is substantially reduced from the preliminary design developed after the discovery of the unexpected movements beneath the roller compacted concrete (RCC) buttress. The preliminary design consisted of 255 piles, all with 3.0 m diameter. The principal reasons that the recommended pile system is significantly less than that in the preliminary design are that 1) investigations have established that an active wedge does not exist in the rock behind the RCC buttress and is very unlikely to develop due to the deformation restraint from the pile system, and 2) additional investigations, including lateral pile load tests, have provided improved understanding of bedrock properties.

The pile system recommendation is supported by detailed numerical analyses indicating calculated displacements that are less than design criteria established in a revised Design Basis Memorandum (DBM) for all cases identified. In addition, "stress test" deformation analyses indicate that the recommended pile system has reserve capacity to limit deformations for loads even greater than those identified in the DBM. Stability analyses completed by the EDT indicate that the design configuration meets CDA stability guidelines without inclusion of the piles for all load cases identified in the DBM. Hence, including the piles to meet deformation criteria will provide reserve stability capacity beyond that required to meet CDA guidelines.

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In the Panel's opinion, the analyses have been completed following best professional practices and the recommended pile system is well supported. It is reasonable to proceed to procure the steel for the recommended system. It is possible that the pile system could be refined and optimized somewhat further, but the risks of costly delay claims from the contractor would likely more than offset the benefits of further optimization.

The EDT has also been progressing a risk analysis for the approach channel water control features and a hydrogeological analysis of the right bank. In the Panel's view, the risk analysis has been thorough and complete and has identified opportunities for refinement of the final design of the water control features. The hydrogeological analysis of the right bank will help to inform decisions on the final design of the water control features for the right bank.

The Panel looks forward to reviewing the final design of the right bank enhancements, supported by the finalization of the numerical analyses, stability analyses, approach channel risk analysis, and hydrogeological analysis.

There have been no significant changes in the earthfill dam design or stability analysis since Panel Report No. 2 issued on February 15, 2021. The Panel's findings remain unchanged from those stated in Report No. 2. BC Hydro has advised the Panel that fill for a construction laydown area will be placed at the downstream toe of the earthfill dam before embankment fill will be advanced to significant height. As noted in Report No. 2, placement of this fill increases the stability of the earthfill dam, and the Panel supports the decision to proceed with its placement.

As the Project prepares for the upcoming resumption of core trench preparation and fill placement, the Panel was recently briefed on the identification of deterioration of some of the protective shotcrete previously placed in the core trench excavation and of a limited depth of the shale underlying the shotcrete. The Panel supports BC Hydro's plan to remove all of the previously placed shotcrete from the cutoff trench excavation and then to excavate any deteriorated shale and prepare the surface immediately before placement of cutoff trench fill to address this critical aspect of the earthfill dam construction.

## **INTRODUCTION**

At the request of BC Hydro, the Technical Review Panel (Panel) has prepared this report as an update to the Panel's previous Reports Nos. 1 and 2, dated January 22, 2021 and February 15, 2021, respectively.

Since February 15, the Panel has attended briefings to the Technical Advisory Board (TAB) by the Engineering Design Team (EDT) on February 24, March 12, and March 29, 2021, during which the EDT updated the TAB on activities related to both the right bank and the earthfill dam. The Panel has also reviewed project information provided by BC Hydro.



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**April 6, 2021**

Based on the information provided to date, the Panel provides updated findings concerning the proposed right bank design upgrades and the earthfill dam.

**FINDINGS**

**Right Bank Design Enhancements**

In the Panel's opinion, the EDT has been proceeding well with the design of the right bank enhancements. The principal activities completed since February 15 include optimization of the pile system design, a risk analysis for the approach channel water control features, and a hydrogeological analysis of the right bank. Work remaining to be done includes finalization of the configuration of the pile cap in the powerhouse tailrace, the approach channel, the foundation drainage system, and the foundation grouting program; compilation of the drawings and specifications for the enhancements; and preparation of a design report documenting the analyses of record for the design.

Pile System Design – The principal focus of the recent work has been on analyses to define the number, size, and depth of the pile system, so that the steel for the piles can be ordered. The Panel agrees with this focus, since ordering the steel for the piles soon is required to limit schedule and cost risks.

The optimization of the pile system design was based on updated design criteria established in revisions to the Design Basis Memorandum (DBM). As noted in Panel Report No. 1, the principal design criterion is to limit the deformations in the foundation to provide both safety and serviceability. The design criteria also include required stability factors of safety to conform to Canadian Dam Association (CDA) guidelines. The design criteria are being considered for a number of assumed loading conditions, ranging from the best estimate of normal operation loading to a loading resulting from the extremely unlikely case of failure of the approach channel lining and failure of the right bank foundation drainage system, such that water pressures in open joints in the foundation rock and at the contact with the rock and the roller compacted concrete (RCC) buttress rise to levels corresponding to the reservoir level (a condition designated Extreme 4).

The criterion established for limiting deformation was a calculated horizontal displacement no greater than 10 mm at the most upstream line of piles. Deformation at the downstream edge of the approach channel liner was also checked in the analyses. The Panel supports both the selected displacement limit at the piles and the check of deformations at the liners.

Furthermore, the computed displacements for the maximum design natural earthquake and estimated seismic events induced by hydraulic fracturing for petroleum development must also be less than the horizontal displacement criterion.

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The optimization work has resulted in a recommended pile system consisting of:

1. A total of 96 concrete-filled steel pipe piles.
2. Each pile will be installed in a 2.4-m diameter drilled shaft.
3. Each pile will include 2.0-m diameter steel casing with 38mm thick wall.
4. This configuration results in a 200-mm thick, concrete-filled annulus outside the steel wall.
5. 50% of the piles will extend to 350-m Elevation and the other 50% of the piles will extend to 360-m Elevation.

For optimization of the pile system design, Extreme 4 was the controlling load case. Numerical analyses of this case for the recommended pile system that have been presented to the Panel to date, resulted in calculated horizontal displacements of 5mm at the upstream piles for both the powerhouse and the spillway, and calculated deformations of 11mm and 9mm at the approach channel liner for the powerhouse and the spillway, respectively. The analyses also included consideration of variations in the plan layout of the piles to limit tensile stress development in rock surrounding the piles. Numerical analyses completed to date have also indicated that, for all cases identified in the DBM except Extreme 4, the calculated deformations at the upstream piles are less than 2 mm.

To further test the robustness of the recommended pile system, the EDT completed additional numerical analyses for loads more severe than the Extreme 4 case (i.e. stress testing). The results indicated that the enhanced design with the recommended pile system has significant reserve capacity.

Stability analyses completed by the EDT indicate that the design configuration meets CDA stability guidelines without inclusion of the piles for all load cases identified in the DBM. Hence, including the piles to meet deformation criteria will provide reserve stability capacity beyond that required to meet CDA guidelines.

In the Panel's opinion, the analyses have been completed following best professional practices and the recommended pile system is well supported. It is reasonable to proceed to procure the steel for the recommended system. It is possible that the pile system could be refined and optimized somewhat further, but the risks of costly delay claims from the contractor could likely more than offset the benefits of further optimization. The recommended pile system is substantially reduced from the preliminary design developed after the discovery of the unexpected movements beneath the RCC buttress. For comparison, the preliminary design consisted of:

1. A total of 255 concrete-filled steel pipe piles.
2. Each pile to be installed in a 3.2-m diameter drilled shaft.
3. Each pile to include 3.0-m diameter steel casing with 22-mm thick wall.

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4. All piles extending to 350-m Elevation.

In addition, the much larger number of piles of larger diameter in the preliminary design would have required larger and more expensive pile caps. The Panel notes that the principal reasons that the recommended pile system is significantly less than that in the preliminary design are that 1) investigations have established that an active wedge does not exist in the rock behind the RCC buttress and is very unlikely to develop due to the deformation restraint from the pile system, and 2) additional investigations, including lateral pile load tests, have demonstrated the rock is stronger and stiffer than the values provided from the earlier investigations.

Detailed specifications for pile installation remain to be developed, but large diameter drilled pile installations have a long-standing history of application in the construction industry, so established precedents exist for developing the required specifications. Further, successful installation of drilled piles at the site was demonstrated by the installation of the two piles used for the lateral load tests. The Panel looks forward to reviewing the final drawings and specifications for the pile system to be included in the right bank enhancements.

Approach Channel Risk Analysis – The EDT has been completing a risk analysis of the various water control features to be included in the approach channel and the right bank. These features include the approach channel liners and associated under-drains, foundation grout curtains in the vicinity of the approach channel, and right bank drainage features (the right bank drainage tunnel and drilled drain holes). The purpose of the risk analysis is to identify potential measures to improve the robustness and resiliency of the water control features.

The EDT has presented the results of the risk analysis in briefings to the TAB and the Panel. In the Panel's view, the risk analysis has been thorough and complete and has identified opportunities for refinement of the final design of the water control features. The Panel looks forward to reviewing the final design of these features.

Right Bank Hydrogeological Analysis – The EDT has been performing a detailed hydrogeological analysis of the right bank to help inform decisions on the final design of the water control features for the right bank. The analysis is still in progress, and the TAB and the Panel have been briefed on the results to date. The Panel looks forward to reviewing the final analysis and its application to final design of the right bank water control features.

#### **Earthfill Dam**

There have been no significant changes in the earthfill dam design or stability analyses since Panel Report No. 2 issued on February 15, 2021. The Panel's findings remain unchanged from those stated in Report No. 2. BC Hydro has advised the Panel that fill for a construction laydown area will be placed at the downstream toe of the earthfill dam before embankment fill will be advanced to significant height. As noted in Report No. 2, placement of this fill increases the stability of the earthfill dam and the Panel supports the decision to proceed with its placement.

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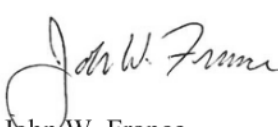
The Project has been appropriately focused on the foundation preparation and grouting for the main dam and the upcoming resumption of core trench preparation and fill placement. The Panel was recently briefed on the identification of deterioration of some of the protective shotcrete previously placed in the core trench excavation and of a limited depth of the shale underlying the shotcrete. BC Hydro has advised the Panel, that the planned approach is to remove all of the previously placed shotcrete from the cutoff trench excavation and then to excavate any deteriorated shale and prepare the surface immediately before placement of cutoff trench fill. The contact between the cutoff trench fill and the underlying shale foundation is a critical aspect of the earthfill dam construction, and the Panel supports BC Hydro's plan for addressing this aspect of construction.

**STATEMENT OF LIMITATIONS**

The Panel functioned as independent reviewers of the methodologies used by the EDT for analysis and design of the right bank enhancements and the earthfill dam, based on information provided by the EDT. Given the large amount of work being completed by the EDT and the associated voluminous documentation, it was not possible for the Panel to perform a detailed review of all of the material in the available time. In particular, the Panel has not performed detailed checks of calculations and designs completed by the EDT. Such detailed checks are provided by the quality control/quality assurance programs for the Project. The Panel provides its opinions concerning the methods and approaches being used based on information provided by the Project Team. However, the ultimate decisions and responsibilities for the designs remains with BC Hydro.

Our review services were performed within the limits prescribed by BC Hydro in a manner consistent with the level of care and skill normally exercised in the current standard of professional engineering practice. No other representation to BC Hydro, expressed or implied, and no warranty or guarantee is included or intended.

Respectfully submitted,

  
John W. France

  
Kaare Hoeg

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## **Site C Clean Energy Project**

### **Technical Advisory Board**

## **Summary Statement on Safety of Dam Structures**

**January 22, 2021**

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## **1. Introduction**

The design of the Site C Project was conceived on the basis of satisfying all Canadian Dam Association (CDA) guidelines for ensuring the safety of such structures. This was supplemented by worldwide expertise and the experience that BC Hydro together with its engineering consultants has in designing, building and operating such structures. Parameters were developed for Site C that assured CDA compliance would be met, and these were incorporated in a Design Basis Memorandum (DBM), which has been followed as the project developed.

The Project Assurance Board has requested a summary assessment from the Technical Advisory Board (TAB) related to their confidence in the design of the dam structures associated with the Site C Project, particularly with respect to safety and the adoption of best practices. The context of the request is to assist the Project Assurance Board in the evaluation of the technical integrity of the Project as it proceeds to finalize the foundation enhancements that have been found necessary in the right bank of the main dam.

The summary assessment has been developed in response to five questions which are addressed sequentially below.

## **2. Questions**

### ***1. Were the analysis and investigations that formed the basis of the design at the time of the authorization for construction of the Project appropriate and in accordance with best practices?***

Investigations for the Site C Project began in 1973. In 1978, it was confirmed that the current site was preferable. The current project was approved in 2014. The specific site investigations that began in 1975 and continued to project approval are listed in Appendix A.

In accordance with best practices:

- i. BC Hydro is an experienced dam owner/operator and together with its engineering consultants had intimate knowledge of the geological challenges associated with dam construction at Site C. This arose from their experience elsewhere along the Peace River, an awareness of how severe geotechnical considerations prevail eastward in Alberta and Saskatchewan, and a detailed appreciation of the valley rebound geomechanics that created the complex conditions that had to be addressed.
- ii. BC Hydro retained independent Technical Advisory Boards for the period 1978-1989 when feasibility of the Base Case design was evolving and thereafter from 2010 to date when the project was renewed and progressed through final design into construction. This is an established practice for major hydroelectric projects and

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allows for leading international experience to be introduced into the planning, design and construction.

- iii. BC Hydro and the Engineering Design Team (EDT) retained individual Subject Matter Experts (SME) as appropriate for additional advice throughout the process.
- iv. Notwithstanding the comprehensive investigations carried out in the 1970s, additional investigations were initiated in 2008 which concluded that the geological/geotechnical model that had been developed and the associated Base Case design remained valid. This involved diversion tunnels within the left bank of the river valley, an embankment fill dam across the valley, and the powerhouse/spillway structure at the right bank of the valley.

In 2010 the EDT undertook an optimization to compare alternate arrangements to either validate the Base Case or modify it before proceeding to final design. This was an important step in the evolution of the design, and the TAB recommended that a formal structured decision-making process be adopted. It was heavily weighted to minimize geotechnical risk. The earthfill dam with the RCC buttress was confirmed as the preferred general arrangement and this conclusion was supported by the SMEs and the TAB.

At the time of the implementation design in 2014, the deepest bedding plane shear that was identified as potentially impacting the stability of the right bank structure was bedding plane BP 33 at El. 378 m. Hence the foundation of the RCC buttress was set at El. 375 m, 3 m below BP 33. An assessment of a bedding plane shear below this level was also undertaken. However, the assumed resistance for this feature did not indicate a concern with respect to satisfying safety design criteria.

Finally, the need for adoption of the Observational Method was recognized and implemented as an integral part of assessing safe design, construction and long-term performance.

In the view of the TAB, the evolution of the design to the time of authorization, both consistently and diligently, was in accordance with best practices.

***2. Were the practices being used during construction of the Project to confirm foundation conditions in accordance with best practices?***

The final design adopted for construction employed an RCC buttress on the right bank primarily because this configuration was assessed to be optimal among the alternative choices to manage the geotechnical challenges associated with constructing on or adjacent to the right bank. Nevertheless, uncertainties existed, and they were recognized.

Best practices in the face of geotechnical uncertainties is to employ the Observational Method (OM). This relies on comprehensive instrumentation to validate that the ground



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response is performing in a manner consistent with the design intent. To be effective, it also assesses the practicality of invoking mitigative measures if observations and related analyses reveal that they are necessary. The OM to be adopted at Site C is documented in detail in the project records (see Appendix B). It relies on both skillful installation of the appropriate instruments and diligent interpretation. It also relies on validation of the geological model by observations and mapping to confirm that conditions being encountered are as anticipated or whether design modifications are required. BC Hydro has considerable experience with the application of the OM and it was implemented in an effective manner.

Considerable monitoring of the RCC buttress excavation and construction was intended to be executed from the Right Bank Drainage Tunnel (RBDT) prior to the start of the RCC excavation. The construction of the RBDT did not occur in a timely manner, which resulted in an incomplete history of the response of the rock during the excavation of the powerhouse buttress foundation. This was ultimately addressed by instrumentation and drainage measures installed from the surface. As anticipated, excavation-induced movements were observed but none were regarded as sufficiently consequential to affect the design.

In concert with these observations, detailed geological mapping was conducted and compiled in state-of-the-art software that integrated all geological information obtained on site in a three-dimensional framework. This attention to detail, which is invaluable, provides another example of best practices employed at Site C.

Following the recorded movement history associated with the powerhouse excavation and RCC placement, the instrumentation to monitor the spillway excavation was revised and inclinometers that monitor bedding plane slip were installed to depths below El. 375 m, the bottom of the RCC foundation. While potential slip at greater depths had been considered in the design, the resistance along these deeper bedding planes was assessed to be too high to make them critical to the design.

As excavation continued for the spillway, small movements, about 5 mm, developed at El. 372 m at a location now referred to as BP 33e. In many projects, monitoring to this accuracy either would not be undertaken or would not be reliable, and such small movements would not be regarded as consequential. A measure of the best practices executed at Site C is the reliability of the data and the commitment to interpret all data that informs matters of safety.

This latter commitment, making use of numerical modelling techniques that have only become practical and reliable in recent years, revealed that the frictional resistance was significantly less than presumed values adopted in the design for bedding planes. These low values were consistent with lower bound values determined from laboratory tests. When used in design, the factors of safety associated with extreme load cases, as

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specified for the project, appeared to be no longer satisfied, prompting a comprehensive study of foundation enhancements to assure dam safety.

The application of the OM produced results as intended in an expedient manner. It is the view of the TAB that without the commitment to best practices, reliable monitoring of the small displacements of concern could not be assured and the related interpretation may have been highly uncertain. The OM in practice relies on a contingency design to be implemented in the event conditions are worse than anticipated and observed. In this case, the contingency case for bedding plane slip at depths below El. 372 m adopted a frictional resistance of 16°. Neither the EDT nor the TAB anticipated that these apparently tight features would mobilize a resistance of  $\approx 11^\circ$ , near the lower limit encountered in laboratory testing. It could be surmised that had they done so, the mitigation design might have involved foundation enhancements similar to those currently under consideration.

***3. Has the project team evaluated and identified the appropriate changes to the design for the RCC buttress foundation?***

The project team has identified and evaluated appropriate changes to the design for the RCC buttress foundations. This was accomplished by utilizing field geologic information, evaluating field instrumented data and engaging in a detailed and intensive program of “state-of-the-art” structural analysis based upon the information gained from the detailed geologic, hydro-geologic and structural engineering.

Findings in the right bank arising from the geological / geostructural synthesis have raised concerns with respect to satisfying some of the original Design Basis Memorandum (DBM) requirements. The assessment of these concerns has progressed along a path that originally considered that factors of safety associated with extreme loading cases would not be satisfied. This is no longer the case since newly obtained data on rock strength and stiffness at depth support the view of the TAB that such factors of safety can be satisfied. However, the reassessment of the design has recognized the need to provide measures that would reduce deformations of the supported rock to the degree practical and this is now the primary focus of the foundation enhancements. This will prevent the evolution of loading conditions associated with substantial rock weakening that were not specifically foreseen in the original DBM with the data available at that time for analysis. In addition, extra foundation enhancements provide the robustness and resilience to respond to residual uncertainties that might exist. The TAB and the Engineering Design Team (EDT) engaged in extensive discussions evaluating the new information, the logic of past design assumptions, particularly for the extreme case, the appropriate analyses to be used going forward to analyze the situation in more detail, and a schedule to develop executable enhancement measures.

As a result of recent information and understanding of the foundation conditions within the right bank, the EDT had investigated several foundation enhancements options to

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increase the stability of the right bank powerhouse and spillways buttresses. Systems containing shear walls, large diameter piles, prestressed anchors, and concrete filled tunnels were considered.

Since it was and is a very complex condition to analyze both geologically and structurally, an evaluation was conducted using a Multiple Accounts Analysis (MAA). This process helps establish an optimal solution to meet the project objectives; dam safety, regulatory, and engineer-of-record requirements; and achieve owner and operator acceptance. The optimal solution considers construction safety, environmental issues, the long-term quality of the project infrastructure, technical risk, constructability, operability, schedule and cost.

The MAA is effective in integrating multiple points of view, with flexibility in efficiently doing sensitivity studies by modifying the weightings if there is interest in assessing the robustness of the conclusions. It also provides a valuable record of the decision-making process.

The MAA was conducted on both the powerhouse and spillway buttresses and considered several options to increase the stability of the structures. Various options were considered to reduce the driving forces, such as controlling the water load on the structures by introducing drainage facilities and others introduced restraining forces such as anchors and tendons. Still others considered structural foundation features developed within the structures and anchored within the rock foundations, such as shear walls and large diameter piles.

***4. Does the design of the Project, including processes followed during construction, incorporate principles of a safe design?***

The Site C Project does incorporate safe design as well as construction processes and principles for safe development of a large hydroelectric project. As described in the response to Question 1 above, the best practices have incorporated BC Hydro's and its consulting design team's experiences as well as the advice of several independent and world-wide technical experts. Various alternative project arrangements were evaluated in favor of a more robust and safe design, as well as construction. The safe design principles have been practiced throughout the project, beginning with geotechnical studies in the 1970s and continue through to today, where numerous good practices, like the Observational Method of monitoring the performance of structures during construction, perform a safety function. In other areas, geologic studies and mapping of foundations are conducted to verify anticipated properties and thus safe and efficient designs. The geologic maps and geotechnical studies that are developed during construction not only facilitate and guide competent designs and construction but also form a record for both construction and future reference, should it be necessary.

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In addition, the TAB anticipates that the operations manual will ensure that all elements of the facility that are critical for safety will continue to perform as intended.

Methods used in developing safe hydraulic structures at Site C utilize both numerical as well as physical modelling for design of hydraulic structures. The hydraulic structures are major structures and demand special attention for safe and efficient functioning. Major hydraulic structures like the spillways, gates and penstocks are designed to withstand extreme events like floods and earthquakes and must be designed to safely handle these events while also being constructible.

A significant feature of the safety in design is developing and adhering to design criteria developed for the project. This establishes the criteria required by BC Hydro to ensure overall safety and the commitment by the EDT to meet them. Specific criteria are established and factors of safety, which reflect the reserve resistance of the structures against failure, are defined. Different load cases are also specified that must be investigated. The criteria and load cases are consistent with international practice and the practice recommended by the Canadian Dam Association. In addition to meeting the target factors of safety, the current design also recognizes the need to satisfy the limiting deformation criteria. The TAB expects that BC Hydro's existing dam safety program will embrace the long-term assurance of safe performance through its operations manuals and other aspects of its safety program.

Analyses have shown that the biggest factor contributing to the potential instability of the spillway and powerhouse RCC buttresses is water loading within the right bank hillside. A recent hydrogeologic study was conducted to determine and evaluate the in-situ permeability of the various rocks in the right bank. This concern and ability for rock formations to conduct water, both laterally and vertically within the formations, was recognized in the tender design with the provision of a Right Bank Drainage Tunnel and by minimizing the potential for water ingress into the hillside from above by water-proofing the approach channel above the slope. However, the behaviour of the hillside upon excavation has shown an extended potential for relaxation movement and cracking, possibly extending into the approach channel. This has necessitated the robustness of channel waterproofing arrangements to be reviewed as well as the means of generally ensuring the drainage of the hillside. Maximum reliability is essential to achieve the controlling loading requirements in the design. Various arrangements are now being developed and evaluated by the Engineering Design Team (EDT), all of which the TAB supports in principle, with some comments on matters of detail. A detailed Failure Mode Analysis (FMA) is presently being conducted to evaluate all aspects of the approach channel watertightness and robustness.

The evolution of the selected design strategies is documented in a report on the structured decision-making analyses based on the Multiple Account Analysis methodology. In this

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procedure, a distinction is made between “musts” and “wants”. Not violating the design criteria, as reflected by the DBM, is categorized as a “must”. With respect to the approach channel, the current FMA also emphasizes the need to minimize risk through adoption of the As Low As Reasonably Practicable (ALARP) considerations.

The development of good and safe practices both during design and during construction is founded in the following elements and principles in order of importance, namely Safety, Quality, Schedule and Budget. Safety is a “must” principle and must be adhered to and practiced, ensuring the safety of all involved in the project. Quality during design, as well as quality of the constructed project, is also a “must” element and feature, since the completed project is a minimum 100-year commitment to the Owner. Quality is an element that ensures both safety in design as well in construction. The elements of Schedule and Budget are “wants” and affect both design and construction.

**5. What is the status of the earthfill dam with regard to safe design?**

These issues have recently been addressed in TAB reports 21A, 22 and 23. Excerpts follow. The current status remains unchanged.

**Excerpt from TAB Report 21A, dated April 2020**

*Question 4. Does the Board have any comment on the earthfill dam foundation review?*

The status of design of the stability of the earthfill dam on its foundation was summarized, together with the past foundation characterization that controlled stability. Detailed assessment of current conditions suggests that this foundation characterization be revised based on the more detailed information currently available.

Progress with respect to this revision suggests that the controlling foundation conditions are more severe than previously used in design with respect to 1) residual strength 2) additional roughness, 3) continuity and depth of controlling bedding planes, and 4) post peak brittleness. The magnitude of pore pressures both at the end of construction and with post construction dissipation remain uncertain and this also has to be considered in the reassessment of stability.

The TAB supports the current effort to advance revised operational properties and to update the stability analysis related to the original design criteria. In so doing, the TAB recommends the following:

1. A distinction should be made for a most likely case (MLC) and reasonably worst case (RWC). Appropriate factors of safety should be recommended for each case and it is recognized that the observational method should be used where appropriate to identify if the reasonably worst case is developing. If the RWC is

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developing, a default design will have to be implemented to bring the RWC up to the appropriate standard and must be demonstrated as feasible.

2. It is conceivable that the distinction between the MLC and the RWC will not be large given the significant brittleness displayed by the laboratory data with respect to the shear strength of the bedding planes.
3. It should be recognized that many agencies adopt lower factors of safety when design is based on residual strength or close to it.

The role of the application of the 3D analysis should be considered in these analyses because of the potential large 3D contributions to stability.

**Excerpt from TAB Report No. 22, dated June 2020**

*Question 6. Does the TAB have any comment on the status of the studies on the foundation conditions for the earthfill dam?*

Arising from the new findings at the Right Bank, it was timely to undertake an updated assessment of the design of the earthfill dam, particularly related to its foundation. This was presented to the TAB for review on May 8, 2020.

The update contained: 1) a review of the foundation geology, 2) a review of the shear strength mobilized along bedding planes, 3) a review of the rock mass strength, 4) a consideration of the model adopted to forecast pore pressures, 5) stability analyses in both two and three dimensions, 6) an assessment of Right Bank deformations, and 7) a summary of the proposed path forward utilizing the observational method.

New information had become available not only from the Right Bank investigation, but also from studies for the design of the cofferdam by the Contractor and from foundation responses. This has resulted in improved foundation characterization leading to some minor changes in excavation for the dam core trench. Shear strength characterization is little changed from that adopted in design but knowledge of deeper weak bedding planes has revealed some potential reduction in Factor of Safety without involving three-dimensional considerations. There has been increasing reliance on three-dimensional restraints in practice and the TAB is of the view that they can be adopted at Site C, given precedence elsewhere. There has been limited advance with respect to pore pressure response during construction. Stability analyses have assumed that they will dissipate during construction, prior to reservoir filling and this remains a matter of observational confirmation.

One matter of conceptual advance in the design of the earthfill dam is the re-casting of the design in terms of a Most Likely Case (which is the business case and has a Factor of Safety of 1.5) and the Reasonable Worst Case (which is the contingency case and has

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a Factor of Safety of 1.1). Observations during construction will be designed to discover whether conditions consistent with the Reasonable Worst Case might be developing. Invoking a Factor of Safety of 1.1 limits the opportunity for unacceptable deformations to develop while a Factor of Safety acceptable for operating conditions is being restored. The updated design has demonstrated that adding downstream berms is one practical method to increase stability if warranted.

Based on this updated review and extension of the observational method to formally recognize both the Most Likely Case and the Reasonable Worst Case, the TAB is content with the status of the studies on the foundation conditions for the earthfill dam and the proposed way forward.

**Excerpt from TAB Report No. 23, dated October 2020**

*Question 3 - Does the TAB believe the information presented to date from the u/s cofferdam (pile installation, grouting and piezometric response) and the core trench (mapping, grouting and performance monitoring) supports the Most Likely Case or is the trend towards a Reasonably Worse Case for the earthfill dam?*

The status of the studies on the foundation conditions for the earthfill dam was last reviewed and discussed in Report No. 22, submitted in June 2020. As presented, best practice for the design and construction of dams on clay shale foundations employs the observational method in a precautionary-based design. A distinction is made in design between the Most Likely Case (MLC) which is the basic business case and requires a Factor of Safety under operational conditions of 1.5 and the Reasonably Worst Case (RWC) which is evaluated to recognize the residual uncertainties that exist prior to construction and requires a Factor of Safety of 1.1. The RWC is evaluated to ensure that no uncontrollable displacements could develop while a contingency design is implemented to provide adequate reserve resistance for the service conditions. The development of the required mitigation measures is part of the RWC design assessment.

To date, no information from any studies on performance observations have been obtained to modify the design basis for the earthfill dam. Observations and assessment of performance have always been part of the design. Comprehensive monitoring of deformation and pore pressure are being adopted and if either indicate that conditions are leading to the RWC condition, downstream slope-flattening is recognized as a proven mitigation measure in such cases and would most likely be favoured. Depending on the detailed response, additional advanced deformation analyses might be undertaken to assess the consequences of the trends observed.

However, at the right abutment of the dam, the powerhouse restricts the opportunity to invoke such measures to a large extent and tolerable deformations are more restricted. Recent construction for the earthfill dam indicates that foundation movements are



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directed toward the river valley, and not toward the powerhouse. These are favourable observations. Nevertheless, consistent with precautionary-based design, it would be prudent to assess local structural details at the powerhouse service bay boundary that would accommodate additional foundation deformations if they were to occur in this direction. However, deformations in this critical direction are already restrained by three-dimensional effects which limit the scale and likelihood of the need for any mitigation.

### 3. Summary

In the view of the Technical Advisory Board, the requirements for safe design have been honoured as an over-arching principle in all phases of the Project, from initial feasibility to current construction. In addition, best practices have been adopted from the initial site investigation studies to the current implementation phase. They are expected to continue to the end of construction and thereafter into operation.

Respectfully submitted,



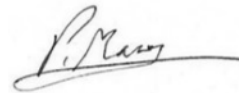
Dr. Norbert R. Morgenstern



Dr. Wynfrith Riemer



Mr. Joseph L. Ehasz, P.E.



Dr. Peter J. Mason

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## **Appendices**

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## **Appendix A – List of Site Investigations**

Site investigations at Site C began in 1975. At the time of project approval in 2014, the following investigations had been completed:

- 211 diamond drill holes with a total length of over 13,600 m
- 29 large diameter (0.9 m) drill holes (LDH) with a total length of 1,810 m. The deepest LDH was 96 m
- 202 percussion drill holes with a total length of over 3440 m
- 271 rotary holes with a total length of over 18,180 m
- 10 sonic drill holes with a total length of over 610 m
- 10.4-m-wide 45 m long test chamber on the left bank
- 5 exploratory adits (tunnels) with a combined length of 950 m. Adits 3 and 5 are on the right bank
- 268 test pits with a total depth of 1230 m
- 12 exploratory trenches with a total length of 1,220 m
- 29 seismic lines with a total length of over 13,000 m

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## **Appendix B – References**

Site C (2017) Site C Clean Energy Project - Implementation Design RCC Buttress -  
Observational Method, prepared by Klohn Crippen Berger Ltd. and SNC-Lavalin Inc. for  
BC Hydro. BKS-03-122

Technical Advisory Board (April 2020) - Site C Clean Energy Project - Meeting No. 21A Report

Technical Advisory Board (June 2020) - Site C Clean Energy Project - Meeting No. 22 Report

Technical Advisory Board (October 2020) - Site C Clean Energy Project - Meeting No. 23  
Report

## **Site C Clean Energy Project**

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### **Quarterly Progress Report No. 21**

#### **Appendix F**

#### **Summary of Individual Contracts Exceeding \$10 Million**

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**Table F-1 Summary of Contracts Exceeding \$10 million – as at March 31, 2021<sup>24</sup>**

Supplier	Scope of Supply	Releases		Total Releases to Date	Expended to Date <sup>25</sup>	Estimate at Completion <sup>26</sup>	Current Contract Status	Comments
Klohn Crippen Berger Ltd.	Engineering Design Services	Release 1	1.4	s.13; s.21	119.7	s.13; s.21	Active	Contract for design for core components including main civil works and generating station and spillways including integration. Contract managed via yearly work releases anticipated to be ongoing until 2024. Estimate at Completion includes anticipated amount for Release 12.
		Release 2	5.8					
		Release 3	4.0					
		Release 4	6.6					
		Release 5	6.7					
		Release 6	5.1					
		Release 7	15.8					
		Release 8	12.5					
		Release 9	14.5					
		Release 10	17.3					
		Release 11	16.0					
		Release 12	s.13; s.21					
SNC-Lavalin Inc.	Engineering Design Services	Release 1	1.1		160.4		Active	Contract for design for core components including main civil works and generating station and spillways including integration. Contract managed via yearly work releases anticipated to be ongoing until 2024.
		Release 2	5.9					
		Release 3	4.2					
		Release 4	6.7					
		Release 5	6.6					
		Release 6	5.4					
		Release 7	15.8					
		Release 8	13.9					
		Release 9	24.9					
		Release 10	26.7					
		Release 11	25.1					
		Release 12	s.13; s.21					

<sup>24</sup> All values are in millions.

<sup>25</sup> Expenditures to date include accruals.

<sup>26</sup> Estimate at completion includes an allocation for future pending change orders.

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Supplier	Scope of Supply	Releases		Total Releases to Date	Expended to Date <sup>25</sup>	Estimate at Completion <sup>26</sup>	Current Contract Status	Comments
Tetra Tech Wei	Engineering Design – Hwy 29	Release 1	0.3	s.13; s.21	28.9	s.13; s.21	Active	Contract for design and owners' engineers' services for roads including access roads and Highway 29. Contract managed via yearly work releases anticipated to be ongoing until 2024.
		Release 2	2.0					
		Release 3	1.0					
		Release 4	0.9					
		Release 5	0.8					
		Release 6	4.3					
		Release 7	10.4					
		Release 8	1.1					
		Release 9	2.1					
		Release 10	5.7					
		Release 13	s.13; s.21					
		Release 14						
		Release 15						
Golder Associates Ltd.	Environmental Consulting	Release 13	3.6	s.13; s.21	26.9	s.13; s.21	Active	Contract for heritage, fish and environmental support services. Contract managed via work releases anticipated to be ongoing until 2024. Reflected in this table are only those work releases within the BC Hydro blanket contract that are related to Site C.
		Release 18	0.2					
		Release 31	7.9					
		Release 42	0.6					
		Release 45	0.4					
		Release 51	1.4					
		Release 53	1.7					
		Release 63	2.2					
		Release 64	0.5					
		Release 65	8.3					
		Release 73	s.13; s.21					
RF Binnie	Engineering Design – Hwy 29	Release 1	0.7	s.13; s.21	36.6	s.13; s.21	Active	Contract for design for Highway 29. Contract managed via yearly work releases anticipated to be ongoing until 2024.
		Release 2	3.0					
		Release 3	0.2					
		Release 4	0.0					

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Supplier	Scope of Supply	Releases		Total Releases to Date	Expended to Date <sup>25</sup>	Estimate at Completion <sup>26</sup>	Current Contract Status	Comments
Hemmera	Wildlife Management Services	Release 5	10.2					
		Release 6	6.8					
		Release 7	s.13; s.21					
		Release 1	0.2	s.13; s.21	3.8	s.13; s.21	Active	Contract managed via work releases anticipated to be ongoing until 2024. Reflected in this table are only those work releases within the BC Hydro blanket contract that are related to Site C.
		Release 2,3,4	0.1					
		Release 5	1.9					
		Release 6,7	0.4					
		Release 8	0.3					
		Release 9	0.4					
		Release 10	0.1					
		Release 11	s.13; s.21					
		Release 12,13, 14, 15, 16						
		Release 17						

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**Table F-2 Summary of Open Contracts Exceeding \$10 Million – as at March 31, 2021<sup>27</sup>**

Supplier	Scope of Supply	Contract Value at Award	Contract Contingency at Award	Internal Contract Value at Award	Expended to Date <sup>28</sup>	Estimate at Completion	Current Contract Status	Comments
Securiguard Services Limited	Guard Services	16.2	s.13; s.21		24.2	s.13; s.21	Active	Scope changes for staff and infrastructure due to protest activities increased the contract value.
ATCO Two Rivers Lodging Group	Worker Accommodation	463.5			482.1		Active	Contract value includes both the construction and operations phases.
Peace River Hydro Partners	Main Civil Works	1,747.5			2,027.6		Active	Work commenced early 2016. Contingency added post award.
Halfway River First Nation SOS International JV	Health Clinic Services	13.3			12.6		Active	Contract ongoing through 2024.
Voith Hydro Inc.	Turbines - Generators	464.3			252.9		Active	Contract ongoing through 2024.
Duz Cho	Blanket Contract for Construction	33.2			65.1		Active	Contract commenced in April 2017 for eastern reservoir clearing, water management sediment control and Portage Mountain Quarry development and operations. Contingency added post award.
s.13; s.21								
Sa-Ra Enerji	Supply of Lattice Tower	13.5			13.6	20.0	Active	Contract commenced in May 2017 to supply 500 kV Lattice towers.
ABB Power Grids Canada Inc.	Supply and Install 550 kV GIS for PCN	17.7			20.0		Closed	Work commenced in 2017. Contingency added post award. Vendor changed name in February 2020.
Aecon-Flatiron-Dragados-EBC Partnership	Generating Station and Spillways Civil Works (Early Works Agreement)	1,603.9			996.9		Active	Contract awarded in March 2018.
REEL COH Inc.	Powerhouse Bridge and Gantry Crane – Supply and Install	23.2			17.4		Active	Work commenced in early 2018.
F&M Installations Ltd.	South Bank Substation Construction	33.3			36.4		Active	Work commenced in early 2018. Contingency added post award.

<sup>27</sup> All values are in millions. Contracts closed in the current reporting period will be removed in the subsequent reporting period.

<sup>28</sup> Expenditures to date include accruals but exclude advances.



Supplier	Scope of Supply	Contract Value at Award	Contract Contingency at Award	Internal Contract Value at Award	Expended to Date <sup>28</sup>	Estimate at Completion	Current Contract Status	Comments
Nexans Canada Inc.	Supply of Overhead Conductors	13.2	s.13; s.21		14.4	s.13; s.21	Active	Work commenced in early 2018. Contingency added post award.
Allteck Line Contractors Inc.	Transmission Line Construction	113.2			119.6		Active	Work commenced in 2018.
ATB Riva Calzoni Hydro Canada Inc.	Hydro Mechanical Equipment	69.0			39.5		Active	Work commenced in 2018.
Saint Augustine Canada Electric Inc.	Generator Terminal Equipment	10.4			2.6		Active	Work commenced in 2019.
Powell Canada Inc.	AC Station Service	12.2			3.3		Active	Work commenced in 2019.
Hyundai Electric and Energy System Co. Ltd	Generator Step-Up Transformer	20.5			2.6		Active	Work commenced in 2019.
M&M Resources Inc.	Construction Services for Fish Habitat	5.9			10.7		Closed	Work commenced in 2018
Minister of Transportation and Infrastructure	Highway 29 & related works	376.3			166.8	Active	Ministry of Transportation and Infrastructure work releases to support Highway 29 related construction work.	
Halfway River IDL Ltd. Partnership	Highway 29 Grading and Paving – Cache Creek West	17.2			16.2	16.2	Closed	Work commenced in 2019
s.13; s.21								
s.13; s.21								
Formula Contractors Ltd	Dry Creek Grading, Paving and Bridge Construction	28.0			7.2		Active	Work commenced in 2020
Formula Contractors Ltd	Farrell Creek East Grading and Paving	12.0			0.4		Active	Work commenced in 2020
s.13; s.21								

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### **Quarterly Progress Report No. 21**

#### **Appendix G**

#### **Project Progression**

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Table G-1 shows the revised cost estimate of \$16 billion announced in February 2021 by key category of work, the life to date actual expenditures to March 31, 2021 and the estimated remaining spend amount.

**Table G-1 Summary of Work Categories**

Description	Revised Cost Estimate (\$million)	LTD Actuals (\$million)	Estimated Remaining Spend (\$million)
Dam, Power Facilities and Associated Structures and Transmission	s.17		
Offsite Works, Direct Construction Supervision and Site Services			
<b>Total Direct Construction Cost</b>			
Indirect Costs			
<b>Total Construction and Indirect Costs</b>			
Interest During Construction			
Contingency / Reserve			
<b>Total</b>			

**Table G-2 Summary of Main Civil Works Progress**

Area and Scope	Unit of Measure	Total Plan (December 2019 Schedule)*	Plan to March 31, 2021, (December 2019 Schedule)*	Actual to March 31, 2021**	Variance Actual – Planned (March 31, 2021)
<b>Excavation</b>					
Left Bank Excavation	m <sup>3</sup>	11,042,042	11,042,042	10,987,572	(54,470)
Approach Channel Excavation	m <sup>3</sup>	8,200,000	4,225,129	4,965,875	740,746
Centre Dam Excavation	m <sup>3</sup>	758,796	758,796	621,041	(137,755)
<b>Roller-compacted concrete</b>					
Dam & Core Buttress	m <sup>3</sup>	490,000	(473,777)	(143,764)	(330,013)
<b>Tunnels &amp; Diversion Scopes**</b>					
Left Bank Drainage Adit	m	454	454	454	Complete
Upstream Cofferdam	m <sup>3</sup>	1,343,635	1,326,806	1,326,806	Complete
Downstream Cofferdam	m <sup>3</sup>	112,012	100,110	79,455	Complete
<b>Dam Scopes</b>					
Dam Fill – Left Bank	m <sup>3</sup>	1,885,867	843,670	52,688	(790,982)
Dam Fill – Right Bank	m <sup>3</sup>	497,561	255,617	163,584	(92,033)

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**Table G-4 Summary of Transmission Line Progress**

Transmission Line Progress					
Area and Scope	Unit of Measure	Total Plan (September 2018 Schedule) *	Plan to March 27, 2021 (September 2018 Schedule) *	Actual to March 27, 2021**	Variance Actual – Planned (March 27, 2021)
<b>Transmission Line 5L006</b>					
Foundations 5L006 <sup>29</sup>	EA	205	205	205	Complete
Towers 5L006 <sup>30</sup>	EA	205	158	205	Complete
Conductor 5L006	EA	205	0	0	Future Planned Work

\* Plan reflects the contractor's schedule (September 2018).

\*\*Progress impacted by COVID-19 pandemic from March 18, 2020 forward.

- Actual quantities reflect work to March 27, 2021.
- Changes to Table D-4 from the Annual Report No 5 (combined with the Quarterly Progress Report No. 20) to this reporting period include:
- Areas added: None
- Completed areas removed: Foundation 5L005, Towers 5L005 & Conductor 5L005 (showed completed previous report).

**Table G-5 Summary of Highway 29 Progress**

Highway 29 Progress					
Area and Scope	Unit of Measure	Total Plan (February 2020 Schedule) *	Plan to March 28, 2021 (February 2020 Schedule) *	Actual to March 28, 2021	Variance Actual – Planned (March 28, 2021)
<b>Halfway River Bridge</b>					
Pier Concrete	m <sup>3</sup>	12,120	12,120	12,030	(90)
Bridge Girder	lbs	7,187,734	7,187,734	7,187,734	Complete
Precast Panels	each	638	608	264	(344)
Deck Concrete	m <sup>3</sup>	2,300	200	0	(200)

<sup>29</sup> A foundation completed includes piles installed, capped and ready for towers.

<sup>30</sup> A completed tower is installed and ready for conductor stringing.

Highway 29 Progress					
Area and Scope	Unit of Measure	Total Plan (January 2021 Schedule) **	Plan to March 27, 2021 (January 2021 Schedule) **	Actual to March 27, 2021	Variance Actual – Planned (March 27, 2021)
<b>Farrell Creek Bridge</b>					
Piles	each	35	33	26	(7)
Pier Concrete	m <sup>3</sup>	1,883	473	0	(473)
Area and Scope	Unit of Measure	Total Plan (February 2021 Schedule) ***	Plan to March 27, 2021 (February 2021 Schedule) ***	Actual to March 27, 2021	Variance Actual – Planned (March 27, 2021)
<b>Cache Creek Bridge</b>					
Piles	each	63	35	35	(0)
Pier Concrete	m <sup>3</sup>	5,129	31	0	(31)
* Plan reflects the contractor's schedule (February 2020). ** Plan reflects the contractor's schedule (January 2021). *** Plan reflects the contractor's schedule (February 2021). • Changes to Table G-5 from the Annual Report No 5 (combined with the Quarterly Progress Report No. 20) to this reporting period include: • <b>Halfway River</b> ○ Actual quantities reflect work to March 28, 2021 ○ Areas added: Precast Panels, Deck Concrete ○ Completed areas removed: Piles Removed • <b>Farrell Creek (added)</b> ○ Actual quantities reflect work to March 27, 2021 ○ Areas added: Piles, Pier Concrete ○ Completed areas removed: None • <b>Cache Creek (added)</b> ○ Actual quantities reflect work to March 27, 2021 ○ Areas added: Piles, Pier Concrete ○ Completed areas removed: None					

**Table G-6 Summary of Hudson's Hope Shoreline Protection and Portage Mountain Quarry Progress**

Hudson's Hope Shoreline Protection Progress					
Area and Scope	Unit of Measure	Total Plan (September 2020 Schedule) *	Plan to March 28, 2021 (September 2020 Schedule) *	Actual to March 28, 2021	Variance Actual – Planned (March 28, 2021)
<b>Hudson's Hope Shoreline Protection</b>					
2.06 Berm Filter Haul & Place	m <sup>3</sup>	171,100	0	23,707	23,707
2.07 10KG (Spec 1) & 50 KG (Spec 4) Haul & Place	m <sup>3</sup>	162,000	80,000	89,018	9,018
Area and Scope	Unit of Measure	Total Plan **	Plan to March 28, 2021 **	Actual to March 28, 2021	Variance Actual – Planned (March 28, 2021)
<b>Portage Mountain Quarry</b>					
100KG Riprap	m <sup>3</sup>	91,192	91,192	91,041	(151)
250KG Riprap Spec 3	m <sup>3</sup>	36,300	17,720	0	(17,720)
10KG Riprap	m <sup>3</sup>	195,800	130,200	96,239	(33,961)
Berm Filter	m <sup>3</sup>	195,800	136,400	82,342	(54,058)
250KG Riprap	m <sup>3</sup>	31,357	31,357	43,768	12,411
70KG Riprap	m <sup>3</sup>	28,600	12,286	0	(12,286)
Blasted Banked	m <sup>3</sup>	561,000	369,000	397,515	28,515

\* Plan reflects the contractor's schedule (September 2020).

\*\* Plan reflects the contractor's target change order.

- Changes to Table G-6 from the Annual Report No 5 (combined with the Quarterly Progress Report No. 20) to this reporting period include:

- Hudson's Hope Shoreline Protection**

- Actual quantities reflect work to March 28, 2021
- Areas added: New table (2.06 Berm Filter Haul & Place and 2.07 10KG (Spec 1) & 50 KG (Spec 4) Haul & Place)
- Completed areas removed: None

- Portage Mountain Quarry (added)**

- Actual quantities reflect work to March 28, 2021
- Areas added: New table (100 KG Riprap, 250 Spec 3 Riprap, 10KG Riprap, berm Filter, 250 KG Riprap, 70KG Riprap and Blasted Banked)
- Completed areas removed: None

REDACTED in PUBLIC VERSION

**Table G-7 Project In-Service Dates**

Description/ Status	Final Investment Decision Planned ISD <sup>31</sup>	Plan February 2018	In-Service Dates (February 2021) based on Announcement from Government of B.C. <sup>32</sup>	Status <sup>33</sup> and Comments
5L5 500 kV transmission line	October 2020	October 2020	October 2020	Complete
Site C substation	November 2020	October 2020	October 2020	Complete
5L6 500 kV transmission line	July 2023	August 2023	July 2023	On track
Unit 1 (first power)	December 2023	December 2023	December 2024	On track
Unit 2	February 2024	February 2024	February 2025	On track
Unit 3	May 2024	May 2024	May 2025	On track
Unit 4	July 2024	July 2024	July 2025	On track
Unit 5	September 2024	September 2024	September 2025	On track
Unit 6	November 2024	November 2024	November 2025	On track

R E D A C T E D i n P U B L I C V E R S I O N

<sup>31</sup> Based on plan at Final Investment Decision, December 2014.

<sup>32</sup> In-service dates based on February 2021 Government announcement. Forecast of project in-service dates and variance to the updated plan will be provided when schedule review complete.

<sup>33</sup> Status based on Expected In-Service Dates.



## **Site C Clean Energy Project**

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### **Quarterly Progress Report No. 21**

#### **Appendix H**

#### **Detailed Project Expenditure**

**CONFIDENTIAL**

**Table H-1 Total Project Expenditure Summary to  
2020/21 to 2022/23 Service Plan  
(\$ million, Nominal)**

Description	Budget	2020/21 to 2022/23 Service Plan, March 31, 2021 YTD	Actual Expenditures March 31, 2021 YTD	Variance
Direct Construction Costs	6,393	s.17		
Indirect Costs	1,456			
<b>Total Construction and Development Costs</b>	<b>7,849</b>			
Contingency <sup>34</sup>	858			
Interest During Construction	1,285			
<b>Project</b>	<b>9,992</b>	<b>1,646</b>	<b>1,740</b>	<b>(94)</b>
Treasury Board Reserve	708	-	-	-
<b>Total Project</b>	<b>10,700</b>	<b>1,646</b>	<b>1,740</b>	<b>(94)</b>

The budget amount in Table H-1 above reflects the approved project budget of \$10.7 billion and the fiscal 2021 plan amounts shown in Table H-1 above reflects the amounts included in the 2020/21 to 2022/23 service plan, published in February 2020.

The total variance of \$94 million shown in Table H-1 is primarily due to: unplanned COVID-19 monthly premiums related to contractor costs to comply with COVID-19 requirements; acceleration of main civil work to meet river diversion; higher than planned costs for Highway 29 and Portage Mountain Quarry work; and debris management work originally planned for F20 was incurred in F21. These are partially offset by generating station and spillways work slowdown to essential work due to COVID-19 earlier in the fiscal year; main civil works embankment, dam and core buttress and spillway buttress work behind schedule; and turbines and generators activities pushed out to future months.

<sup>34</sup> Actual contingency incurred to date is presented with the applicable direct or indirect cost component.

Table H-2 below shows the budget in total based on the approved budget of \$10.7 billion as well as the budget amounts to March 31, 2021 compared to actual results to the same date.

**Table H-2 Total Project Expenditure Summary  
Budget (\$ million, Nominal)**

Description	Budget	Budget, Life to Date (March 31, 2021)	Actual, Life to Date (March 31, 2021)	Plan vs Actual to Date
Direct Construction Costs	6,393	s.17		
Indirect Costs	1,456			
<b>Total Construction and Development Costs</b>	<b>7,849</b>			
Contingency	858			
Interest During Construction	1,285			
<b>Project</b>	<b>9,992</b>	<b>6,158</b>	<b>6,867</b>	<b>(709)</b>
Treasury Board Reserve	708	-	-	-
<b>Total Project</b>	<b>10,700</b>	<b>6,158</b>	<b>6,867</b>	<b>(709)</b>

The budget amount and the life to date budget amount included in the [Table H-2](#) above reflects the approved budget of \$10.7 billion.

The total variance of \$709 million shown in [Table H-2](#) is primarily due to: higher than planned main civil works expenditures for unplanned investment in equipment, spillway buttress work, claims, left bank excavation, diversion tunnel work and COVID-19 premiums; schedule advancement of highway work; higher than planned Portage Mountain Quarry work, transmission, and worker accommodation expenditures. These are partially offset by generating station and spillways work slowdown to essential work due to COVID-19, timing differences for turbines and generators, and property acquisitions.

REDACTED in PUBLIC VERSION

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## Site C Clean Energy Project

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### Quarterly Progress Report No. 21

#### Appendix I

#### First Nations Consultation and Impact Benefits Agreements

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REDISTRIBUTE FOR ANY OTHER PURPOSE**

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BC Hydro has made accommodation offers to the 10 Treaty 8 First Nations determined to be affected by the Project (seven in British Columbia, three in Alberta).

Agreements may provide lump-sum payments and/or payment streams over time, directed procurement opportunities, transfer of Provincial Crown land in fee simple and land protection measures.

Impact Benefits Agreements with McLeod Lake Indian Band and Doig River, Halfway River, Sauteau and Prophet River First Nations, and a Project Agreement with Dene Tha' First Nation have been publicly announced, while a Project Agreement with Duncan's First Nation has also been reached. In February 2019, the Government of British Columbia, BC Hydro, West Moberly First Nations and Prophet River First Nation agreed to enter into confidential discussions to seek alternatives to litigation related to Site C. West Moberly First Nations withdrew from the discussions in August 2019 and filed an amended Notice of Civil Claim in September 2019. Prophet River First Nation signed their Impact Benefit Agreement on March 27, 2020. BC Hydro is also in confidential discussions with Blueberry River First Nations.

Table I-1 below presents the status of negotiations with the 10 Treaty 8 First Nations with which BC Hydro intends to conclude agreements. The final value held against the mandate is subject to change, pending conclusion of negotiations.

REMOVED FROM BCUC AND PUBLIC VERSIONS

1

**Table I-1 Status of First Nations Negotiations**

First Nation	Status of Negotiations	Confidentiality
Saulteau	September 27, 2016 Impact Benefits Agreement	Press release issued. Detailed terms are confidential, but the tripartite land agreement is public.
McLeod Lake	July 5, 2016, Impact Benefits Agreement	Press release issued. Detailed terms are confidential, but the tripartite land agreement is public.
Blueberry River	Strictly Confidential	Confidential
Doig River	March 22, 2017 Impact Benefits Agreement	Press release issued. Detailed terms are confidential, but the tripartite land agreement is public.
Halfway River	March 22, 2017 Impact Benefits Agreement	Press release issued. Detailed terms are confidential, but the tripartite land agreement is public.
Prophet River	March 27, 2020 Impact Benefits Agreement	Press release issued. Detailed terms are confidential, but the tripartite land agreement is public.
West Moberly	West Moberly First Nations withdrew from the discussions in August 2019 and filed an amended Notice of Civil Claim in September 2019	Confidential
Duncan's (AB)	December 2015, Project Agreement	Confidential
Horse Lake (AB)	In negotiations	Confidential
Dene Tha' (AB)	May 2016, Project Agreement	Press release issued. Detailed terms are confidential, but the general terms of the Project Agreement have been publicly announced.
Total value of Impact Benefits Agreements/Project Agreements is within mandate.		

*Consultation*

As the detailed design of Cache Creek Highway 29 realignment progressed, BC Hydro continued to work with Treaty 8 First Nations communities to reduce effects on potential Indigenous burial sites and areas of cultural importance identified by Treaty 8 First Nations.

REMOVED FROM BCUC AND PUBLIC VERSIONS

Page 227 of 716 to/à Page 228 of 716

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s.12 ; s.13 ; s.17



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s.12 ; s.13 ; s.19

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Page 237 of 716 to/à Page 239 of 716

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s.12 ; s.13 ; s.17

Page 240 of 716 to/à Page 241 of 716

Withheld pursuant to/removed as

s.12 ; s.13

## Jang, Monica EMLI:EX

---

**From:** Foster, Doug FIN:EX  
**Sent:** May 10, 2021 7:20 AM  
**To:** MacLaren, Les EMLI:EX; Mihlar, Fazil EMLI:EX; Cuddy, Andrew EMLI:EX  
**Cc:** Wieringa, Paul EMLI:EX; Sopinka, Amy EMLI:EX; Rowe, Katherine EMLI:EX  
**Subject:** RE: Site C Update

Thanks Les.  
Some additional thoughts.

April 19 Meeting:  
s.13

s.13

Over these meetings, there was also some updates on what BCH is doing to respond to evolving COVID-19 conditions and orders of the PHO. A number of major contractor employees have been affected and BCH/contractors are taking actions to ensure a safe worksite and that work schedules are maintained. There will be a section on this within the Treasury Board submission on rebaselined budget.

s.13

d

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**From:** MacLaren, Les EMLI:EX <Les.MacLaren@gov.bc.ca>  
**Sent:** May 10, 2021 6:38 AM  
**To:** Mihlar, Fazil EMLI:EX <Fazil.Mihlar@gov.bc.ca>; Cuddy, Andrew EMLI:EX <Andrew.Cuddy@gov.bc.ca>  
**Cc:** Wieringa, Paul EMLI:EX <Paul.Wieringa@gov.bc.ca>; Sopinka, Amy EMLI:EX <Amy.Sopinka@gov.bc.ca>; Rowe, Katherine EMLI:EX <Katherine.Rowe@gov.bc.ca>; Foster, Doug FIN:EX <Doug.Foster@gov.bc.ca>  
**Subject:** Site C Update

Fazil/Andrew

s.12; s.13

The PAB subsequently had an orientation session on May 4 (second session is May 11), and a Special Workshop on Risk on May 7.

April 19 Meeting:

The new Chair opened with thanks to John Nunn for his work as Chair (John remains Chair of the Capital Projects Committee of the BCH Board). The Chair noted PAB's focus will be on safety, budget, schedule, risk, quality, and contract/claims management. A new sub-committee on Claims Management was struck that included the three new PAB members joining.

s.13; s.17

The Engineering Services Agreement change is a \$48M increase to the contracts for SNC Lavalin and Kohn Crippen Berger for the period June 1, 2021, to May 31, 2022. This contract is structured for annual releases to cover services, and each increase is treated as a separate direct award contract which has been highlighted by critics (even though the SNC and KCB teams are integrated with the BCH on-site team and critical to advancing the project).

s.12; s.13

s.12; s.13; s.17

May 4 Orientation Session #1:

Although this session was optional for existing PAB members, almost all attended. The Site C team provided orientation materials and an overview of the project, including a construction sequencing and drone videos. The session also covered project governance and oversight, safety, construction updates for on- and off-site activities, the right bank



foundation enhancements, and environmental programs, social commitments and indigenous relations. Orientation Session #2 is scheduled for May 11.

s.13

s.13 There was very good discussion of these issues, and the new PAB members were fully engaged.

Doug may have some further observations from these meetings.

*Les MacLaren*

Assistant Deputy Minister  
Electricity and Alternative Energy Division  
BC Ministry of Energy, Mines and Low Carbon Innovation  
Office: 778-698-7183  
Cell: 250-889-3479

*Energizing BC—clean, sustainable and productive*

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s.12; s.13; s.17

s.12; s.13

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s.12; s.13

s.12; s.13; s.17

### **Background / Context:**

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s.12; s.13; s.17

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s.12 ; s.13 ; s.17



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s.12 ; s.13 ; s.17

Page 305 of 716 to/à Page 312 of 716

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Page 313 of 716 to/à Page 316 of 716

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Page 317 of 716 to/à Page 348 of 716

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s.12 ; s.13



Page 349 of 716 to/à Page 356 of 716

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Page 360 of 716 to/à Page 362 of 716

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Page 363 of 716 to/à Page 401 of 716

Withheld pursuant to/removed as

s.12 ; s.13

**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, ScD, NAE**  
**REPORT NO. 3**  
**April 6, 2021**

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## **EXECUTIVE SUMMARY**

This report presents an update to the Technical Review Panel's (Panel's) findings subsequent to Panel Reports Nos. 1 and 2, issued on January 22, 2021 and February 15, 2021, respectively.

In the Panel's opinion, the Engineering Design Team (EDT) has been proceeding well with the design of the right bank enhancements. The principal focus of the recent work has been on analyses to define the number, size, and depth of the pile system, so that the steel for the piles can be ordered. The Panel agrees with this focus, since ordering the steel for the piles soon is required to limit schedule and cost risks.

The optimization work has resulted in a recommended pile system consisting of:

1. A total of 96 concrete-filled steel pipe piles.
2. Each pile will be installed in a 2.4-m diameter drilled shaft.
3. Each pile will include 2.0-m diameter steel casing with 38mm thick wall.
4. This configuration results in a 200-mm thick, concrete-filled annulus outside the steel wall.
5. 50% of the piles will extend to 350-m Elevation and the other 50% of the piles will extend to 360-m Elevation.

The recommended pile system is substantially reduced from the preliminary design developed after the discovery of the unexpected movements beneath the roller compacted concrete (RCC) buttress. The preliminary design consisted of 255 piles, all with 3.0 m diameter. The principal reasons that the recommended pile system is significantly less than that in the preliminary design are that 1) investigations have established that an active wedge does not exist in the rock behind the RCC buttress and is very unlikely to develop due to the deformation restraint from the pile system, and 2) additional investigations, including lateral pile load tests, have provided improved understanding of bedrock properties.

The pile system recommendation is supported by detailed numerical analyses indicating calculated displacements that are less than design criteria established in a revised Design Basis Memorandum (DBM) for all cases identified. In addition, "stress test" deformation analyses indicate that the recommended pile system has reserve capacity to limit deformations for loads even greater than those identified in the DBM. Stability analyses completed by the EDT indicate that the design configuration meets CDA stability guidelines without inclusion of the piles for all load cases identified in the DBM. Hence, including the piles to meet deformation criteria will provide reserve stability capacity beyond that required to meet CDA guidelines.

**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, ScD, NAE**  
**REPORT NO. 3**  
**April 6, 2021**

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In the Panel's opinion, the analyses have been completed following best professional practices and the recommended pile system is well supported. It is reasonable to proceed to procure the steel for the recommended system. It is possible that the pile system could be refined and optimized somewhat further, but the risks of costly delay claims from the contractor would likely more than offset the benefits of further optimization.

The EDT has also been progressing a risk analysis for the approach channel water control features and a hydrogeological analysis of the right bank. In the Panel's view, the risk analysis has been thorough and complete and has identified opportunities for refinement of the final design of the water control features. The hydrogeological analysis of the right bank will help to inform decisions on the final design of the water control features for the right bank.

The Panel looks forward to reviewing the final design of the right bank enhancements, supported by the finalization of the numerical analyses, stability analyses, approach channel risk analysis, and hydrogeological analysis.

There have been no significant changes in the earthfill dam design or stability analysis since Panel Report No. 2 issued on February 15, 2021. The Panel's findings remain unchanged from those stated in Report No. 2. BC Hydro has advised the Panel that fill for a construction laydown area will be placed at the downstream toe of the earthfill dam before embankment fill will be advanced to significant height. As noted in Report No. 2, placement of this fill increases the stability of the earthfill dam, and the Panel supports the decision to proceed with its placement.

As the Project prepares for the upcoming resumption of core trench preparation and fill placement, the Panel was recently briefed on the identification of deterioration of some of the protective shotcrete previously placed in the core trench excavation and of a limited depth of the shale underlying the shotcrete. The Panel supports BC Hydro's plan to remove all of the previously placed shotcrete from the cutoff trench excavation and then to excavate any deteriorated shale and prepare the surface immediately before placement of cutoff trench fill to address this critical aspect of the earthfill dam construction.

## **INTRODUCTION**

At the request of BC Hydro, the Technical Review Panel (Panel) has prepared this report as an update to the Panel's previous Reports Nos. 1 and 2, dated January 22, 2021 and February 15, 2021, respectively.

Since February 15, the Panel has attended briefings to the Technical Advisory Board (TAB) by the Engineering Design Team (EDT) on February 24, March 12, and March 29, 2021, during which the EDT updated the TAB on activities related to both the right bank and the earthfill dam. The Panel has also reviewed project information provided by BC Hydro.



**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, ScD, NAE**  
**REPORT NO. 3**  
**April 6, 2021**

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Based on the information provided to date, the Panel provides updated findings concerning the proposed right bank design upgrades and the earthfill dam.

## **FINDINGS**

### **Right Bank Design Enhancements**

In the Panel's opinion, the EDT has been proceeding well with the design of the right bank enhancements. The principal activities completed since February 15 include optimization of the pile system design, a risk analysis for the approach channel water control features, and a hydrogeological analysis of the right bank. Work remaining to be done includes finalization of the configuration of the pile cap in the powerhouse tailrace, the approach channel, the foundation drainage system, and the foundation grouting program; compilation of the drawings and specifications for the enhancements; and preparation of a design report documenting the analyses of record for the design.

Pile System Design – The principal focus of the recent work has been on analyses to define the number, size, and depth of the pile system, so that the steel for the piles can be ordered. The Panel agrees with this focus, since ordering the steel for the piles soon is required to limit schedule and cost risks.

The optimization of the pile system design was based on updated design criteria established in revisions to the Design Basis Memorandum (DBM). As noted in Panel Report No. 1, the principal design criterion is to limit the deformations in the foundation to provide both safety and serviceability. The design criteria also include required stability factors of safety to conform to Canadian Dam Association (CDA) guidelines. The design criteria are being considered for a number of assumed loading conditions, ranging from the best estimate of normal operation loading to a loading resulting from the extremely unlikely case of failure of the approach channel lining and failure of the right bank foundation drainage system, such that water pressures in open joints in the foundation rock and at the contact with the rock and the roller compacted concrete (RCC) buttress rise to levels corresponding to the reservoir level (a condition designated Extreme 4).

The criterion established for limiting deformation was a calculated horizontal displacement no greater than 10 mm at the most upstream line of piles. Deformation at the downstream edge of the approach channel liner was also checked in the analyses. The Panel supports both the selected displacement limit at the piles and the check of deformations at the liners.

Furthermore, the computed displacements for the maximum design natural earthquake and estimated seismic events induced by hydraulic fracturing for petroleum development must also be less than the horizontal displacement criterion.

**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, ScD, NAE**  
**REPORT NO. 3**  
**April 6, 2021**

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The optimization work has resulted in a recommended pile system consisting of:

1. A total of 96 concrete-filled steel pipe piles.
2. Each pile will be installed in a 2.4-m diameter drilled shaft.
3. Each pile will include 2.0-m diameter steel casing with 38mm thick wall.
4. This configuration results in a 200-mm thick, concrete-filled annulus outside the steel wall.
5. 50% of the piles will extend to 350-m Elevation and the other 50% of the piles will extend to 360-m Elevation.

For optimization of the pile system design, Extreme 4 was the controlling load case. Numerical analyses of this case for the recommended pile system that have been presented to the Panel to date, resulted in calculated horizontal displacements of 5mm at the upstream piles for both the powerhouse and the spillway, and calculated deformations of 11mm and 9mm at the approach channel liner for the powerhouse and the spillway, respectively. The analyses also included consideration of variations in the plan layout of the piles to limit tensile stress development in rock surrounding the piles. Numerical analyses completed to date have also indicated that, for all cases identified in the DBM except Extreme 4, the calculated deformations at the upstream piles are less than 2 mm.

To further test the robustness of the recommended pile system, the EDT completed additional numerical analyses for loads more severe than the Extreme 4 case (i.e. stress testing). The results indicated that the enhanced design with the recommended pile system has significant reserve capacity.

Stability analyses completed by the EDT indicate that the design configuration meets CDA stability guidelines without inclusion of the piles for all load cases identified in the DBM. Hence, including the piles to meet deformation criteria will provide reserve stability capacity beyond that required to meet CDA guidelines.

In the Panel's opinion, the analyses have been completed following best professional practices and the recommended pile system is well supported. It is reasonable to proceed to procure the steel for the recommended system. It is possible that the pile system could be refined and optimized somewhat further, but the risks of costly delay claims from the contractor could likely more than offset the benefits of further optimization. The recommended pile system is substantially reduced from the preliminary design developed after the discovery of the unexpected movements beneath the RCC buttress. For comparison, the preliminary design consisted of:

1. A total of 255 concrete-filled steel pipe piles.
2. Each pile to be installed in a 3.2-m diameter drilled shaft.
3. Each pile to include 3.0-m diameter steel casing with 22-mm thick wall.

**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, ScD, NAE**  
**REPORT NO. 3**  
**April 6, 2021**

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4. All piles extending to 350-m Elevation.

In addition, the much larger number of piles of larger diameter in the preliminary design would have required larger and more expensive pile caps. The Panel notes that the principal reasons that the recommended pile system is significantly less than that in the preliminary design are that 1) investigations have established that an active wedge does not exist in the rock behind the RCC buttress and is very unlikely to develop due to the deformation restraint from the pile system, and 2) additional investigations, including lateral pile load tests, have demonstrated the rock is stronger and stiffer than the values provided from the earlier investigations.

Detailed specifications for pile installation remain to be developed, but large diameter drilled pile installations have a long-standing history of application in the construction industry, so established precedents exist for developing the required specifications. Further, successful installation of drilled piles at the site was demonstrated by the installation of the two piles used for the lateral load tests. The Panel looks forward to reviewing the final drawings and specifications for the pile system to be included in the right bank enhancements.

Approach Channel Risk Analysis – The EDT has been completing a risk analysis of the various water control features to be included in the approach channel and the right bank. These features include the approach channel liners and associated under-drains, foundation grout curtains in the vicinity of the approach channel, and right bank drainage features (the right bank drainage tunnel and drilled drain holes). The purpose of the risk analysis is to identify potential measures to improve the robustness and resiliency of the water control features.

The EDT has presented the results of the risk analysis in briefings to the TAB and the Panel. In the Panel's view, the risk analysis has been thorough and complete and has identified opportunities for refinement of the final design of the water control features. The Panel looks forward to reviewing the final design of these features.

Right Bank Hydrogeological Analysis – The EDT has been performing a detailed hydrogeological analysis of the right bank to help inform decisions on the final design of the water control features for the right bank. The analysis is still in progress, and the TAB and the Panel have been briefed on the results to date. The Panel looks forward to reviewing the final analysis and its application to final design of the right bank water control features.

### **Earthfill Dam**

There have been no significant changes in the earthfill dam design or stability analyses since Panel Report No. 2 issued on February 15, 2021. The Panel's findings remain unchanged from those stated in Report No. 2. BC Hydro has advised the Panel that fill for a construction laydown area will be placed at the downstream toe of the earthfill dam before embankment fill will be advanced to significant height. As noted in Report No. 2, placement of this fill increases the stability of the earthfill dam and the Panel supports the decision to proceed with its placement.

**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, ScD, NAE**  
**REPORT NO. 3**  
**April 6, 2021**

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The Project has been appropriately focused on the foundation preparation and grouting for the main dam and the upcoming resumption of core trench preparation and fill placement. The Panel was recently briefed on the identification of deterioration of some of the protective shotcrete previously placed in the core trench excavation and of a limited depth of the shale underlying the shotcrete. BC Hydro has advised the Panel, that the planned approach is to remove all of the previously placed shotcrete from the cutoff trench excavation and then to excavate any deteriorated shale and prepare the surface immediately before placement of cutoff trench fill. The contact between the cutoff trench fill and the underlying shale foundation is a critical aspect of the earthfill dam construction, and the Panel supports BC Hydro's plan for addressing this aspect of construction.


**STATEMENT OF LIMITATIONS**

The Panel functioned as independent reviewers of the methodologies used by the EDT for analysis and design of the right bank enhancements and the earthfill dam, based on information provided by the EDT. Given the large amount of work being completed by the EDT and the associated voluminous documentation, it was not possible for the Panel to perform a detailed review of all of the material in the available time. In particular, the Panel has not performed detailed checks of calculations and designs completed by the EDT. Such detailed checks are provided by the quality control/quality assurance programs for the Project. The Panel provides its opinions concerning the methods and approaches being used based on information provided by the Project Team. However, the ultimate decisions and responsibilities for the designs remains with BC Hydro.

Our review services were performed within the limits prescribed by BC Hydro in a manner consistent with the level of care and skill normally exercised in the current standard of professional engineering practice. No other representation to BC Hydro, expressed or implied, and no warranty or guarantee is included or intended.

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Respectfully submitted,

  
John W. France

  
Kaare Hoeg

## Jang, Monica EMLI:EX

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**From:** Foster, Doug FIN:EX  
**Sent:** May 25, 2021 7:21 AM  
**To:** MacLaren, Les EMLI:EX; Mihlar, Fazil EMLI:EX; Cuddy, Andrew EMLI:EX  
**Cc:** Wieringa, Paul EMLI:EX; Sopinka, Amy EMLI:EX; Rowe, Katherine EMLI:EX; Gonzalez, Selina FIN:EX; Jang, Monica EMLI:EX  
**Subject:** RE: Site C Update

Thanks Les.

A good summary.

s.22

Wasn't sure what a Despite Notice is but assume its just a notice of claim.

d

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**From:** MacLaren, Les EMLI:EX <Les.MacLaren@gov.bc.ca>  
**Sent:** May 25, 2021 6:28 AM  
**To:** Mihlar, Fazil EMLI:EX <Fazil.Mihlar@gov.bc.ca>; Cuddy, Andrew EMLI:EX <Andrew.Cuddy@gov.bc.ca>  
**Cc:** Wieringa, Paul EMLI:EX <Paul.Wieringa@gov.bc.ca>; Sopinka, Amy EMLI:EX <Amy.Sopinka@gov.bc.ca>; Rowe, Katherine EMLI:EX <Katherine.Rowe@gov.bc.ca>; Foster, Doug FIN:EX <Doug.Foster@gov.bc.ca>; Gonzalez, Selina FIN:EX <Selina.Gonzalez@gov.bc.ca>; Jang, Monica EMLI:EX <Monica.Jang@gov.bc.ca>  
**Subject:** Site C Update

Fazil/Andrew

Doug and I attended the Site C Project Assurance Board meeting on May 18. s.13  
s.13; s.17

s.13; s.17

McLay (Chair), Amanda Farrell, and Fred Cummings.

s.13; s.19

Members include Mitchell Gropper, Cathy

Heading into the summer construction season, safety of both workers and the public is heightened with more workers (and new contractors) on site, and summer recreation activities of the public.s.13

s.13

s.13; s.19

s.13; s.14

s.13

Doug may have further comments.

*Les MacLaren*

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s.13 ; s.14

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Withheld pursuant to/removed as

s.14



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Withheld pursuant to/removed as

s.13 ; s.14

## Jang, Monica EMLI:EX

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**From:** MacLaren, Les EMLI:EX  
**Sent:** July 26, 2021 5:26 PM  
**To:** Mihlar, Fazil EMLI:EX; Tseng, Eugene EMLI:EX  
**Cc:** Wieringa, Paul EMLI:EX; Rowe, Katherine EMLI:EX; Sopinka, Amy EMLI:EX; Cuddy, Andrew EMLI:EX; Jang, Monica EMLI:EX; Foster, Doug FIN:EX  
**Subject:** Site C Update

Fazil/Eugene

Doug Foster and I have attended three Site C Project Assurance Board (PAB) meetings in the past two weeks:  
s.13; s.17

- July 19 for a workshop on safety; and
- July 23 for the regular monthly PAB meeting.

July 14  
s.13; s.17

### July 19

The PAB previously requested a special workshop on safety. BCH reviewed the comprehensive measures to focus on safety for both BCH and contractors led by both a Safety Team and Construction Management. While the contractors as employers are responsible for the safety of their work scopes and workers, BCH as owner is responsible for communicating safety hazards and providing assurance on contractors' Safety Management Systems. The site has a number of areas where BCH and contractors are "prime contractors" responsible for coordinating safety of all contractors and employees in their safety area.

s.13

BCH has been on the site for 6 years and has learned a lot, but there is still a lot of activity ahead. For the upcoming year there will be major material movement with traffic control, heavy equipment interactions, equipment-human interactions, and silica safety risks. In addition, there will be new contractors on site for the balance of plant work, and the right bank foundation enhancements layered on to the existing contractors and their base work.

Safety statistics are good and trending favourably. The PAB was impressed with the safety culture at BCH, but expressed some concerns with the contractors.<sup>s.13</sup>

s.13

July 23

s.13; s.17

s.13

s.13      s.13; s.16

At PAB's request, BCH presented an update on the schedule for the main earthfill dam and approach channel given the SWA and progress on the design of the right bank foundation enhancements, respectively.<sup>s.13; s.17</sup>

s.13; s.17

Doug may have further commentary.

*Les MacLaren*

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## Jang, Monica EMLI:EX

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**From:** MacLaren, Les EMLI:EX  
**Sent:** August 5, 2021 10:34 AM  
**To:** Mihlar, Fazil EMLI:EX; Roberts, Lloyd E EMLI:EX  
**Cc:** Sopinka, Amy EMLI:EX; Jang, Monica EMLI:EX  
**Subject:** FW: Site C Permitting Update

Fazil/Lloyd

s.13

We will confirm at the Authorizations Oversight Team meeting this afternoon.

Les

---

**From:** Sopinka, Amy EMLI:EX <Amy.Sopinka@gov.bc.ca>  
**Sent:** August 5, 2021 9:57 AM  
**To:** MacLaren, Les EMLI:EX <Les.MacLaren@gov.bc.ca>  
**Cc:** Chapman, Connie FLNR:EX <Connie.Chapman@gov.bc.ca>; Cooper, Christopher FLNR:EX <Christopher.Cooper@gov.bc.ca>  
**Subject:** Site C Permitting Update

Les,

s.13

A



Amy Sopinka  
Director, Transmission and Interjurisdictional Branch  
Ministry of Energy, Mines and Low Carbon Innovation  
Office: 778-698-7280 Mobile: 250-888-5183

## Jang, Monica EMLI:EX

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**From:** Magre, Leela <Leela.Magre@bchydro.com>  
**Sent:** August 17, 2021 12:56 PM  
**To:** Mihlar, Fazil EMLI:EX; Sopinka, Amy EMLI:EX  
**Cc:** MacLaren, Les EMLI:EX; Wieringa, Paul EMLI:EX; Sauer, Darwin; XT:Scott, Mora GCPE:IN  
**Subject:** COVID-19 outbreak to be declared at Site C

**[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.**

Good afternoon Fazil and Amy,

Please see the following message from Chris.

Thank you,  
Leela

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Good afternoon,

Later today, Northern Health will declare a COVID-19 outbreak on the Site C project. The outbreak will remain in place for at least 28 days and Northern Health has determined there is no need to stop any work on the project at this time.

As of this morning, there are currently 28 active cases and more than 100 workers are isolating either at home or in camp. The recent cases are a combination of community and workplace transmissions and are dispersed across multiple contractors, work fronts and geographic home locations.

As part of the outbreak declaration, Northern Health will support the implementation of enhanced infection control measures including:

- limiting interaction between the project workforce and local communities, which means workers staying in camp will not be able to leave site for the duration of the outbreak;
- reimplementing COVID-19 prevention measures such as wearing masks and physical distancing on the worksites; and
- increasing focus on ongoing workforce COVID-19 immunizations which include developing plans for requiring workers coming to the dam site to have either a COVID-19 vaccination, a negative COVID-19 test within 72 hours, or an approved exemption before returning to work.

The project will also be reinstituting some preventative measures at site including mandating masks across the work site, limiting non-essential travel to site, and reinforcing mask wearing, handwashing and physical distancing in the worker lodge.

I recognize this is disappointing news and another reminder the pandemic is not over. We will continue to remain vigilant in our efforts to keep our workers and the community safe.

I will provide you with updates as the situation continues to evolve.

Thank you,  
Chris

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## Jang, Monica EMLI:EX

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**From:** MacLaren, Les EMLI:EX  
**Sent:** September 1, 2021 11:42 AM  
**To:** Mihlar, Fazil EMLI:EX; Cuddy, Andrew EMLI:EX  
**Cc:** Wieringa, Paul EMLI:EX; Rowe, Katherine EMLI:EX; Sopinka, Amy EMLI:EX; Foster, Doug FIN:EX; Jang, Monica EMLI:EX  
**Subject:** Site C Update

Fazil/Andrew:

Doug Foster, Amy Sopinka and I attended the Site C Project Assurance Board regular monthly meeting on August 23. Key agenda items were: approval of a commercial strategy and funding for the approach channel component of the Right Bank Foundation Enhancements; approval of the second of six Balance of Plant contracts (electrical); and approval of the updated cost and schedule risk analyses.s.12; s.13

### Project Update:

Health Authorities declared another COVID outbreak on August 18 based on 41 positive tests and 110 isolations since August 4. Spread has been both from the community and within multiple contractor crews. As of August 22, there were 31 active cases and 91 isolations (36 in camp; 54 at home; and 1 in hospital). Over 80% of the cases were either unvaccinated or had only one dose. Safety measures have been ramped back up, including mask wearing when working on the various work fronts and stopping workers in camp from leaving to socialize the community. The on-site clinic continues to administer vaccinations.

s.13

s.13; s.17

### Approach Channel Commercial Strategy and Budget:

s.13



Balance of Plant Contract #2 – Electrical:

This contract was posted on BC Bid in April and closed in June with 3 proposals received. The scope includes water to wires equipment installation, protection and controls for medium and high voltage equipment, and installation of unit transformers. The evaluation committee unanimously recommended F&M Installations, whose head office is in Nanaimo, for the \$147.8M contract (includes \$20.8M in contingency). This contract value is consistent with the P50 budget and does not require access to unallocated P50 contingency. F&M has extensive experience working with BCH on other projects, and with the previously selected BoP mechanical contractor. Upcoming BoP contracts (posted/closing) include: architectural works (June/August); upstream fishway and out structures (July/Sept); fire protection (August/October); and heating, ventilation and air conditioning (Sept/November).

CRA/SRA:

s.12; s.13; s.17

s.13

In Camera:

One item of note was a discussion on recruitment of a successor to s.19 as EVP for Site C. s.19 s.22  
s.22 and has agreed to stay on for 6 months after a successor is chosen. BCH is quietly working with headhunters to identify a candidate. The BCH Chair would like the new EVP to be based in or spend more time in Fort St John for a greater authority presence.

Also of note is the increasingly productive working relationship between BCH and EY, and their work with EMLI and FIN. Upcoming work EY is focusing on is related to claims, and using the enhanced risk management system to focus on and strategically manage potential upcoming claims.

Doug or Amy may have further commentary.

*Les MacLaren*

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# **Site C Clean Energy Project**

## **Technical Advisory Board Meeting No. 24**

### **Report**

**(May 10, 13 and 14, and June 16 and 17, 2021)**

**June 2021**



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## List of Attachments

Attachment A – Technical Update Conference Calls Agendas  
Attachment B – Meeting Agendas  
Attachment C – List of Meeting Attendees

## 1. Introduction

The 24<sup>th</sup> meeting of the Site C Technical Advisory Board (TAB) was convened via MS Teams conference calls on May 10, 13 and 14, and June 16 and 17, 2021. The meeting did not include a site visit. The primary objectives were to assess the progress and performance of the project, as well as review some recent design re-assessments. Technical considerations focussed primarily on the Main Civil Works (MCW).

### 1.1 Meeting Organization

Since the last meeting, Meeting No. 23 in October 2020, the TAB has convened for a number of technical updates via MS Teams which are recorded in the following documents:

1. Notes from other technical updates of November 18, November 26 and December 21, 2020, and January 5, January 19, January 27, February 24, March 12, March 29 and April 23, 2021. These notes are filed on the TAB Sharepoint site and are available on request.

The agendas for these technical updates are included in Attachment A.

The agendas for this meeting are included as Attachment B.

### 1.2 Meeting No. 24

Most of the recent meetings concentrated on the critical right bank design issues of foundation enhancement and the approach channel design. This meeting was intended to be a more general update and assessment. No specific questions were put to the TAB. Instead, this report summarizes briefly the various updates to the TAB and where comments are warranted by the TAB, they are presented in a **bold font**.

Attachment C is a list of attendees during the meeting. A debriefing is scheduled to be conducted with members of the Project Team and Executives of BC Hydro (BCH), and the Project Assurance Board on June 24, 2021.

The TAB wishes to acknowledge the excellent overviews and presentations that it received. It recognizes the substantial effort that goes into the preparation for the TAB meeting and the technical update conference calls. It appreciates the frank and informative discussions that take place during the meetings.

## 2. Project Update

As indicated above, the TAB was updated on both the engineering as well as construction progress during the several meetings and workshops conducted during the later months

of 2020 and up to the present in 2021. Although held virtually, these meetings and workshops did keep the TAB up to date on the Project's progress. The focus of many meetings was concentrated on the Right Bank Foundation Enhancements as well as the improvements within and along the Approach Channel. A recent aerial photo of the project is shown below. The descriptions and updates below are concentrated on the Generating Station and Spillways (GSS) and Main Civil Works (MCW) areas.



## 2.1 GSS Update

The GSS Civil Works design and engineering is well advanced, with 99% of the drawings issued for construction (IFC) design. The photograph presented below illustrates the status of the activities.

The work is divided into three main civil packages, namely (Intake/Penstocks/Transition Block, Powerhouse, Spillway). The IFC drawings for each package have been issued.

The package total and number of IFC drawings issued to date are:

- Intake, Penstock and Transition Block: 266 total and 266 issued
- Powerhouse: 1,141 total and 1,126 issued
- Spillway: 654 total and 654 issued

- **TOTAL: 2,061 and 2,046 (99%) issued**

The TAB regards this as a significant achievement.

## AFDE Construction Progress



### 2.1.1 Hydromechanical Equipment Update

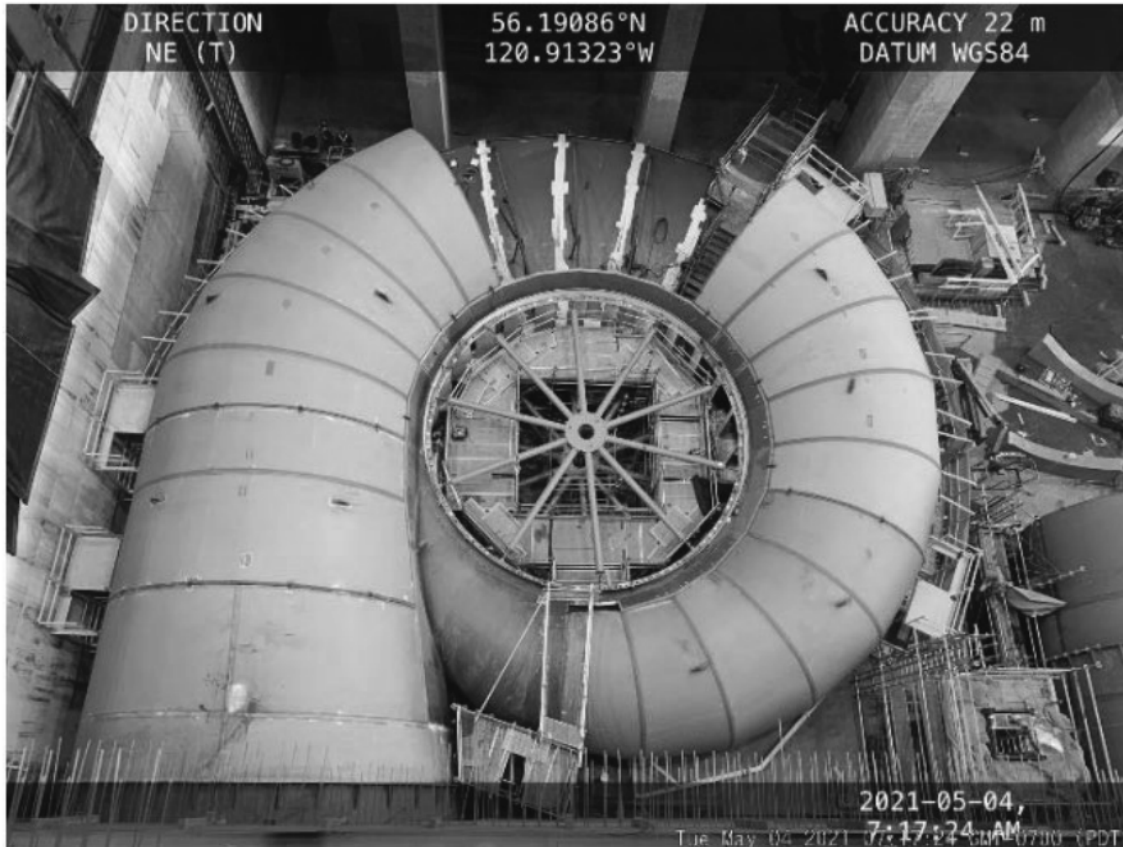
All the Hydromechanical Equipment, including the large gates, valves and stoplogs, are in design and manufacture with ATB Riva Calzoni. This equipment is presently on schedule for delivery and will be installed by AFDE. At present, the support to construction continues with either delivery to the site location or to storage facilities near the site.

**This is a significant achievement considering the problems associated with managing the worldwide supply as well as the effects of COVID-19.**

### 2.2 Turbine and Generator Update

The Turbines, Generators, Exciters, and Governors design, manufacture and installation are by Voith Hydro. The Turbine and Generator parts and equipment are being manufactured throughout the world and delivered and installed at the site on schedule. As with other equipment, it is either installed directly or stored on site or in a prepared and protected storage facility nearby. The magnitude of this undertaking is illustrated by the photograph of the Turbine scroll case installation shown below.

The TAB note above also applies here.



## 2.3 Balance of Plant Update

The original concept regarding Balance of Plant equipment (BoP) and installation was that it was to be a completion contract supplied and/or installed by a single large installation contractor. The one large contract was to encompass all the final completion items of the Project, essentially a completion contract. However, the bids for the completion contract were too excessive and above the Engineers Estimate. BCH chose to divide the BoP completion work into several smaller contracts and manage the various contracts.

**The TAB supports the judgement of BCH's decision in this regard and it is being implemented in an effective manner.**

## 2.4 Update on Quality

Quality is one of the Project's most significant areas of importance within the Project design and construction. It falls within the Project mission statements of Safety, Quality, Schedule, Budget and Environmental.

The Project quality areas of focus in 2021 are 1) the MCW and 2) the GSS Civil Works. Project quality is measured in the following areas and aspects:

- Each contractor is responsible for its own Quality Control
- BC Hydro is responsible for overall Quality Assurance
- For offsite manufacturing Quality Assurance, BC Hydro is supported by subcontractors skilled in Quality Assurance and BC Hydro's Powertech Labs for onsite welding quality assurance
- For onsite construction Quality Assurance, BC Hydro teams supporting the Quality Assurance processes are:
  - Site Quality Team
  - Resident Engineering Team
  - Construction Management Team
  - Engineering Design Team (Klohn Crippen and SNC Lavalin)
  - Owner's Engineering Team (BC Hydro)

The areas of focus in 2021 are:

- Main Civil Works
  - Foundation grouting for main dam
  - Earthworks construction
  - Roller Compacted Concrete (RCC) completion
  - MCW contractor (PRHP) materials testing laboratory and implementation of lessons learned from cofferdam construction
  - Monitoring of PRHP quality resources (inspectors)
- GSS Civil Works
  - Concrete (thermal control; strength)
  - Penstock welding and coating
  - Hydromechanical equipment installation
- Turbines and Generators (site)
  - Embedded part installation and alignment
  - Spiral case welding and testing
- Offsite manufacturing
  - Coordination of local inspectors (Italy, Brazil, Canada, USA, Korea)
  - BC Hydro remote participation in factory acceptance tests (COVID-19)

Each of the quality aspects were evaluated regarding engineering, manufacturing and construction. The TAB was advised that Quality Performance Indicators were developed that indicate that good quality is being obtained in a consistent manner. This is indicated by the table below.

**Quality Performance Indicators for May 1, 2021**

			Engineering	Manufacturing	Construction
● Main Civil Works (MCW)	● Main Dam (MND)		●	N/A	●
	● RCC Buttress (RCC)		●	N/A	●
● GSS Civil Works (GSS)	● Generating Station (STA)		●	●	●
	● Intake and Penstocks (IAP)		●	●	●
	● Spillway (SPL)		●	●	●
● GSS Equipment Supply	● Hydromechanical (HME)		●	●	●
	● Large Cranes (CRA)		●	●	●
● Turbines-Generators (TG)			●	●	●
● Balance of Plant Contract (BoP)	● Balance of Plant Contract (BoP)		●	●	●
	● Transformers (TXM)		●	●	●
	● Generator terminal Equipment (GTE)		●	●	●
	● AC Station Service (ACS)		●	●	●
● Transmission & Substation	● Transmission Lines (TRM)		●	●	●
● Highway 29 Realignment (HWY)			●	●	●
		<b>Legend:</b>	●	= No Risk to Quality	
			●	= Potential Risk to Quality	
			●	= Actual Risk to Quality	

Another indicator of quality in the constructed Project is to monitor the number of non-conformance reports (NCRs). The majority of the NCRs for the GSS work are focused on thermal control of concrete, reinforcing bar detailing and procedural processes. With recognition of these aspects through the NCR process, these areas are being corrected and better quality can be maintained in these areas in the future.

As with the GSS work, the MCW can also be monitored and controlled by reviewing and studying the range and distribution of the NCR's.

**The TAB wishes to commend the project for its high diligence to addressing quality assurance matters and communicating the outcome in an effective manner.**

**On a matter of detail, the TAB was advised in May about an earlier steady decline in GSS concrete strengths during parts of 2020. Reasons for this were being explored and changed or modified. Fly ash supplies seem to be the likely culprit. The TAB was advised that strengths have now stabilized and remain at acceptable levels.**

**Given the high volumes of GSS concrete placement that are planned for 2021, and indeed which are currently underway, the TAB would emphasise the need for continued vigilance over this aspect of quality control of concrete.**

## **2.5 Earthfill Dam Construction Update**

### **i. Cofferdam**

The TAB was presented with a summary of construction and testing of the Stage II cofferdams during several review meetings and on May 10, 2021. The Contractor performed their own QC; however, BCH utilized an independent testing firm and laboratory to check the procedures and testing of the cofferdam earthworks. The observation and testing of this cofferdam construction were determined to be beneficial to the future work of constructing the Main Dam. Since the Main Dam earthworks will begin this summer, this cofferdam earthwork placement, compacting and testing essentially served the purpose of a “test fill program” for the upcoming Main Dam. The following information and benefits were gained with these additional quality and control and testing verification efforts.

- Contractor utilized the cofferdam as an opportunity to fine tune testing procedures and communication protocols (QC to production) for the Main Dam work
- QA/QC testing demonstrated good agreement – offered more confidence in the contractor
- Contractor utilized seasoned inspectors and testing technicians
- Appeared to be good communication between contractor QC and production – minimized remove/replace corrective action
- Good relationship between BC Hydro QA and PRHP QC

The installation of the geomembrane placed on the upstream cofferdam was discussed in detail. The Contractor performed this work very well.

### **ii. Foundation Preparation and Fill Placement**

Now that the river has been diverted and the central portion of the dam has been dewatered and exposed, the original riverbed overburden materials have been excavated. The foundation rock is being exposed and the foundation is being mapped and studied. Sections of both the Right and Left Banks of the rock foundations are being treated with dental concrete and the foundation grouting is underway. The consolidation grouting is complete, and the curtain grouting is presently nearly complete. Refer to the grouting discussion and details in Section iii. Dam Foundation Grouting below.

Sections of the Main Dam foundations along both the left and right areas that have been mapped, grouted and treated, are prepared for the core placement in accordance with the specifications. These areas of the foundation that have been finally treated and photographed are prepared by moisture treatment and covered with the select core



materials and compacted in place. Water misters and portable blowers are used to moisten and clean small debris from the foundation ahead of the till placement. This is the first placement of the Main Dam embankment. Foundation preparation for the fill dam has been ongoing since April and has accelerated more recently as presented in the meeting on June 16.

The first fill on the foundation is illustrated in the photograph below.

**The TAB is favourably impressed with the careful attention being paid in the field to foundation mapping and treatment, control of construction equipment, and recognition of the care required at all material interfaces. The TAB is of the view that the direction of the data gathering, control of construction and material management are at the highest level. This early phase earthworks also validates that the material selections and specifications are fit for purpose.**



### iii. Dam Foundation Grouting

#### **Status**

On occasion of the workshop organized in September 2019, the TAB had inspected ongoing grouting works in the core foundation on the left bank. Since then, the river has been diverted and grouting works for the blanket/consolidation and the main curtain continued. BC Hydro recurrently informs on the progress of the grouting works. A teleconference dedicated specifically to this subject was held on April 23, 2021 (see Appendix A), and on May 10 (see Appendix B) a summary of the progress was presented. On June 16, BC Hydro updated on the progress of the grouting works and elaborated on previous comments of the TAB. To date, the consolidation grouting is complete, except

for the upper left abutment, and more than 90 % of curtain grouting has been accomplished (not considering the pending work at the approach channel).

## Criteria

The following closure criteria for the grouting works had been considered:

1. absorption rate 0.3 litres/m/minute for a duration of 10 minutes
2. absorption 35 kg/m
3. hydraulic conductivity, final Lugeon value to be less than 3 l/m/min (at 10 bar)

Additionally, it was specified that the injection pressure should not exceed 25 kPa per metre of depth. However, during the performance of the work, pressures up to 40 kPa per metre have locally been admitted, subject to control of surface heave, limited to max. 2 mm. The Design Team recognized that such precautions taken in this relation are appropriate, as evidenced by the highly sensitive reaction of the rock mass to changes in pore pressures experienced during construction.

As BC Hydro explains, the criteria 1 and 2 derive from precedence with dams on comparable foundations. The Lugeon criterion is not conventional in Canada but was added for the deep curtain of Site C. As judged by standard practice, the criteria are conservative. But, in the context of Site C project, their individual weights are not identical and need to be assessed.

Criteria 1 and 2 essentially deal with the technical viability and efficiency of the applied methodology. The technical objectives of the grouting works have to be considered, as they are typically:

1. reducing seepage losses
2. homogenizing important areas of the dam foundation
3. preventing erosion from the embankment
4. preventing erosion/suffosion in the foundation
5. enhancing geotechnical characteristics in respects of shear strength and deformations
6. controlling uplift pressures

Item 1 is not critical at Site C. The experience with the cofferdams has demonstrated that underseepage discharge is insignificant. Regarding item 2, the variation of rock mass quality in the core foundation is moderate but the grout takes concentrated in the area

affected by the Little Ricky Shear indicate a favorable effect of the grouting works. Item 3 is addressed primarily by the thorough foundation treatment and, the observed limitation to the penetration of the particularly fine-grained cement shows that migration of fines from the core are not a hazard. The foundation rock itself is of moderate strength but the sequence does not include erodible strata. For item 5 the respective analyses, carried out with conservative parameters, show acceptable performance of the dam with its foundation. Thus, item 6 remains as a topic to be discussed. This item has to be viewed in relation with the Lugeon value, which informs on the permeability of the foundation rock. Another observation to be considered in this relation is the occurrence of confined water or gas found in some boreholes.

### Specific Observations

The Project recognized that the Lugeon requirement does not correspond well with grout take and that strictly satisfying this criterion throughout as indicated in the specifications could be relaxed. While the information obtained by the Lugeon testing was of value, modifications had been made to the design basis to reduce the requirements of the Lugeon test results. High Lugeon values can be found in areas that have been adequately grouted in terms of grout acceptance criteria.

### Suspensions

The suspensions are prepared with a Type III cement. It has a Blaine value of 6110 cm<sup>2</sup>/g and the maximum grainsize measures 0.045 mm. The following table states properties of batches prepared with this cement.

Mix ID	W/C	Plasticizer	Marsh Viscosity
	by weight	%	sec
1	1	1	29
2	0.85	0	32
3	0.75	0	35

Mixes 1 and 2 have a very favourable viscosity and should also display acceptable stability. The Blaine value is favorably high. The cement is considerably more-fine grained than commonly used for grouting in rock. The effectiveness of grouting is much related to grout mix adopted and the nature of the cement employed in the mixture. The Design Team has employed mixes appropriate for the intended application and cements which are finer than commonly used in rock. Even so, the grain size will limit penetration into fine fissures as reflected by the Lugeon data mentioned above.

### Methodology

Site staff have judiciously raised the injection pressure, exploring the limits admissible at this specific site.

Some fairly wide seams of grout found in check holes indicate that jacking has occurred locally but that the applied grout mix has satisfactorily filled and effectively sealed the cracks.

### **Concluding Remarks**

As the TAB suggested on previous occasions, the results of the grouting works are being assembled in a 3D model for visualization and analysis. Sections generated with this model show grout takes concentrating on the shear in the valley centre and on bedding plane BP32 at depth. Thus, the grouting has been effective on these particularly important elements.

The grout take of the curtain holes has accumulated 105 t of cement. In relation to the area covered by the completed holes, the take barely averages 10 kg/m<sup>2</sup>. This is a low value but is consistent with the foundation consisting predominantly of massive shale, mudstone and marl.

The limit of technical viability of cement grouting in this kind of rock has been reached. Still, the aspired 3 LU have not been rigidly obtained. Reflecting on information provided from check holes and televiwer scans, a notable proportion of the high Lugeon values appears restricted to narrowly localized conditions, not pervasively affecting the rock mass.

The experience with the grouting works also expands our understanding of some general hydrogeological characteristics of the foundation rock:

- There is a significant anisotropy in hydraulic conductivity, capable of generating confined and even artesian conditions.
- The overall conductivity is very low but stratigraphic and structural conditions produce heterogeneous and complex hydrogeological conditions.

**One item of detail to be pursued as performance of the foundation continues to be monitored is the development of small deformations in the left abutment at BP28 reported to the TAB. The TAB looks forward to further information on these circumstances in the context on the remaining grouting to be completed on the upper Left Bank.**

**The TAB wishes to emphasize that the successful completion of the grouting to such a high standard is a major milestone of the Project. The grouting programs are developed with a model and when they are successfully completed without challenges to the model, it constitutes a significant achievement. The TAB wishes to complement the Project Team and the Contractors on achieving this milestone with such high quality.**

### **3. Earthfill Dam Ongoing Analysis**

#### **3.1 Right Bank – Shear Key Foundation Excavation and Powerhouse Interaction**

The implications of a sliding plane loaded by the Earthfill Dam impacting the Powerhouse has been recognized for some time. To address this issue, a shear key was excavated to El. 390, extensive inclinometer installations were placed adjacent to the shear key, from the Earthfill Dam to the Service Bay at the Powerhouse, and monitoring was undertaken both during shear key excavation and backfilling. The local geology is complicated not only by the presence of bedding planes, but also due to a complex shear zone at this location. The TAB received a summary of the analyses that revealed the influence of the shear zone on the magnitude and direction of slip in the bedding planes.

**The TAB appreciates the detailed consideration of what might have been a complex interaction of the Earthfill Dam with the Powerhouse and the insightful analysis of the local movements. From a practical perspective, all movements observed are in favourable directions and no adverse interaction with the Powerhouse due to the construction of the Earthfill Dam is anticipated. This was further reinforced by comprehensive FLAC analyses that the TAB accepts.**

#### **3.2 FLAC 3D Earthfill Dam – Modelling Approaches**

Confirmation that the Earthfill Dam is behaving as intended will rely on FLAC 3D modelling. This modelling has already demonstrated its capability for including the substantial degree of complexity needed to assess the response of the foundation at Site C to dam construction. It is proposed to adopt two models to simulate the evolving complex behaviours:

- i. Model 1 – will predict deformations at the end of Year 1 (El. 414 m) ignoring construction sequencing. It will adopt simplifying properties for the fill material but will conduct sensitivity checks on the influence of the strength of the bedding planes on foundation response.
- ii. Model 2 – will initiate simulation in support of performance-based design by incorporating geological structures as uncovered and revisions of models of fill material behaviours and pressures to match observed behaviours. This incremental updating will continue to the end of construction and subsequent filling following the construction sequences.

The application of performance-based design relies on early installation of reliable instrumentation to a degree that is greater than normally adopted in precautionary-based design (the “Observational Method”) and this is recognized in the project planning. In

addition, a Leapfrog geological model for the Earthfill Dam has been created so that the results of ongoing mapping can be integrated in the Model 2 analysis.

**In keeping with current best practices, the Design Team is adopting performance-based design to verify that the Earthfill Dam is behaving as intended during construction and will ultimately satisfy design criteria. The TAB is content that the Design Team has formulated an effective approach to performance-based design, and it looks forward to receiving updates on findings throughout the period of construction and first filling. Performance-based design provides a more authoritative basis for assuring that dam safety is being addressed in a timely and effective manner than the more traditional Observational Method. The capacity for conducting projections to future performance based on continuous monitoring is embodied in performance-based design. One site issue already managed by performance-based design is the successful determination that the Earthfill Dam will not impact the construction of the adjacent Powerhouse as mentioned in section 3.1 above.**

**Successful execution of performance-based design involves an intimate interaction within the Design Team to assess all current information in a timely manner. This includes all instrumentation being monitored by GeoViewer, geological data being integrated within Leapfrog and other aspects of performance relevant to the process. The TAB recommends that the Project Team provide a brief on its current capacity to continue to conduct performance-based design for discussion and review with the TAB.**

### **3.3 Options to Add Passive Resistance**

The Design Team has assessed the options available to improve downstream stability by adding passive resistance. There are two feasible choices: i) additional fill on the downstream slope, and ii) extend the downstream toe farther downstream. A comprehensive study of stability enhancement associated with alternative configurations has been conducted. In the short term, the Project proposes to exploit this opportunity temporarily by establishing a laydown area beyond the current location of the downstream toe of the dam, which would be removed incrementally for operation of the Powerhouse and Spillway. The laydown would be constructed to El. 418-420 m. The TAB was advised that the temporary stockpile and associated permitting are being undertaken, but any additional buttressing would remain a contingency measure.

**The TAB is pleased to see that these extra stabilization measures have been assessed. Design of the Earthfill Dam consistent with design criteria is based on a Most Likely Case (MLC), which is the current design basis and a Reasonably Worst Case (RWC), which requires a contingency design. The options to add passive**

resistance has been recognized in the event that the RWC is encountered, and contingency measures are required.

### **3.4 Left Bank Colluvium**

A deposit of colluvium exists of about 18,000 m<sup>3</sup> along the left abutment downstream of the core of the Dam. Under normal circumstances, this would be removed; however, the TAB was advised that in the present circumstances due to stability considerations, it is difficult to remove. Characterization studies have been performed based on sampling and penetration testing. The deposit is about 6.6 m thick and partly saturated. Under its current condition, leaving it in place does not significantly impact stability and the anticipated settlements would not impact the coarse filter. The Design Team concludes that drainage trenches that had been proposed are not needed.

The TAB was also advised that the Project has recently undertaken FLAC analyses to explore whether wetting and softening of the colluvium might affect the functionality of the downstream filter or the core. These analyses have concluded that the potential deformations associated with these processes would not be significant.

**The TAB was pleased to learn about the more recent analyses that would support the view that the colluvium could be left in place untreated. However, before agreeing with this position, further degree of analyses should be conducted involving the following activities.**

- 1. Undertake saturation collapse testing of undisturbed samples related to the Proctor density reference data to determine how collapsible the material might be.**
- 2. If significant, repeat the analyses conducted by FLAC by using prescribed displacement to simulate the collapse and determine its implications.**

**At this time the TAB does not anticipate that the above recommendation will alter the conclusions presented so far.**

## **4. Dam and Core Buttress Updates**

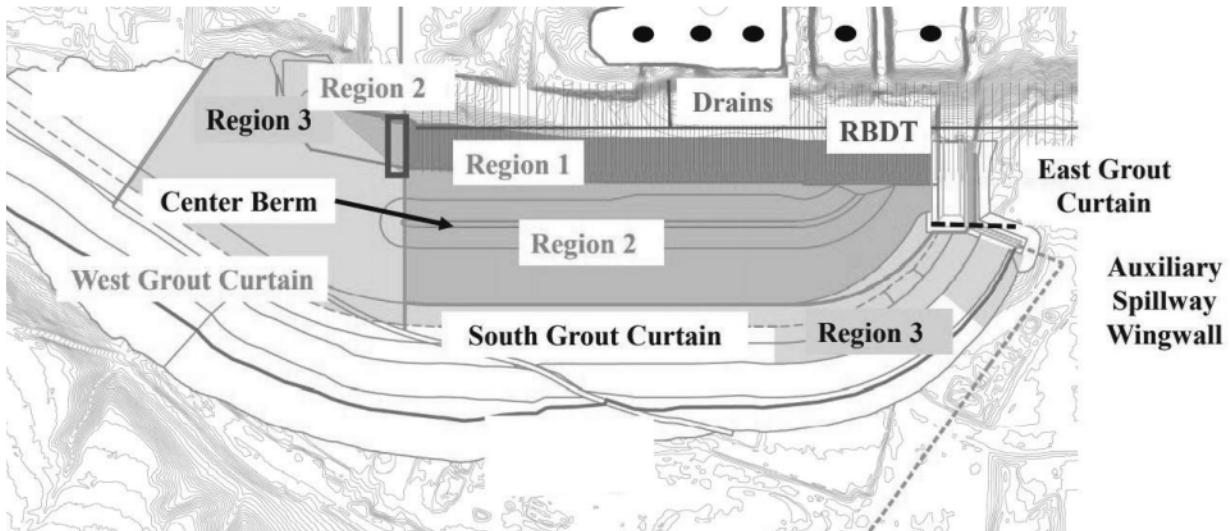
RCC placement of both Dam and Core Buttresses started in 2020 and the season finished with the Dam Buttress at El. 434.3 m sloping to the Core Buttress at El. 414.2 m. Placement has now re-commenced at the Core Buttress. In both cases, a 130/80 (fly-ash/cement) mix has been adopted. This mix has already been successfully used to construct both the Spillway and Powerhouse Buttresses. As trials have shown, exchanging 20 kg/m<sup>3</sup> of cement for fly-ash makes little change to temperature peaks and might well introduce other detrimental effects such as reduced early tensile strengths.

In terms of crack control, one key is minimizing temperature differentials within the buttresses and presented data indicated that acceptable differentials were being achieved. Cylinder strength testing also showed good batch control with 180 and 365 day mean strengths of 30.8 and 36.4 MPa, respectively, and low associated coefficients of variation of just 8.1 and 9.4%.

**In view of the above, the TAB would recommend no change to the 130/80 mix being used at this stage for the Dam and Core Buttresses. The TAB would, however, recommend continued core testing of the in-situ Dam and Core Buttresses concrete to confirm that the good control implied by the cylinder testing is being translated into an equally good final in-situ product.**

## 5. Approach Channel Update

The TAB was pleased to see the continued developments and elaboration of the arrangements for the Approach Channel and the clear delineation between region 1, incorporating Carpi membranes, region 2, incorporating HDPE membranes and outer regions 3 utilizing just plastic till protected by riprap and associated bedding material (see the plan below). However, these developments and elaborations have now also produced a total of 10 sub-regions within the umbrella of the main three.



**Simplified Plan of Approach Channel showing key regions**

Region 1 will be compartmentalized to ensure that any leakages stay localized and so facilitate leakage location detection. **The TAB would recommend that some form of compartmentalization, but perhaps less elaborate, is also extended into region 2 for the same reasons.**

The proposed connection details between the regions were also elaborated for the first time during the discussions. The TAB was pleased to note that these will now be further



discussed with the Contractors and with joint Contractor discussions where different contracts overlap. The TAB would stress the importance of these negotiations so that both Contractors buy into the details finally adopted. While appreciating that some intricacy may be inevitable at such interconnections, the TAB would stress the need for simplicity wherever possible. As already discussed, there may also be merit in amending some region boundaries so as to coincide with other features and changes, such as geometrical ones.

In the case of region 2, connections will also take place between smooth HDPE linings and textured linings and the TAB was pleased to note that this had also been thought through, as well as the need to ensure that any texturing was in place on both sides of the HDPE membrane concerned.

Regions 1 and 2 will be isolated by a triple grout curtain extending down to El.410 m installed on the south and east sides from an anchored concrete plinth. This will connect with a plinth and grouting gallery on the west side and with the central line of that grout curtain taken down to El. 380 m to transition into the main dam grout curtain. Similarly, the gallery concerned will connect to the main core buttress grouting gallery and the main headworks gallery via a water-tight bulkhead door. The TAB would commend the degree of detail to which all these works are now being developed and coordinated. At the same time, benefit can be gained by coordinating such aspects with the relevant Contractor. The TAB was pleased to note that the EDT fully appreciated the level of detail and quality to which the bulkhead door will need to be both manufactured and installed.

**The TAB was advised that while the critical path for Site C completion remains with the construction of the Main Dam, the completion of the Approach Channel is also now seen as having very little float. Some long-standing aspects of the design still remain to be confirmed, such as the final connection and interface arrangements between different regions. This is again why the TAB would stress the need for a focus on robustness, simplicity and ease of construction as arrangements are finalized. It is also why the TAB would again stress the need for associated discussions and agreements with the Contractors involved in developing final arrangements.**

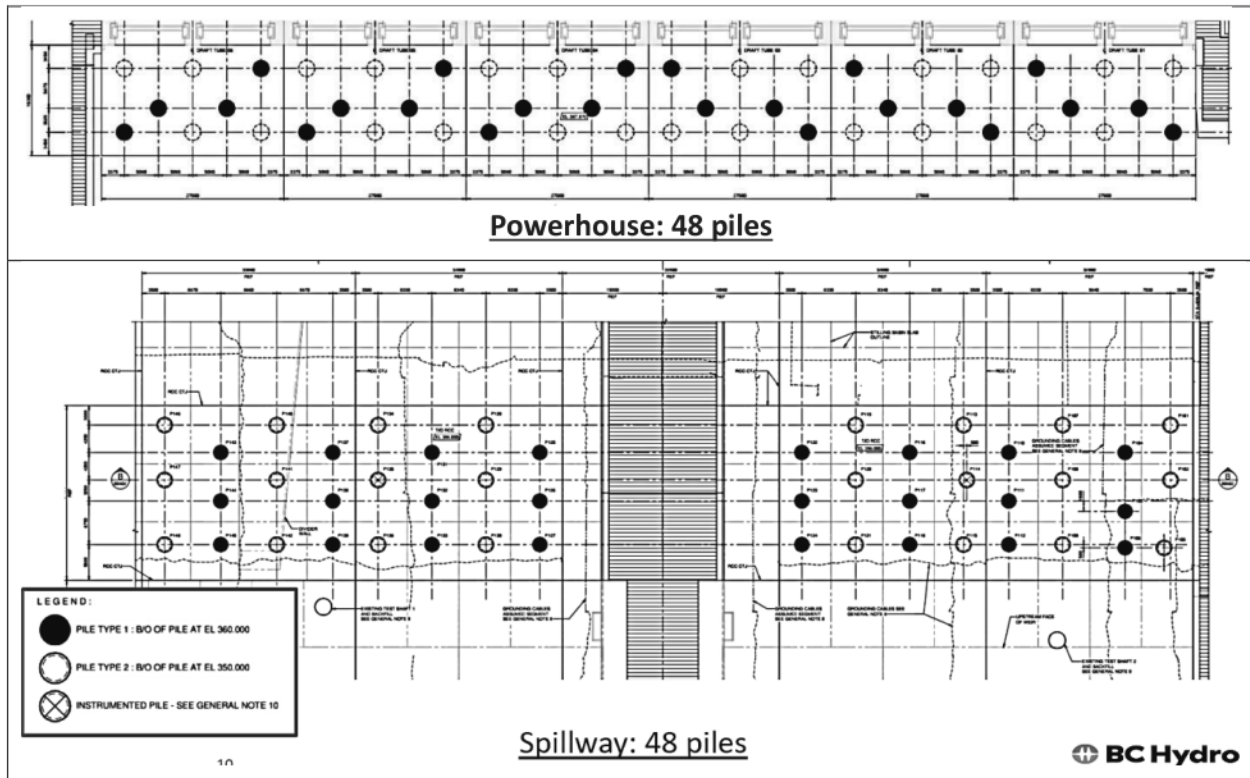
## **6. Powerhouse and Spillway Piles Update**

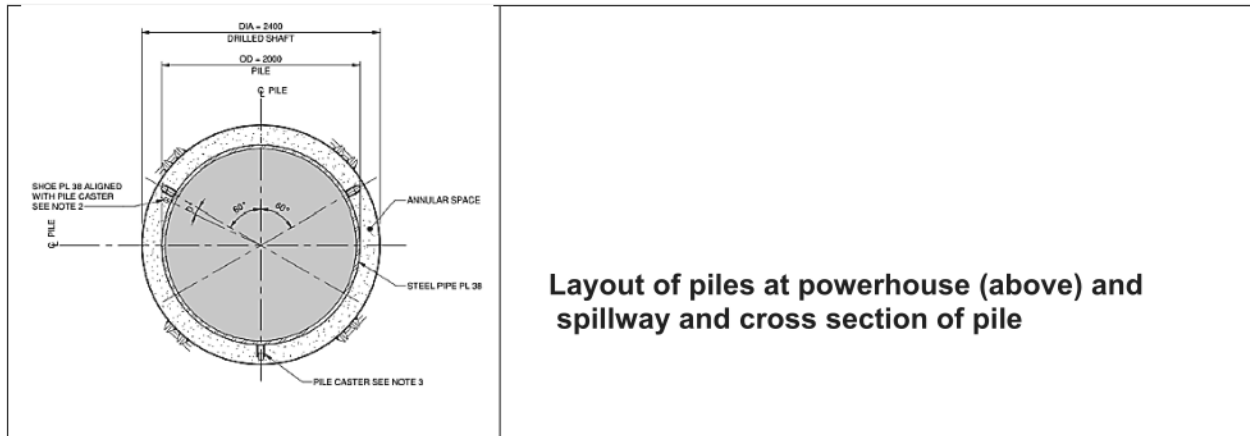
An uncommonly comprehensive program of geological and geotechnical investigations identified highly sensitive conditions and, considering the complexity of the combination of rock mass properties, geohydraulic effects and ambient stress patterns, an observational approach for the construction works had been adopted to handle inevitable uncertainties. This approach detected deformations in the rock mass beyond the depth to which likely responses had been envisaged. As these deformations threatened to affect

the shear strength of the rock mass and, in consequence, the stability of the structures, the need for intervention was seen.

A wide range of options, suitable for enhancing the performance of the foundation, was developed. From a meticulously performed Multiple Accounts Analysis, large diameter piles emerged as the optimal solution in all relevant regards. State-of-the-art geotechnical analysis demonstrated that limiting deformations on bedding planes to 10 mm would be required. Thus, stiffness of the pile system became decisively important for the stability of the structures built against the right bank slope. In-situ, full scale lateral load tests with complementary tests (e. g. pressuremeter), started in October 2020 and in combination with monitoring in the rock mass supplied the necessary information. Incidentally, the tests found an increase of the rock mass modulus over the values of the DBM starting at a depth of El. 370 m, helping the performance of the piles.

Coordinated analysis by FLAC 3D and ABAQUS guided the final design of the piles. The finally adopted design includes 48 piles each for spillway and powerhouse, arranged in parallel rows, drilled on laterally shifted centers and staggered in depth to El. 350 and 360 m, respectively (see the figures below).





Stability and performance of the structures was evaluated by Finite Difference and Finite Element simulation as well as by sliding wedge analysis. The results demonstrate compliance with the guidelines of the Canadian Dam Association, applying the analysis defined by the USACE method and prevent inadmissible deformations in the foundation.

Whereas the piles at the spillway will be drilled through the concrete of the stilling basin and thus directly connect to the structure, at the powerhouse a pile cap must be added at the outlets. The required excavation has to proceed such as to avoid excessive relaxation effects and the most appropriate methodology for this target is still being assessed. Details currently under discussion concern the connection granting the load transfer between the existing powerhouse concrete and the pile cap.

Other features as alignment of boreholes, cleaning of the borehole, centering and concreting of the pile have been satisfactorily considered.

A selected number of piles will be instrumented for remote read-out. Options for the range of instrumentation – deformation, strain, pore pressures – and selection of suitable techniques have been discussed and respective decisions will be taken shortly.

The construction sequence for the Powerhouse pile caps currently envisages the excavation of the necessary pits and then constructing the piles and pile caps sequentially in discrete elements. The TAB notes that the excavated pits will become increasingly congested by the steel piles rising 3+ metres above excavated base level. This will restrict operational access for the necessary piling rigs, the plant and equipment needed to load and haul the muck from the excavations, any brushing or jet wash equipment for the piles, the equipment necessary for pile placement, pile cap rebar placement and concreting. The pile sequencing proposed suggests that all these operations could be taking place in a single pit at the same time. It will also involve considerable trafficking of the excavated base which then might need further treatment before concreting of the pile cap can take place.

Alternative sequencing and staging options may be possible, and the TAB recommends that all potential options are explored, finalized and agreed in conjunction with the Contractors involved.

## 7. Future Meetings

The TAB recommends that the next TAB meeting be virtual and the date to be determined. In addition, TAB update teleconferences will convene as follows: July 16 and August 5, 2021. Other conference calls will be scheduled as required.

Respectfully submitted,



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Dr. Norbert R. Morgenstern



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Dr. Wynfrith Riemer



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Mr. Joseph L. Ehasz, P.E.



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Dr. Peter J. Mason

## **Attachment A – Technical Update Conference Calls Agendas**

**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
18 November 2020**

**Location: Conference Call and Screenshare**

**AGENDA**

1. Project update s.19
2. Approach Channel Region 2 Liner – HDPE versus LLDPE
3. Right Bank Geological Model – Update
4. Powerhouse and Spillway – Design Approach

**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
26 November 2020**

**Location: Conference Call and Screenshare**

**AGENDA**

1. Introduction
2. Geomorphological information refresh on right bank
3. Criteria & Stability Cases – continued discussion

s.19

**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
21 December 2020**

**Location: Conference Call and Screenshare**

**AGENDA**

1. Project update s.19
2. Right Bank Foundation Enhancement
  - a) Lateral Load Tests – Update
  - b) Design Basis and Proposed Changes to DBM
  - c) Powerhouse and Spillway Stability Analyses Update
  - d) Powerhouse and Spillway Pile Options
3. Approach Channel – Design Optimization Process
  - a) Framework
  - b) Review of Right Bank Foundation Hydrogeology
  - c) Preferred Layout



**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
05 January 2021**

**Location: Conference Call and Screenshare**

**AGENDA**

1. Project Update s.19
2. Approach Channel Design Assessment
  - a) Framework
  - b) Preferred Layout
  - c) Risk Assessment Approach
  - d) Right Bank Foundation Hydrogeology – Discussion
3. Bedding Planes Pore Pressures

**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
19 January 2021**

**Location: Conference Call and Screenshare**

**AGENDA**

1. Project Update	s.19	20 min
2. Right Bank Foundation		
a) Lateral Load Test Results		45 min
b) RCC Buttress Design Criteria		30 min
c) Powerhouse and Spillway Stability Results		30 min
d) Powerhouse and Spillway Economic Analysis and Pile Layout		20 min
<del>3. Approach Channel FMEA</del>		<del>30 min</del>
<del>4. Right Bank Historical Buried Channel</del>		<del>20 min</del>

**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
27 January 2021**

**Location: Conference Call and Screenshare**

**AGENDA**

1. Project Update s.19
2. Right Bank Foundation – Proposed changes to DBM (Discussion)
3. Approach Channel FMEA
4. Right Bank Historical Buried Channel
5. Quality Assurance (QA) Update

**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
24 February 2021**

**Location: Conference Call and Screenshare**

**AGENDA**

1. Project Update s.19
2. Powerhouse and Spillway RCC Buttress
  - a) Review of Loading Cases
  - b) Stability Analyses Update
  - c) Deformation Analyses under Static Loading Conditions (FLAC)
  - d) Deformation Analyses under Seismic Loading Conditions
  - e) Update on Pile Design

**Break (10 min)**

3. Approach Channel Risk Assessment
4. Discussion – Topics and timing for forthcoming meetings
  - a) Mid to late March (Hydrogeology, RCC Buttress stability and final pile design)
  - b) April (Earthfill Dam and Right Bank foundation drainage)
  - c) May (Approach channel progress)

**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
12 March 2021**

**Location: Conference Call and Screenshare**

**AGENDA**

1. Project Update s.19
2. Powerhouse and Spillway RCC Buttress
  - a) Action Items from previous TAB Meeting
    - Breakout Zone – Sensitivity analyses
    - Extreme 5 Loading Case – Contribution of Cohesion to FoS
    - Deformation Analyses under Seismic Loading Conditions
    - Strain-Weakening and Tensile Strength Parameters
    - Spillway Buttress – Reduction of piles vs. impact on deformations
  - b) Summary of Stability Analyses
  - c) Proposed Pile Layout and Design Update
  - d) Pile Parameters – Equivalent vs. Explicit Pile
  - e) Summary of Deformation Analyses under Static Loading Conditions (FLAC)
  - f) Powerhouse Buttress – Decompression Zone (Abaqus)
3. Right Bank Foundation – Hydrogeology Review

**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
29 March 2021**

**Location: Conference Call and Screenshare**

**AGENDA  
Revision 1**

1. Project Update
2. Right Bank Foundation – Hydrogeology Review
3. Powerhouse and Spillway Buttress – Pile Layout vs. Tensile Stresses in Rock
4. Earthfill Dam
  - a) Grouting Update
  - b) Earthfill Dam Foundation Preparation

s.19

**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
23 April 2021**

**Location: Conference Call and Screenshare**

**AGENDA**

1. Grouting Update
2. Lugeon vs Grout Take

s.19

## **Attachment B – Meeting Agenda**



**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
May 10, 13 and 14 2021**

**Location: Conference Call and Screenshare**

## **AGENDA**

### **MAY 10, 2021**

s.19

1. Project Update
2. GSS Update
3. BoP Update
4. Project Quality Update
5. Earthfill Dam
  - a) Cofferdam Construction and QA/QC Results
  - b) Earthfill Dam Foundation Preparation and Fill Placement – Status Update
  - c) Earthfill Grouting Update

### **MAY 13, 2021**

5. Earthfill Dam
  - d) Shear Key Excavation and Backfilling – Review of BPs response
  - e) Shear Key Excavation – Flac3D Calibration
  - f) Simplified 3D Deformation Model – Prediction of Deformations at Service Bay
  - g) Work Plan for Flac3D deformation modelling
  - h) Benefit of Temporary Laydown Area on Dam Stability

**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
May 10, 13 and 14 2021**

**Location: Conference Call and Screenshare**

- i) Left Bank Abutment – Colluvium Berm Settlement Assessment s.19
- 6. Dam and Core RCC Buttress – Update

**MAY 14, 2021**

- 7. Approach Channel – Update
- 8. Powerhouse and Spillway Piles
  - a) IFC drawings and Specifications Update
  - b) Tailrace Cap Connection to the Powerhouse
  - c) Tailrace Excavation and Sequence of Work
  - d) Instrumentation

**Site C Clean Energy Project  
Technical Advisory Board  
Conference Call  
June 16, 2021**

**Location: Conference Call and Screenshare**

## **AGENDA**

1. Project Update s.19
2. Earthfill Dam
  - a) Grouting Update
  - b) Fill Placement
  - c) Left Bank Colluvium Berm – Assessment of Deformations using FLAC3D
3. Powerhouse Pile Cap – Design Update
  - a) Pile Cap Layout
  - b) Pile Cap Reinforcement
  - c) Rock Trap Serviceability
  - d) Instrumentation

## Attachment C - List of Meeting Attendees

### **TAB Members:**

Joe Ehasz  
Norbert Morgenstern  
Wynfrith Riemer  
Peter Mason

### **Site C Engineering:**

s.19

### **BC Hydro:**

John Nunn

### **Other:**

Rob McLean – Water Management Branch,  
Government of BC  
Jeff Grass – Water Management Branch,  
Government of BC  
Tim Little – Independent Engineer  
John France – Independent Reviewer  
Kaare Høeg – Independent Reviewer

**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, ScD, NAE**  
**REPORT NO. 4**  
**August 12, 2021**

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## **EXECUTIVE SUMMARY**

This report presents an update to the Technical Review Panel's (Panel's) findings subsequent to Panel Reports Nos. 1, 2, and 3, issued on January 22, 2021, February 15, 2021, and April 6, 2021, respectively.

The Panel's opinions expressed in the previous reports remain unchanged. The work associated with the right bank design enhancements, the design of the approach channel, and the earthfill dam has been progressing as anticipated at the time of preparation of Panel Report No. 3.

The pile designs for the right bank enhancement have been completed. Steel pipe for the piles has been ordered and is expected to begin arriving on site soon. Pile installation is expected to commence later this year and be completed by Spring 2023.

With the steel pipe ordered, the Engineering Design Team (EDT) has turned its attention to progressing the work related to the approach channel. Designs are being advanced in anticipation of continuation of excavation of the approach channel commencing later this year and channel liner installation commencing in Spring 2022. The EDT is currently anticipating five work packages with two contractors and is in discussions with the contractors to finalize the work plans. As the EDT finalizes the approach channel design, the Panel encourages the team to give strong preference to construction of the Region 2 polyvinyl chloride (PVC) liner as a continuous liner beneath the center berm, rather than constructing the liner over the top of the berm.

The EDT is considering improvements to the existing right bank drainage tunnel (RBDT), in light of several local shotcrete liner failures that previously have occurred in the tunnel. The RBDT must be made safe, as it is indispensable for the future drainage work.

There have been no changes to the earthfill embankment design since early this year. Foundation grouting has progressed to near completion in the valley, and reported grouting records indicate an effective program and high-quality execution. Earthfill placement has commenced. Foundation preparation for earthfill placement appears to be carefully and appropriately done. Foundation conditions observed in the core trench have been quite favorable. The limited shears that have been found have been treated appropriately. Quality control / quality assurance (QC/QA) testing of the earthfill placed to date indicates placements and compaction in accordance with the project specifications.

The Panel concurs with the EDT's conclusion that the area (berm) of colluvium to be left in place beneath the earthfill embankment at the left bank will have no significant effect on the dam core and filter performance after reservoir filling.

**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, ScD, NAE**  
**REPORT NO. 4**  
**August 12, 2021**

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The EDT has developed instrumentation data presentation templates and a three-dimensional FLAC deformation model which will both be helpful in evaluating earthfill dam performance during construction and first reservoir filling.

## **INTRODUCTION**

At the request of BC Hydro, the Technical Review Panel (Panel) has prepared this report as an update to the Panel's previous Reports Nos. 1, 2, and 3, dated January 22, 2021, February 15, 2021, and April 6, 2021, respectively.

Since April 6, the Panel has attended briefings to the Technical Advisory Board (TAB) by the EDT on April 23, May 10, May 13, May 14, June 16, July 16, and August 5, 2021, during which the EDT updated the TAB on activities related to the right bank enhancements, the approach channel, and the earthfill dam. The Panel has also reviewed project information provided by BC Hydro.

Based on the information provided to date, the Panel provides updated findings concerning the proposed right bank design upgrades, the approach channel, and the earthfill dam.

## **FINDINGS**

### **Right Bank Design Enhancements**

In the Panel's opinion, the EDT has been proceeding well with the implementation of the right bank enhancements. The principal activities completed since April 6 have been finalization of the pile system design, placing orders for the steel pile casings, and advancements of concept designs and details for the approach channel. Work remaining to be done includes finalization of designs for the pile caps downstream of the powerhouse, the approach channel, the foundation drainage system, and the approach channel foundation grouting program. A detailed schedule has been established for the remaining activities.

The Panel has been regularly updated on the various activities related to the right bank design enhancements through the TAB briefings.

Pile System Design – Subsequent to our Report No. 3, the EDT finalized the number, size, and configuration of piles to be installed downstream of the spillway and powerhouse. The steel pipe for the piles has been ordered and is expected to begin arriving on site soon. Installation of the piles is scheduled to begin later this year and be completed in Spring 2023. The EDT is still finalizing some details of the pile cap design for the powerhouse piles, but this should not affect the overall schedule.

The EDT has completed its documentation of the stability, displacement, and stress analyses to support the pile design.

**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, ScD, NAE**  
**REPORT NO. 4**  
**August 12, 2021**

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Approach Channel – With the pile design completed and documented and the steel pipe ordered, the EDT has turned its attention to progressing the design of the approach channel. Final selection of materials and configuration of the approach channel liner is currently in progress. The EDT is in discussions with contractors concerning the approach channel work. At this time, the EDT anticipates five work packages to be completed by two different contractors. The current estimated schedule, to be finalized after completion of designs and discussion with the contractors, is for continuation of excavation of the approach channel to begin later this year and liner installation to commence in Spring 2022. The current estimated completion date for the approach channel is in the middle of 2023.

In its design activities, the EDT is attempting to simplify construction, while still preserving the planned functions of the approach channel water control features. Among options being considered is to construct the Region 2 PVC liner as a continuous liner beneath the center berm, rather than constructing the liner over the top of the berm. In the Panel's opinion, the horizontal liner configuration seems significantly superior to the over-the-berm alternative and should be given strong preference.

Right Bank Drainage Features – The EDT is currently using the results of hydrogeological analysis of the right bank to complete the final design of the right bank water control measures and drainage features, with construction of these features scheduled to commence in 2022.

The EDT is considering improvements to the existing RBDT, in light of several local shotcrete liner failures that previously have occurred in the tunnel. As the Panel has stated previously, the RBDT provides access for some of the contingency actions for the right abutment, if such contingency actions are found to be needed. The RBDT also provides access for observation of right bank drainage and for conveyance of collected drainage. As such, the RBDT must be made safe, as it is indispensable for the future drainage work.

### **Earthfill Dam**

There have been no significant changes in the earthfill dam design or stability analyses since Panel Report No. 2 issued on February 15, 2021. The Panel's findings remain unchanged from those stated in Report No. 2.

Foundation grouting for the earthfill dam has progressed substantially since Panel Report No. 3 issued on April 6, 2022. Consolidation grouting and curtain grouting in the valley section of the dam are nearly complete, with only some grouting in the abutments remaining to be done. Reports of grouting results presented at the TAB briefings indicate an effective and high-quality grouting program.

Placement of earthfill has commenced since Panel Report No. 3. Photographs presented at the TAB briefings indicate the foundation is being prepared appropriately before fill is placed. Foundation conditions observed in the core trench have been quite favorable. The Little Ricky Shear and an associated conjugate shear are the only significant shear zones observed in the core

**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, ScD, NAE**  
**REPORT NO. 4**  
**August 12, 2021**

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trench foundation. These shears have been appropriately treated. Only minor shears have been observed elsewhere in the core trench foundation.

Records of QC/QA test results for the embankment fill indicate that the fill is being placed and compacted in accordance with the project specifications.

In our opinion, earthfill dam construction has started well.

The EDT has evaluated the potential consequences of leaving an area (berm) of colluvium in place beneath the earthfill dam on the left abutment and concluded that this will have no significant effect on the dam core and filter performance after reservoir filling. The Panel concurs with this conclusion.

The EDT has developed templates for plotting embankment dam instrumentation data and has populated these templates with initial data. The team is also developing a three-dimensional FLAC deformation model to evaluate predicted versus actual performance of the earthfill dam and its foundation. The instrumentation templates and the FLAC model will be valuable in assessing performance as construction proceeds and during first reservoir filling after construction.

#### **STATEMENT OF LIMITATIONS**

The Panel functioned as independent reviewers of the methodologies used by the EDT for analysis and design of the right bank enhancements, the approach channel, and the earthfill dam, based on information provided by the EDT. Given the large amount of work being completed by the EDT and the associated voluminous documentation, it was not possible for the Panel to perform a detailed review of all of the material in the available time. In particular, the Panel has not performed detailed checks of calculations and designs completed by the EDT. Such detailed checks are provided by the quality control/quality assurance programs for the Project. The Panel provides its opinions concerning the methods and approaches being used based on information provided by the Project Team. However, the ultimate decisions and responsibilities for the designs remains with BC Hydro.

Our review services were performed within the limits prescribed by BC Hydro in a manner consistent with the level of care and skill normally exercised in the current standard of professional engineering practice. No other representation to BC Hydro, expressed or implied, and no warranty or guarantee is included or intended.

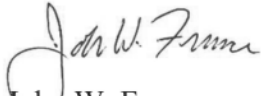
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**Site C Technical Review Panel**  
**John W. France, P.E., D.GE, D.WRE and Kaare Hoeg, ScD, NAE**  
**REPORT NO. 4**  
**August 12, 2021**

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Respectfully submitted,

  
John W. France

  
Kaare Hoeg

## Jang, Monica EMLI:EX

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**From:** MacLaren, Les EMLI:EX  
**Sent:** October 6, 2021 7:36 AM  
**To:** Mihlar, Fazil EMLI:EX; Cuddy, Andrew EMLI:EX  
**Cc:** Wieringa, Paul EMLI:EX; Sopinka, Amy EMLI:EX; Rowe, Katherine EMLI:EX; Foster, Doug FIN:EX; Jang, Monica EMLI:EX  
**Subject:** Site C Update

Fazil/Andrew

Doug Foster and I attended the Site C Project Assurance Board regular monthly meeting on September 27. s.13  
s.13

s.13  
the meeting. There were no decisions/approvals at

Project Update

s.13

- A second COVID outbreak was declared by Northern Health on August 19. BCH has subsequently reported there have been no new cases linked to the outbreak since mid-September, and if this persists the outbreak could be declared over October 11. As of October 1 there were 24 active cases, none related to the outbreak.
- With support of Northern Health, BC Hydro is collecting vaccination status for all Site C workers, and has initiated asymptomatic rapid testing of individuals identified through contract tracing (150 tests with 5 follow-ups as of October 1). BCH reports that Northern Health is very supportive of BCH's actions to be essentially self-sufficient with its clinic, vaccinations, contract tracing and testing. Northern Health is otherwise overwhelmed and cannot keep up with contract tracing.
- Traffic and vehicle safety risk has increased with the hauling of dam fill material using large trucks. One way haul roads and berms to separate lanes on two-way roads have been implemented.
- All required permits and leaves to commence construction for clearing in the western reservoir area and the Right Bank Foundation Enhancements, respectively, have been issued. An EA Certificate amendment is outstanding that would allow trucking of dam fill material as a back up in the event that till conveyor is out of service for an extended period. As till can only be placed above certain temperatures, that activity will be suspended over the winter so the EA Amendment is not currently critical.

s.13; s.16; s.18.1

- Two audits are underway. A BCH Internal Audit review of payment verifications will occur in October. The Auditor General will review procurement governance and fraud risk management in October/November as part of a larger cross-government project.

Risks/Commercial

- In addition to the traffic risk noted above, risks associated with COVID and securing permits following the Blueberry River First Nation court ruling have increased.

- Subsequent to the PAB meeting there was media coverage of issues with the North Shore Water Treatment Plant where Acciona is the lead partner. EMLI, BCH, MoTI and FIN have worked on messaging related to Site C and other major projects where Acciona is involved (Broadway Skytrain and Pattullo Bridge replacement).

Schedule

s.13

Doug may have further commentary.

*Les MacLaren*

Assistant Deputy Minister  
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*Energizing BC—clean, sustainable and productive*

Page 588 of 716

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s.12 ; s.13

Page 589 of 716 to/à Page 591 of 716

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s.12 ; s.13 ; s.17

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Page 656 of 716 to/à Page 659 of 716

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s.12 ; s.13

## Jang, Monica EMLI:EX

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**From:** Sopinka, Amy EMLI:EX  
**Sent:** October 28, 2021 7:59 AM  
**To:** Mihlar, Fazil EMLI:EX  
**Cc:** MacLaren, Les EMLI:EX; Foster, Doug FIN:EX; Jang, Monica EMLI:EX; Tseng, Eugene EMLI:EX; Richardson, Roari EMLI:EX; Warnock, Joie EMLI:EX; Rowe, Katherine EMLI:EX; Wieringa, Paul EMLI:EX  
**Subject:** Site C PAB Update

Fazil,

Doug Foster and I attended the Site C Project Assurance Board meeting on 25 October; with Les in attendance for a portion of it. The following is a summary of that meeting. Doug and Les may have additional comments.

### Construction Update

The August COVID-19 outbreak was declared over on October 12, however, there continues to be a steady number of cases identified and cleared. As of October 12, there were 17 active cases and 45 isolations. There has been a spike in vaccinations since mandatory vaccination is now required for commercial and charter flights. BC Hydro estimates that between 75% to 83% of the Site C workers are vaccinated based on the vaccination status information recently collected at the instruction of the Northern Health Authority.

The Project met a major milestone with Peace River Hydro Partners (PRHP) completion of the roller-compacted concrete (RCC) program on October 8. PRHP continues to exceed expectations on productivity with the Summer Works Acceleration on the Earthfill Dam, which was aided by the good weather. To date, 7 of the 48 piles required for the Right Bank Foundation Enhancement work have been placed. PRHP are currently excavating the Approach Channel, however that work is not progressing as quickly as expected and BC Hydro is working to finalize agreements that would completion of the approach channel by April 1, 2022.

s.13; s.17

Reservoir clearing, transmission line work and highway construction continue to progress to plan.

Richard Raine, an independent construction advisor, visited the site and confirmed the observations of BC Hydro management - good progression on multiple work fronts,

### Costs

s.13; s.17

### Risks

s.13



s.13

s.13

The Office of the Auditor General will be conducting two audits on Site C: payment verification (fraud) audit and a general performance audit.

#### Quarterly Progress Report

s.13

#### Commercial Update

BC Hydro continues to advance multiple commercial negotiations with PRHP. A tentative agreement on the right bank design changes was reached in early October and work on the settlement agreement has begun. BC Hydro is now focussing on reaching an agreement with PRHP this fall on the approach channel.

s.13

#### Advisor Update

Technical Advisory Board (TAB) meets monthly with the design team; the design work is on schedule and is not holding up construction. Recent geotechnical readings are showing very little movement.

EY is working through construction management costs and estimates and how updates are made to the schedule rebaseline . They are working on basis of estimate that sits behind the assessed claims versus the contractor's assessment and developing traceability around these to the CRA and SRA. EY is also working with BC Hydro on how to get ahead of claims rather than responding reactively.

Amy



Amy Sopinka

Director, Transmission and Interjurisdictional Branch  
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**MINISTRY OF ENERGY, MINES AND LOW CARBON INNOVATION**

**BRIEFING NOTE FOR INFORMATION**

**PREPARED FOR:** Honourable Bruce Ralston, Minister of Energy, Mines and Low Carbon Innovation

**ISSUE:** Site C Continuation Measures

**BACKGROUND:**

The BC Utilities Commission conducted the Site C Inquiry in accordance with Order-in-Council No. 244 issued on August 2, 2017. In December 2017, government confirmed the decision to continue with the Site C Project (Project or Site C) with a new budget of \$10.7B that included a \$708M Project Reserve to account for events outside of BC Hydro's (BCH) control. The December 2017 announcement made specific reference to three new measures created as a response to the decision to continue with the Project (Continuation Measures):

- 1) A Peace River Legacy Fund (PRLF) to implement solutions to longer term environmental, social and economic issues;
- 2) Consideration of an Indigenous Clean Energy Program (ICEP) as a new procurement stream for smaller scale renewable electricity projects where Indigenous Nations are proponents or partners; and
- 3) A new BC Food Security Fund (BCFSF) dedicated to supporting farming and enhancing agricultural innovation and productivity across the province.

**DISCUSSION:**

s.12; s.13; s.17

In July 2020, following continued Project budget pressures and technical issues, the Province announced a third-party review of the Site C project, led by Peter Millburn, to review cost, schedule, procurement, and geotechnical and scope risks associated with the project. The report was submitted to government and led to the March 2021 decision to continue with dam construction at a new cost estimate of \$16B.

s.12; s.13

s.13; s.16

## **2) ICEP**

ICEP was originally conceived as a Province-wide program to support clean energy procurement from Indigenous led projects. As BCH is currently operating in an electricity surplus environment which is expected to continue into the 2030s, s.12; s.13; s.17

s.12; s.13; s.17

With the current electricity surplus, and the decision to indefinitely suspend the SOP coming out of the recommendations of Phase 1 of the Comprehensive Review of BCHs.<sup>13</sup>

s.13; s.16

Action 4.34 of the Draft *Declaration on the Rights of Indigenous Peoples Act* 2021-2026 Action Plan proposes that B.C. engage with FNs to identify and support clean energy opportunities related to CleanBC, the Comprehensive Review of BCH, and the B.C. Utilities Commission Inquiry on the Regulation of Indigenous Utilities.

The Indigenous Clean Energy Opportunities (ICEO) review is an outcome of Phase 2 of the Comprehensive Review of BCH in response to feedback from Indigenous participants on the need for further Indigenous engagement on clean energy opportunities and support for Indigenous participation in the clean energy sector. A collaborative process is under development between EMLI and the FNs Leadership Council to establish a structure and approach for the ICEO. s.13; s.16

s.13; s.16

FNs' leadership has also stated that replacing diesel generation in remote communities with clean alternatives is also a priority. s.13

s.13

### **3) BCFSF**

The BCFSF is intended to be provincial in scope. s.13

s.13

s.13

s.12; s.13

s.12; s.13

### **NEXT STEPS:**

s.12; s.13; s.17

s.12; s.13

s.13; s.16

**DRAFTED BY:**

Eric Negulic, Sr. Policy Analyst,  
IAB, SIAD

Jacla Shockey, Sr. Negotiations  
Lead, IAB, SIAD

**APPROVED BY:**

Emmy Beaton, ED, IAB, SIAD ✓  
Paul Wieringa, ED, EPB, EAED ✓  
Les MacLaren, ADM, EAED ✓  
Simon Coley, ADM, SIAD ✓  
Fazil Mihlar, DM✓

**MINISTRY OF ENERGY, MINES AND LOW CARBON INNOVATION**

**BRIEFING NOTE FOR INFORMATION**

**PREPARED FOR:** Fazil Mihlar, Deputy Minister, Ministry of Energy, Mines and Low Carbon Innovation

**ISSUE:** Site C High Priority Authorizations

**BACKGROUND:**

With construction progressing on Site C, BC Hydro still requires a number provincial authorizations under the *Land Act*, *Forest Act* and *Water Sustainability Act* prior to reservoir filling, which is currently targeted for Fall 2023. Several critical authorizations are required within the next 30 days including Leaves to Commence Construction. The permits are related to reservoir clearing, material sources for the earth fill dam, and Highway 29 realignment, which were reviewed and consulted on as part of the joint federal-provincial environmental assessment process and are approved under the Project's Environmental Assessment Certificate and federal Decision Statement.

Reservoir filling and dam site works were also consulted on and approved under the Project's Water Licences. Delays to these high priority permits – many of which enable construction this fall and early 2022 -- are likely to result in delays to the overall construction schedule and potentially result in significant additional costs to BC Hydro.

**DISCUSSION:**

Prior to the initial meeting between BC's Negotiating Team and the Blueberry River First Nation (BRFN), line ministries were asked to compile a list of high priority permits that were required immediately. BC Hydro provided a comprehensive list of pending and future authorizations required to complete the Site C Project (Attachment A). The eight described below are required within the next 30 days.

**A. Western Reservoir Clearing Permit Amendments (Provincial Permit List Ref #13-#15)  
Required 15 September 2021**

***#13 License of Occupation – Western Reservoir – Amendment and Extension***

***#14 Occupant License to Cut 20A – Western Reservoir – Amendment.***

***#15 Occupant License to Cut 21 – Western Reservoir- Amendment***

BC Hydro has one *Land Act* and two *Forest Act* permits to occupy and clear 230 hectares of the Western Reservoir area. BC Hydro requires an amendment to the three permits already issued to include the ability to clear an additional 44 hectares needed to access land that is already permitted for clearing. The work is seasonal, requires two years to complete, and must commence in the fall of 2021. A map showing the relevant area is provided in Attachment B.

All but 0.75 ha (equivalent to 0.0075 square kilometres) covered by the requested amendment was granted to BC Hydro pursuant to the Crown Land grants issued to BC Hydro in 2016 with BC Hydro's Conditional Water Licences. The remaining 0.75 ha arises from adjustments to private property boundaries.

BC Hydro is seeking to confirm whether that small piece of additional land is required to complete the clearing. BC Hydro and staff from EMLI and FLNRO are compiling a comprehensive history of the consultation for these areas to support the decision on these permits.

## **B. Hwy 29 Realignment (Provincial Permit List Ref # 3, #6 -#7)**

***#3 License of Occupation – Peaceview Borrow Area – Replacement Tenure Rollover Extension***

***#6 License of Occupation – Halfway River Inundated Materials Source – Rollover Extension***

***#7 License of Occupation – Lynx Creek East/Dry Creek Material Source – Rollover Extension***

Realignment of Highway 29 must be completed ahead of reservoir filling in order to maintain road access provided by the highway. The realignment includes construction of several new highway segments and bridges which are currently underway, as well as decommissioning of existing structures, such as bridges and distribution lines.

Land tenure over material source is required to continue construction of the Cache Creek segment of the Hwy 29 realignment and construction of the bridge ahead of reservoir filling. The original applications requested land tenure for 10 years and this is the duration consulted on. However, because this area was in the flood reserve at the time of the application, Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRO) could only issue the land tenure for a period of two years.

In July 2021, this land area was removed from the flood reserve. Therefore, this land tenure, which was previously consulted on, is to be administratively extended (or "rolled over") for a period of 8 years. No further consultation is required.

## **C. Leaves to Commence Construction under the Water Licence**

***LCC 18-1 Leave to Commence Construction - Balance of Plant***

***LCC 14 Leave to Commence Construction – Right Bank Enhancement – Overview, Spillway Piles, Powerhouse Excavation, Powerhouse Piles***

BC Hydro also requires a number of Leaves to Commence Construction (LCCs) from the Engineer under the *Water Sustainability Act*, pursuant to BC Hydro's Conditional Water Licences. The terms and conditions in the Water Licences require BC Hydro to obtain an LCC prior to moving on to the next phase of construction.

LCCs are administrative in nature and provide regulatory guidance to BC Hydro and its contractors. All activity under LCC's occurs within the existing footprint and the areas that were



consulted on with respect to the Water License. Once a decision is made on the LCC, BC Hydro is contacted and no further consultation or notification is required.

## **SUMMARY**

Of the eight priority authorizations required by BC Hydro, five (two LCCs and three rollover permits) can be issued by the statutory decision maker without further consultation. The remaining three authorizations are required to access and clear the Western Reservoir.

s.13; s.14

## **Attachments:**

Attachment A: BC Hydro List of Pending and Future Authorizations for the Site C Project

Attachment B: Map of Western Reservoir clearing areas

### **DRAFTED BY:**

Amy Sopinka, Dir. TIB  
778-698-7280

### **APPROVED BY:**

Paul Wieringa, Exec. Dir, EPB ✓  
Les MacLaren, ADM, EAED ✓

**TOTAL APPROVALS SUMMARY:**

*Permit list is based on current information as of August 13, 2021 and subject to change according to project requirements.*

Total Approvals required for Construction	Provincial Permits	Federal Permits	EAC Amendments	Water Licence Leaves*	TOTALS
Approvals received to date	282	109	9	16	416
Approvals/Notices pending (applications submitted, but not issued)	6	2	2	4	14
Future/Notices approvals (applications not yet submitted)	30	15	0	15	60
<b>Totals</b>	<b>318</b>	<b>126</b>	<b>11</b>	<b>35</b>	<b>490</b>

*Summary does not include provincial (FLNRORD) extensions, permit amendments or renewals*

*\*Includes only Leaves/Orders issued by WSA Engineer; not Leaves recommended by Independent Engineer*

Provincial Permits Pending

Permit list based on current information as of August 13, 2021 and subject to change according to project requirements. Permits are sorted by project component.  
Amendments, Extensions and Renewals are in italics and shaded grey

Reference #	Project Component	Activity	Act	Tenure Type/Purpose	Date Application Submitted	Date Required	Priority (H/M/L)	Agency	Status of Consultation	Comments
1	Dam Site and Moberly	Construction	<i>Water Sustainability Act</i>	Groundwater Licence (PRHP Wells and Cistern) - On Hold	15-May-20	TBD	L	FLNRD	Not started	Required for concrete processing if water quality guidelines cannot be met from surface water sources. Contractor has put this on hold at this time, may be required in the future.
2	Dam Site and Moberly	Works In/Near a Stream	<i>Water Sustainability Act</i>	S. 11 Approval - Peace River Construction Bridge - Access to Piers/Ripraping of Piers	21-Apr-21	01-Aug-21	M	FLNRD	Completed	In-stream works permit required to place riprap around piers of Peace River Construction Bridge to protect from scouring and ensure safety of the bridge.
3	<i>Hwy. 29 Realignment</i>	<i>Land Tenure</i>	<i>Land Act</i>	<i>Licence of Occupation - Peaceview Borrow Area Replacement Tenure - Rollover extension</i>	<i>n/a</i>	<i>27-Jul-21</i>	<i>H</i>	<i>FLNRD</i>	<i>Completed</i>	Land tenure over material source is required to continue construction of Cache Creek segment of Hwy 29 realignment and construction of the bridge ahead of reservoir filling. The original application requested land tenure for 10 years and this is the duration consulted on. However, because this area was in the flood reserve at the time of the application, FLNRD could only issue the land tenure for a period of two years.  In July 2021, this land area was removed from the flood reserve. Therefore, this land tenure, which was previously consulted on, is to be administratively extended (or "rolled over") for a period of 8 years.
4	Hwy. 29 Realignment	Non-farm use	<i>Agricultural Land Act</i>	Non-Farm Use - Lynx Creek Boat Launch	06-Apr-19	09-Aug-21	M	ALC	Not required	Site C Outdoor Recreation Mitigation Plan requirement (EAC #E14-02, Condition 40). Boat launches are a non-farm use within the ALR and require a permit from the ALC in order to proceed with construction.
5	Hwy. 29 Realignment	Non-farm use	<i>Agricultural Land Act</i>	Non-Farm Use - Halfway River Boat Launch	16-Apr-21	01-Aug-21	M	ALC	Not required	Site C Outdoor Recreation Mitigation Plan requirement (EAC #E14-02, Condition 40). Boat launches are a non-farm use within the ALR and require a permit from the ALC in order to proceed with construction.

6	Hwy. 29 Realignment	Construction Materials Source	Land Act	Licence of Occupation - Halfway River Inundated Materials Source - Rollover extension	n/a	09-Sep-21	H	FLNRORD	Completed	<p>Land tenure over material source is required to continue construction of Halfway River segment of Hwy 29 realignment and construction of the bridge ahead of reservoir filling. The original application requested land tenure for 10 years and this is the duration consulted on. However, because this area was in the flood reserve at the time of the application, FLNRORD could only issue the land tenure for a period of two years.</p> <p>In July 2021, this land area was removed from the flood reserve. Therefore, this land tenure, which was previously consulted on, is to be administratively extended (or "rolled over") for a period of 8 years.</p>
7	Hwy. 29 Realignment	Construction   In-river Materials Source	Land Act	Licence of Occupation - Lynx Creek East/Dry Creek Material Source - Rollover extension	n/a	31-Oct-21	H	FLNRORD	Completed	<p>Land tenure required to provide material for construction of Lynx and Dry Creek segments of Hwy 29 realignment. The original application requested land tenure for 10 years and this is the duration consulted on. However, because this area was in the flood reserve at the time of the application, FLNRORD could only issue the land tenure for a period of two years.</p> <p>In July 2021, this land area was removed from the flood reserve. Therefore, this land tenure, which was previously consulted on, is to be administratively extended (or "rolled over") for a period of 5 years.</p>
8	Hwy. 29 Realignment	Construction   Water Use	Water Sustainability Act	S. 10 Short-term Use of Water - Halfway River Groundwater well and dugout - Renewal	16-Jul-21	01-Nov-21	M	FLNRORD	Not started	
9	Hwy. 29 Realignment	Construction   Water Use	Water Sustainability Act	S. 10 Short Term Use of Water - Lynx Creek East -Renewal	23-Jul-21	20-Nov-21	M	FLNRORD	Not started	Short-term Use of Water permits can only be issued for 24 months at a time. These renewals are required to continue Hwy 29 realignment construction and complete works prior to reservoir filling. Water is used for dust suppression, concrete curing and production, soil compaction, etc.
10	Hwy. 29 Realignment	Construction Water Use	Water Sustainability Act	S. 10 Short Term Use of Water - Peaceview Borrow Area - Renewal	30-Jul-21	30-Nov-21	M	FLNRORD	Not started	
11	Mitigation	Land Tenure   Permanent	Land Act	Licence of Occupation - Groundwater Monitoring Wells	08-Apr-19	23-Jul-21	M	FLNRORD	In process	Land tenure is required for the long-term monitoring of groundwater wells placed along the transmission line as part of the Wetland Monitoring Program (Federal Decision Statement Condition 11).
12	Reservoir Clearing	Land Tenure	Land Act	Licence of Occupation - Middle Reservoir (OLTC #17, 19) - Rollover extension	n/a	29-Jul-21	H	FLNRORD	Completed	<p>Land tenure is required over Middle Reservoir area to continue and complete clearing prior to reservoir filling. The original application requested land tenure for 10 years and this is the duration consulted on. However, because this area was in the flood reserve at the time of the application, FLNRORD could only issue the land tenure for a period of two years.</p> <p>In July 2021, this land area was removed from the flood reserve. Therefore, this land tenure, which was previously consulted on, is to be administratively extended (or "rolled over") for a period of 8 years.</p>

13	Reservoir Clearing	Land Tenure   Permanent	Land Act	Licence of Occupation - Western Reservoir - Amendment and Extension	28-Jun-21	15-Sep-21	H	FLNRORD	Not started	Required to access over 230 ha of reservoir clearing in 2021/2022 season and complete these works ahead of reservoir filling. Land tenure and forest act permits have been issued for occupying and clearing the 230 ha of this area (Licence of Occupation 816131; Occupant Licence to Cut L51499 and L51500). Except for 0.75 ha, this amendment overlaps with land already granted to BC Hydro under the Project's Permit over Crown Land (PCL), issued with the Conditional Water Licences. The 0.75 ha falling outside the Crown Land grant is a result of corrected property boundaries along private land. <b>The LOO also expires on October 29, 2021. An extension is therefore also required.</b>
14	Reservoir Clearing	Vegetation Clearing	Forest Act	Occupant Licence to Cut 20A - Western Reservoir - Amendment	28-Jun-21	15-Sep-21	H	FLNRORD	Not started	
15	Reservoir Clearing	Vegetation Clearing	Forest Act	Occupant Licence to Cut 21 - Western Reservoir - Amendment	28-Jun-21	15-Sep-21	H	FLNRORD	Not started	
16	Transmission and Distribution	Land Tenure   Permanent	Land Act	Licence of Occupation - Transmission line relocation at Halfway River (11364)	19-Jan-21	03-Jan-22	H	FLNRORD	Completed	Land tenure required to relocate a section of the existing 11364 transmission line that crosses Halfway River. Creation of the Site C reservoir will result in inundation of one transmission line tower site and risk of erosion to other tower sites. Works must be completed prior to reservoir filling.

#### Future Provincial Permits

Reference #	Project Component	Activity	Act	Tenure Type/Purpose	Target Draft Submission Date	Date Required	Priority (H/M/L)	Agency	Comments
17	Dam Site and Moberly	Vegetation Clearing	Forest Act	Occupant Licence to Cut 1 - South Bank - Extension	11-Aug-21	06-Nov-21	H	FLNRORD	Permit extension required to complete clearing and debris removal from area prior to reservoir filling.
18	Dam Site and Moberly	Land Tenures   Clearing	Land Act	Licence of Occupation - Moberly Clearing - Extension	11-Aug-21	07-Nov-21	H	FLNRORD	Permit extension required for tenure to complete clearing and debris removal from area prior to reservoir filling.
19	Dam Site and Moberly	Land Tenure   Permanent	Land Act	Road Permit - Permanent - Dam Site Access	15-Jan-23	15-Jul-23	M	FLNRORD	Permanent road permit will be required at completion of the project.
20	Dam Site and Moberly	Fish Collection	Wildlife Act	Fish Collection for Permanent Fish Passage Facility	01-Apr-23	01-Sep-23	H	FLNRORD	Required for collection of fish related to Permanent Fish Passage Facility.
21	Hwy. 29 Realignment	Construction   In-stream Works	Water Sustainability Act	S. 11 Approval - Halfway River Crossing - Extension	17-Sep-21	31-Dec-21	H	FLNRORD	Extension of in-stream works permit required to continue bridge construction at Halfway River segment of Hwy 29 realignment which must be completed ahead of reservoir filling.
22	Hwy. 29 Realignment	Works In/Near a Stream	Water Sustainability Act	S11 Approvals - Regional Least Risk Window Variance Extensions	15-Oct-21	31-Dec-21	H	FLNRORD	Variance covers 7 instream works approvals for Hwy 29 construction and allows construction works to take place year-round as needed. These are required to meet schedule deadlines and complete work prior to reservoir filling.
23	Hwy. 29 Realignment	Land Tenure	Land Act	Licence of Occupation - Distribution Line Removal at Cache Creek West	01-Nov-21	01-Apr-22	H	FLNRORD	Tenure for distribution line removal required prior to reservoir filling
24	Hwy. 29 Realignment	Works In/Near a Stream	Water Sustainability Act	S. 11 Approval - Distribution Line Removal at Watson Slough	01-Nov-21	01-Apr-22	H	FLNRORD	In-stream works permit for distribution line removal required prior to reservoir filling
25	Hwy. 29 Realignment	Land Tenure	Land Act	Licence of Occupation - Distribution Line Removal at Cache Creek East	01-Nov-21	01-Apr-22	H	FLNRORD	Tenure for distribution line removal required prior to reservoir filling
26	Hwy. 29 Realignment	Land Tenure	Land Act	Licence of Occupation - Distribution Line Relocation at Highway 29 (TBD)	01-Nov-21	01-Apr-22	H	FLNRORD	Tenure for distribution line removal required prior to reservoir filling
27	Hwy. 29 Realignment	Construction   Vegetation Clearing	Forest Act	Occupant Licence to Cut (OLTC 14) - Hwy 29 Cache Creek	1-Dec-21	30-Apr-22	H	FLNRORD	Permit extension required to complete clearing and debris removal from area prior to reservoir filling.

28	Hwy. 29 Realignment	Construction Tenure / Materials Source	Land Act	Licence of Occupation - Farrell Creek - Rollover extension	n/a	16-Jul-22	H	FLNRORD	Tenure is required o complete construction of Farrell Creek segment of Hwy 29 realignment prior to reservoir filling.The original application requested land tenure for 10 years and this is the duration consulted on. However, because this area is in the flood reserve, FLNRORD could only issue the land tenure for a period of two years. On expiry of this permit, BC Hydro will request an extension of two years.
29	Hwy. 29 Realignment	Works In/Near a Stream	Water Sustainability Act	S. 11 Approval - Decommissioning of Lynx Creek Bridge	06-Jan-22	01-Jun-22	H	FLNRORD	In-stream works permit required to remove existing Lynx Creek bridge prior to reservoir filling.
30	Hwy. 29 Realignment	Works In/Near a Stream	Water Sustainability Act	S. 11 Approval - Decommissioning of Cache Creek Detour Bridge	01-Feb-22	01-Jul-22	H	FLNRORD	In-stream works permit required to remove Cache Creek detour bridge prior to reservoir filling.
31	Hwy. 29 Realignment	Works In/Near a Stream	Water Sustainability Act	S. 11 Approval - Decommissioning of Cache Creek Bridge -partial salvage	01-Feb-22	01-Jul-22	H	FLNRORD	In-stream works permit required to remove existing Cache Creek bridge prior to reservoir filling.
32	Hwy. 29 Realignment	Works In/Near a Stream	Water Sustainability Act	S. 11 Approval - Decommissioning of Dry Creek Culvert	01-Feb-22	01-Jul-22	H	FLNRORD	In-stream works permit required to remove existing Dry Creek culvert prior to reservoir filling.
33	Hwy. 29 Realignment	Works In/Near a Stream	Water Sustainability Act	S. 11 Approval/Notification - Removal of Highway 29 culverts (TBD)	01-Feb-22	01-Jul-22	H	FLNRORD	Approval or Notification required to remove existing culverts along Hwy 29 prior to reservoir filling.
34	Hwy. 29 Realignment	Construction / Water Use	Water Sustainability Act	S. 10 Short Term Use of Water - Farrell Creek Construction	15-Feb-22	06-Jul-22	H	FLNRORD	Short-term Use of Water permits can only be issued for 24 months at a time. These renewals are required to continue Hwy 29 realignment construction and complete works prior to reservoir filling. Water is used for dust suppression, concrete curing and production, soil compaction, etc.
35	Hwy. 29 Realignment	Material Source / Land Tenure	Land Act	Licence of Occupation - Lynx Creek West - Rollover extension	n/a	26-Aug-22	H	FLNRORD	Tenure is required for construction of Lynx Creek West segment of Hwy 29 realignment prior to reservoir filling. The original application requested land tenure for 10 years and this is the duration consulted on. However, because this area is in the flood reserve, FLNRORD could only issue the land tenure for a period of two years. Prior to expiry of this permit, BC Hydro will request an extension of two years.
36	Hwy. 29 Realignment	Construction / Land Tenure	Land Act	Licence of Occupation - Lynx Creek West Hwy Realignment - Rollover extension	n/a	26-Aug-22	H	FLNRORD	Tenure is required for construction of Lynx Creek segment of Hwy 29 realignment prior to reservoir filling. The original application requested land tenure for 10 years and this is the duration consulted on. However, because this area is in the flood reserve, FLNRORD could only issue the land tenure for a period of two years. Prior to expiry of this permit, BC Hydro will request an extension of two years.
37	Hwy. 29 Realignment	Land Tenure	Land Act	Licence of Occupation - Farrell Creek East Segment B (TBD)	01-Sep-23	01-Jan-24	L	FLNRORD	Tenure for construction on the Farrell Creek East segment of Hwy 29 realignment. This work will not take place prior to reservoir filling. Timing and need for work will depend on outcome of geotechnical monitoring.
38	Multi-Site	Scientific Fish Collection	Wildlife Act	Mon 2 - Peace River Fish Indexing	15-Jan-22	03-Jun-22	M	FLNRORD	Required to support Fisheries and Aquatic Habitat Monitoring and Follow-up Program.
39	Multi-Site	Fish Collection	Wildlife Act	Reservoir Tributaries Fish Indexing	15-Jan-22	30-Jun-22	M	FLNRORD	Required to support Fisheries and Aquatic Habitat Monitoring and Follow-up Program.
40	Quarries/Pits	Mining Activities	Mines Act	Mines Act Permit & Notice of Work - Wuthrich Quarry - Extension	17-Sep-21	21-Dec-21	H	MEMLCI	Wuthrich provides riprap for the dam site construction; extension of permit needed until dam site construction complete

41	Quarries/Pits	Exclusion	Agricultural Land Act	Temporary exclusion - Area E and Haul Route	01-Sep-21	15-Jan-22	H	ALC	Required to temporarily remove the Area E material source and haul route from the ALR. Material source is required to meet Project's need for material for dam construction.
42	Quarries/Pits	Vegetation Clearing	Forest Act	Occupant Licence to Cut 26 - Area E Material Source	01-Sep-21	15-Jan-22	H	FLNRORD	Clearing permit required for site preparation at material source to meet Project's need for material for dam construction.
43	Quarries/Pits	Land Tenure   Material Source	Land Act	Licence of Occupation - Area E Material Source	01-Sep-21	15-Jan-22	H	FLNRORD	Tenure required for material source to meet Project's need for material for dam construction.
44	Quarries/Pits	Mining Activities	Mines Act	Mines Act Notice of Work - Area E Material Source	01-Sep-21	15-Jan-22	H	MEMLCI	Mines Act Notice of Work is required to mine the Area E material source to provide material for dam construction.
45	Quarries/Pits	Vegetation Clearing	Forest Act	Occupant Licence to Cut 27 - Area E Haul Route	01-Sep-21	15-Jan-22	H	FLNRORD	Clearing permit required for access to material source to meet Project's need for material for dam construction.
46	Quarries/Pits	Land Tenure	Land Act	Licence of Occupation - Area E Haul Route	01-Sep-21	15-Jan-22	H	FLNRORD	Tenure required for access to material source to meet Project's need for material for dam construction.
47	Quarries/Pits	Works In/Near a Stream	Water Sustainability Act	S. 11 Approval or Notification - stream crossings - Area E Haul Route	01-Sep-21	15-Jan-22	H	FLNRORD	In-stream works permit may be required for crossing streams along haul route to Area E material source.
48	Quarries/Pits	Operations   Water Use	Water Sustainability Act	S. 10 Short Term Use - Portage Mtn. Quarry	01-Nov-21	24-Mar-22	H	FLNRORD	Short-term Use of Water permits can only be issued for 24 months at a time. This renewal is required for Portage Mtn Quarry to provide material for Hwy 29 construction. Water is used for dust suppression.
49	Quarries/Pits	Operations   Water Use	Water Sustainability Act	S. 10 Short Term Use - West Pine Quarry Dust Suppression	15-Feb-22	13-Jul-22	H	FLNRORD	Short-term Use of Water permits can only be issued for 24 months at a time. This renewal is required for West Pine Quarry to provide material for dam site. Water is used for dust suppression.
50	Quarries/Pits	Mining Activities	Mines Act	Mines Act Permit & Notice of Work - West Pine Quarry	15-Jul-22	31-Dec-22	H	MEMLCI	Permit extension for material source for Dam Site.
51	Reservoir Clearing	Vegetation Clearing	Forest Act	Section 52 - Moberly Access Clearing - Extension	11-Aug-21	05-Oct-21	H	FLNRORD	Permit extension required to complete clearing and debris removal from area prior to reservoir filling.
52	Reservoir Clearing	Water Use	Water Sustainability Act	S. 10 Short Term Use of Water - Eastern Reservoir/Moberly River - Renewal	11-Aug-21	01-Nov-21	H	FLNRORD	Permit extension required to complete clearing and debris removal from area prior to reservoir filling.
53	Reservoir Clearing	Vegetation clearing	Forest Act	Occupant Licence to Cut 6 - Eastern Reservoir SB - Extension	10-Sep-21	11-Dec-21	H	FLNRORD	Permit extension required to complete clearing and debris removal from area prior to reservoir filling.
54	Reservoir Clearing	Vegetation clearing	Forest Act	Occupant Licence to Cut 7 - Eastern Reservoir NB - Extension	10-Sep-21	11-Dec-21	H	FLNRORD	Permit extension required to complete clearing and debris removal from area prior to reservoir filling.
55	Reservoir Clearing	Vegetation clearing	Forest Act	Occupant Licence to Cut 8 - Eastern Reservoir Access- Extension	10-Sep-21	11-Dec-21	H	FLNRORD	Permit extension required to complete clearing and debris removal from area prior to reservoir filling.
56	Reservoir Clearing	Land Tenure	Land Act	Licence of Occupation - Cache Creek Drainage - Rollover	n/a	28-May-22	H	FLNRORD	Tenure is required prior to complete clearing and debris removal from area prior to reservoir filling. The original application requested land tenure for 10 years and this is the duration consulted on. However, because this area was in the flood reserve at the time of the application, FLNRORD could only issue the land tenure for a period of two years. Prior to expiry of this permit, BC Hydro will request an extension of two years.
57	Reservoir	Exclusion/Placement of fill	Agricultural Land Act	Exclusion/Placement of fill - Wilder Creek Fish Habitat Enhancement	01-Oct-21	15-Mar-22	M	ALC	Required as part of mitigation program for fish habitat enhancement.
58	Reservoir	Land Tenure	Land Act	Licence of Occupation - Wilder Creek Fish Habitat Enhancement	06-Jan-22	01-Jul-22	M	FLNRORD	Required as part of mitigation program for fish habitat enhancement.

59	Transmission and Distribution	Vegetation Clearing	Forest Act	Occupant Licence to Cut 11 - Transmission Line - Extension	11-Aug-21	10-Oct-21	M	FLNRORD	Required for debris/waste wood management along Site C to Peace Canyon Transmission line.
60	Transmission and Distribution	Works In/Near a Stream	Water Sustainability Act	S. 11 Notification - Transmission Line/Pole decommissioning (wetlands in frozen conditions) - Variance Extension	15-Aug-21	31-Oct-21	H	FLNRORD	Required for pole decommissioning along the Site C to Peace Canyon transmission line. Stringing of the second 500kv transmission line is expected to be done in March 2022 and the line energized next spring.
61	Transmission and Distribution	Works In/Near a Stream	Water Sustainability Act	S. 11 Notification - Transmission Line Crossing of wetland for splicing work/stringing of 5L006 - Extension	15-Aug-21	31-Oct-21	H	FLNRORD	Required for stringing the Site C to Peace Canyon transmission line. Stringing of the second 500kv transmission line is expected to be done in March 2022 and the line energized next spring.
62	Transmission and Distribution	Land Tenure	Land Act	Licence of Occupation - Transmission Line Access Roads - Rollover	n/a	02-Feb-22	H	FLNRORD	Required to continue construction of the Site C to Peace Canyon transmission line. Stringing of the second 500kv transmission line is expected to be done in March 2022 and the line energized next spring.
63	Transmission and Distribution	Land Tenure - Distribution	Land Act	Statutory Right of Way - North Bank Distribution Line	2023	2023	M	FLNRORD	Convert Licence of Occupation to SROW for permanent works.
64	Transmission and Distribution	Land Tenure - Permanent	Land Act	Statutory Right of Way - Powerhouse to Substation (25kv lines)	2023	2023	M	FLNRORD	Convert Licence of Occupation to SROW for permanent works.
65	Transmission and Distribution	Land Tenure - Distribution	Land Act	Statutory Right of Way - South Bank Distribution Line	2023	2023	M	FLNRORD	Convert Licence of Occupation to SROW for permanent works.
66	Transmission and Distribution	Land Tenure - Permanent	Land Act	Statutory Right of Way - 138kV Connector along toe of slope	2023	2023	M	FLNRORD	Convert Licence of Occupation to SROW for permanent works.
67	Transmission and Distribution	Land Tenure - Permanent	Land Act	Statutory Right of Way - Powerhouse to Substation (500 lines)	2023	2023	M	FLNRORD	Convert Licence of Occupation to SROW for permanent works.
68	Transmission and Distribution	Land Tenure - Permanent	Land Act	Statutory Right of Way - South Bank Slope (500kv lines)	2023	2023	M	FLNRORD	Convert Licence of Occupation to SROW for permanent works.
69	Transmission and Distribution	Land Tenure - Permanent	Land Act	Statutory Right of Way - PCN Connection	2023	2023	M	FLNRORD	Convert Licence of Occupation to SROW for permanent works.
70	Reservoir	Works In/Near a Stream	Land Act	Statutory Right of Way - Hudson's Hope Berm	2023	2023	M	FLNRORD	Convert Licence of Occupation to SROW for permanent works.
71	Transmission and Distribution	Land Tenure   Permanent	Land Act	Statutory Right of Way - Transmission line relocation at Halfway River 1L364	2023	2023	M	FLNRORD	Convert Licence of Occupation to SROW for permanent works.



## Water Licence Leaves to Commence Construction, Diversion and Operations

Water Licence Leaves List is based on current information as of August 13, 2021 and subject to change according to project requirements.

### Pending

LCC	Description	Submission Date
LCC18-1	Right Bank Enhancement - Overview, Spillway Piles, Powerhouse Excavation, Powerhouse Piles,	16-Apr-21
LCC14	Balance of Plant	23-Apr-21
LCC17	Powerhouse Hydromechanical Equipment and Gantry Cranes	24-Mar-21
LCC19-1	Lynx Creek Boat Launch	06-Apr-21
<b>Other (Note 1)</b>	Related to LCC15 - Western Reservoir – Regulatory guidance for 14 causeway/bridge crossings required for reservoir clearing	01-Aug-21

**Note 1** - Not considered a Leave to Commence Construction, but as further guidance regarding causeway and bridge crossings and

### Future Leaves

LCC #	Description	Submission Date
LCC18-2	Right Bank Enhancement -RCC Buttress Directional Drain Holes -Right Bank Drainage Tunnel Drainage Improvements -Approach Channel Excavation -Instrumentation	Aug-21
LCC20	Reservoir Shoreline Fish Habitat Enhancement	20-Aug-21
LCC18-3	Right Bank Enhancement -Approach Channel Concrete Plinth, Gallery and Grout Curtain, Approach Channel Lining, Spillway Right Wall	Fall 2021
PUF LCC1	Permanent Upstream Fish Passage Facility - Construction	15-Sep-21
TUF LCO1	Temporary Upstream Fish Passage Facility Order to Commence Operations	Fall/Winter 2021
LCC19-2	Boat Ramps and Recreation Facilities – Halfway River Boat Launch	TBD
LCC21	Final Works and Reservoir Filling Preparations	TBD
LCC19-3	Boat Ramps and Recreation Facilities – Hudson's Hope Boat Launch	TBD
LCD02	Reservoir Filling and Wet Testing and Commissioning of Gates and Generating Units	TBD
LCC22	Demobilization	TBD
PUF LCD01	Leave to Commence Diversion for Permanent Fish Passage Facility	TBD

PUF Order	Order to Implement OPP/OEMP/Flow Management for Permanent Fish Passage Facility	TBD
TUF LCC3	Decommissioning of the Temporary Upstream Fish Passage Facility	TBD
PUF LCO1	Leave to Commence Operation of Permanent Fish Passage Facility	TBD
LCO1	Leave to Commence Operation (Units 1 – 6 Online)	TBD

uirements.

Date Required	Priority
01-Sep-21	H
2021-09-01 (Some flexibility on this date)	H
30-Oct-21	H
Spring 2022	M
01-Sep-21	H

thorized under LCC15 for Western Reservoir.

Date Required	Priority
Fall 2021	H
29-Oct-21	M
Winter 2021	H
Apr-22	H
Spring 2022	M
Spring 2022	M
Fall 2022	H
Spring 2023	M
Fall 2023	H
TBD 2023	H
Spring 2024	H

Summer 2024	H
Fall 2024	M
Fall 2024	H
2024	H

Pending Federal Authorizations

Permit list is based on current information as of August 13, 2021 and subject to change according to project requirements.

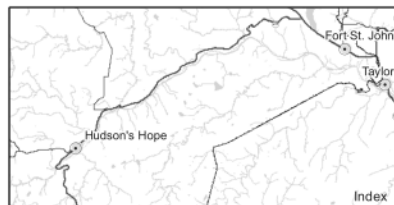
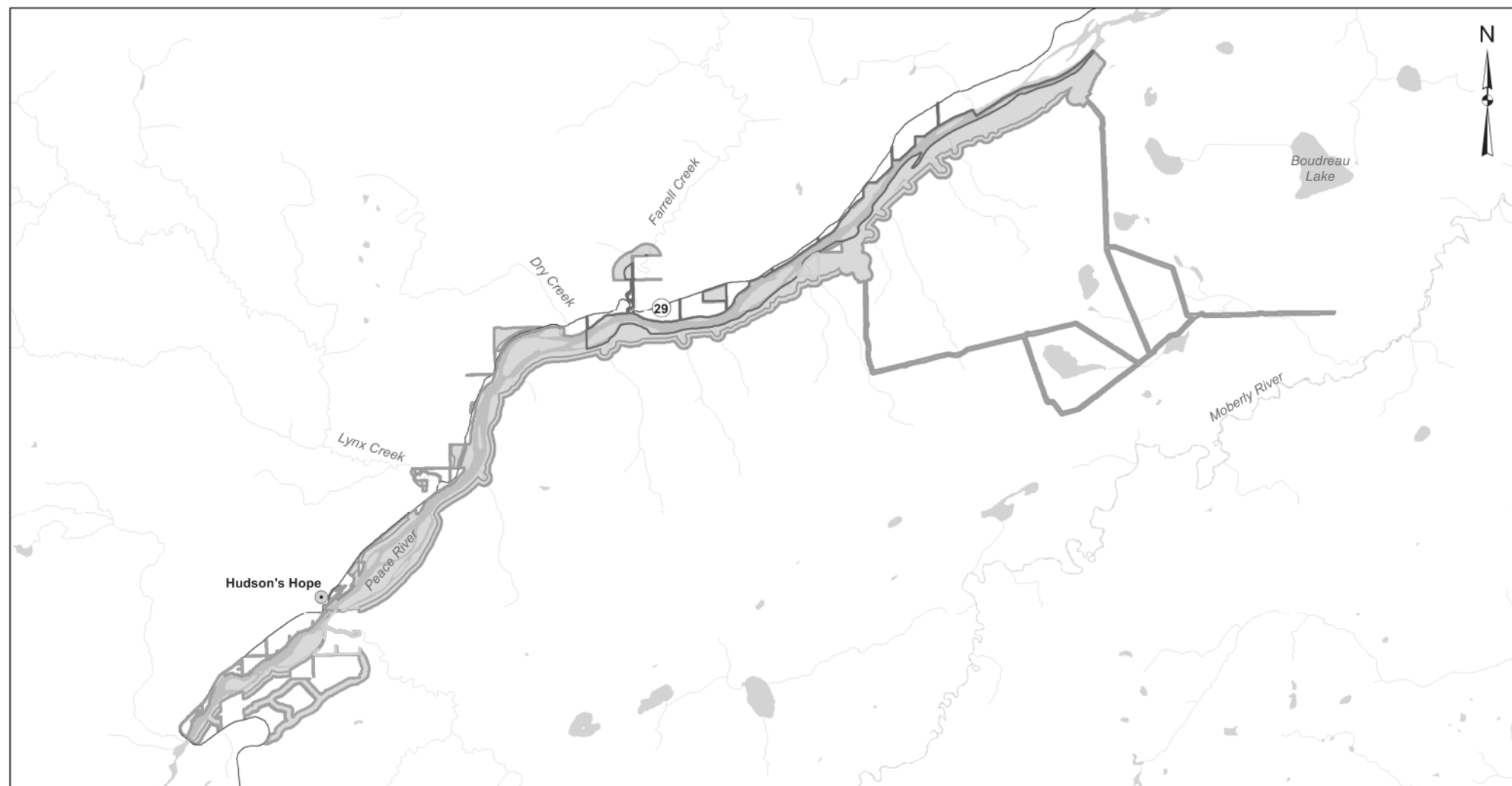
Project Component	Activity	Act	Tenure Type/Purpose	Date Submitted	Date Required	Status of Consultation
Reservoir	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	Approval - Reservoir Shoreline Protection - Fish Habitat Enhancement (KM 26]	2-Jun-21	31-Oct-21	Not started
Dam Site Area	In-River Works	Federal - <i>Fisheries Act</i>	<i>Fisheries Act</i> Authorization (Amendment) for In-River Laydown	10-Jun-21	Fall 2021	Not started
Future CNWA Applications						
Project Component	Activity	Act	Purpose	Target Submission Date	Date Required	
Hwy. 29 Realignment	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	Approval - Temporary Cache Creek Detour Bridge Decom	01-Sep-21	01-Mar-23	
Hwy. 29 Realignment	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	No Interference Notice of Work - Exisiting Dry Creek Culvert Crossing Decom	01-Sep-21	01-Mar-23	
Hwy. 29 Realignment	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	No Interference Notice of Work - Exisiting Hwy 29 Halfway River Bridge Decom	01-Sep-21	01-Mar-23	
Hwy. 29 Realignment	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	No Interference Notice of Work - Exisiting Hwy 29 Farrell Creek Bridge Decom	01-Sep-21	01-Mar-23	
Hwy. 29 Realignment	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	No Interference Notice of Work - Existing Hwy 29 Cache Creek Bridge Decom	01-Sep-21	01-Mar-23	
Hwy. 29 Realignment	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	No Interference Notice of Work - Lynx Creek West Bridge Decom	1-Dec-21	1-Jun-22	
Hwy. 29 Realignment	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	No Interference Notice of Work - Hwy 29 culverts remaining below 455m	1-Sep-21	1-Mar-23	
Hwy. 29 Realignment	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	Approval - Hwy 29 asphalt to remain above 455m	1-Sep-21	1-Mar-23	
Hwy. 29 Realignment	Boat Launch	Federal - <i>Canadian Navigable Waters Act</i>	Approval - Halfway River Boat Launch	1-Dec-21	TBD	
Reservoir	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	Approval - Reservoir Shoreline Protection - Fish Habitat Enhancement (KM 21]	1-Sep-21	1-Apr-22	
Reservoir	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	No Interference Notice of Work - Halfway River Stockpiles of Surplus Material	TBD	TBD	
Reservoir	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	No Interference Notice of Work - Halfway River Shoreline Riprap Protection	TBD	TBD	
Reservoir	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	No Interference Notice of Work - Foundation of House	1-Feb-23	1-Mar-23	
Reservoir	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	Minor Work Notification of Work - Hudson's Hope Boat Launch	2025	2025	
Dam Site	Navigation Barriers	Federal - <i>Canadian Navigable Waters Act</i>	Approval - Peace River Debris Booms for Operations	2022/2023	TBD	

## List of Pending EAC Amendments

EAC Amendment List is based on current information as of August 13, 2021 and subject to change according to project requirements.

Description	Submission Date	Date Required	Priority	Comments
85 <sup>th</sup> Avenue Industrial Source – hauling material to dam site	16-Mar-21	15-Sep-21	H	BC Hydro transports material needed for the earthfill dam from 85th Avenue Industrial Lands to the dam sit via conveyor. BC Hydro is requesting an amendment to the EAC to allow for contingency hauling of this material to the dam site area in the event the conveyor breaks down for reasons beyond BC Hydro's control (such as vandalism/sabotage, extreme and prolonged inclement weather, equipment repair delay/disruption, expertise disruption, localized fires, vehicle, equipment or human accident, and “Force Majeure” or “Act of God” events).
Recreation - Eastern Reservoir Boat Launch	14-Jun-21	Spring 2022	M	Condition #40 of EAC Schedule B requires that BC Hydro establish “three new boat launch/day use sites, complete with parking, picnic areas and toilets, at Cache Creek, Lynx Creek and Hudson’s Hope Shoreline, and accessible via Highway 29. BC Hydro was unable to locate a suitable site for the boat launch at Cache Creek. Based further evaluation and consultation with Indigenous Nations, BC Hydro is requesting to amend this condition to allow for the construction of a boat launch location on the reservoir shoreline east of the Halfway River, near the existing Halfway River boat launch.

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Map Notes:  
1. Datum: NAD 83  
2. Projection: UTM Zone 10N  
3. Base Data: Province of B.C.

Index

### Legend

- Western Reservoir Revised Licence of Occupation Boundary (5,103 ha)
- Western Reservoir LOO Amended Areas
- Occupant Licence to Cut OLTC 20A (2,693 ha)
- Occupant Licence to Cut OLTC 20B (936 ha)
- Occupant Licence to Cut OLTC 21 (624 ha)

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### Western Reservoir Revised Land Act Licence of Occupation Overview Map

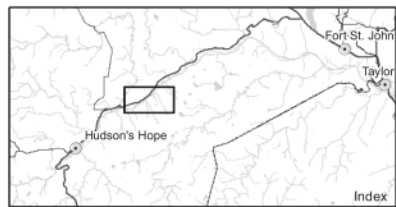
Date	Jun. 25, 2021	DWG NO	1016-N11-01039-1	R 0
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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.

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Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map Notes:  
1. Datum: NAD 83  
2. Projection: UTM Zone 10N  
3. Base Data: Province of B.C.  
4. Imagery: ESRI Online Basemapping  
5. Property boundary locations are best available but should be considered approximate. Property information is a combination of surveyed data representing BC Hydro's current ownership records and ICIS data.  
6. All land with no ownership category displayed is considered to be crown land.

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### Legend

- Western Reservoir Revised Licence of Occupation Boundary (5,103 ha)
- Western Reservoir LOO Amended Areas
- BC Hydro Owned Land
- BC Hydro Owned Land - Leased
- Crown Land
- Private Land

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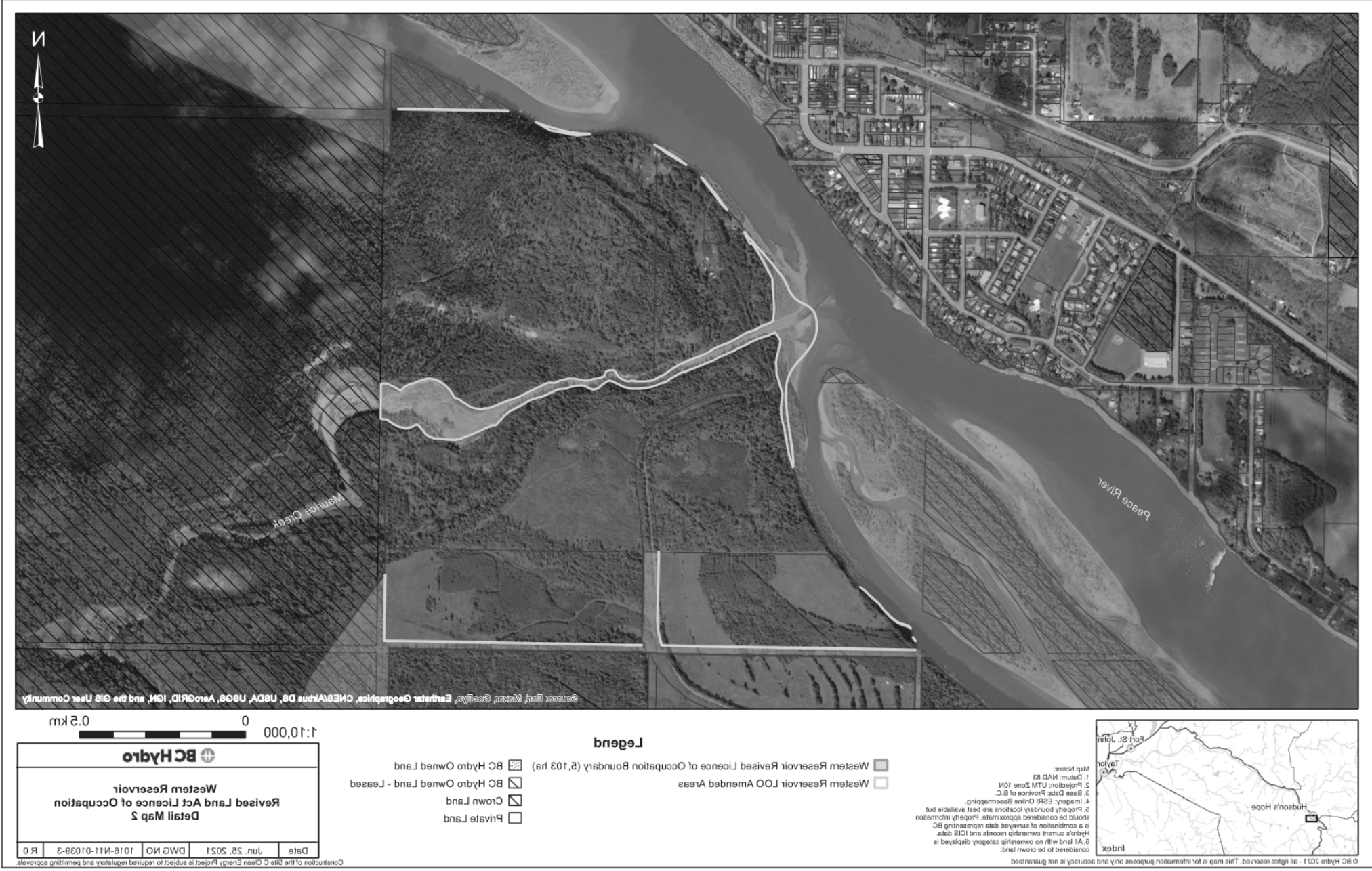


### Western Reservoir Revised Land Act Licence of Occupation Detail Map 1

Date	Jun. 25, 2021	DWG NO	1016-N11-01039-2	R 0
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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.





## EMLI FOI EMLI:EX

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**From:** MacLaren, Les EMLI:EX  
**Sent:** October 8, 2021 5:10 PM  
**To:** Mihlar, Fazil EMLI:EX; Cuddy, Andrew FLNR:EX; Wieringa, Paul EMLI:EX; Sopinka, Amy EMLI:EX  
**Cc:** Foster, Doug FIN:EX  
**Subject:** FW: Construction Photos: Installation of first pile in spillway

Big day at Site C. The first of the piles for the Right Bank Foundation Enhancements was installed this morning (photos below), and the last of the roller-compacted concrete for the dam core buttress was placed at 1:00 am this morning. This completes the MCW's RCC work on the project.

Les

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**From:** s.19  
**Sent:** October 8, 2021 12:27 PM  
**To:** MacLaren, Les EMLI:EX <Les.MacLaren@gov.bc.ca>  
**Subject:** FW: Construction Photos: Installation of first pile in spillway

**[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.**

As discussed.

s.19

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**From:** s.19  
**Sent:** Friday, October 8, 2021 12:12 PM  
**To:** O'Riley, Christopher <[Chris.Oriley@bchydro.com](mailto:Chris.Oriley@bchydro.com)>; Allen, Doug <[Doug.Allen@bchydro.com](mailto:Doug.Allen@bchydro.com)>; 'Mitchell Gropper' <[mgropper@farris.com](mailto:mgropper@farris.com)>  
**Cc:** s.19  
**Subject:** Construction Photos: Installation of first pile in spillway

The first right bank foundation enhancement pile (pile 143) has now been installed in the spillway (installed this morning). See photos below.

It is pretty amazing what the team accomplished in the past 5 months including finalizing the design, obtaining our LCC permit, procuring the steel and mobilizing Aecon foundations in parallel with finalizing the commercial terms. We could not have accomplished this on such an accelerated timeline without our strong working relationship with AFDE and the hard work of the GSS team. Great job!

s.19





m





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s.19

Pronouns: he/him/his

BC Hydro

s.19

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## EMLI FOI EMLI:EX

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**From:** MacLaren, Les EMLI:EX  
**Sent:** October 19, 2021 10:55 AM  
**To:** Richardson, Roari LWRS:EX; Mihlar, Fazil EMLI:EX  
**Cc:** Wieringa, Paul EMLI:EX; De Champlain, Rhonda EMLI:EX; Jang, Monica EMLI:EX; Robb, Amanda EMLI:EX; Tseng, Eugene EMLI:EX; Warnock, Joie EMLI:EX  
**Subject:** RE: Revised TB Speaking Notes for Site C  
**Attachments:** s.12; s.13

As requested. I put it up front in response to TB Staff report.

Les

---

**From:** Richardson, Roari EMLI:EX <Roari.Richardson@gov.bc.ca>  
**Sent:** October 19, 2021 10:29 AM  
**To:** MacLaren, Les EMLI:EX <Les.MacLaren@gov.bc.ca>; Mihlar, Fazil EMLI:EX <Fazil.Mihlar@gov.bc.ca>  
**Cc:** Wieringa, Paul EMLI:EX <Paul.Wieringa@gov.bc.ca>; De Champlain, Rhonda EMLI:EX <Rhonda.DeChamplain@gov.bc.ca>; Jang, Monica EMLI:EX <Monica.Jang@gov.bc.ca>; Robb, Amanda EMLI:EX <Amanda.Robb@gov.bc.ca>; Tseng, Eugene EMLI:EX <Eugene.Tseng@gov.bc.ca>; Warnock, Joie EMLI:EX <Joie.Warnock@gov.bc.ca>  
**Subject:** RE: Revised TB Speaking Notes for Site C

Hi Les and Fazil,

I have a quick follow-up question on this for you.

s.13

I know that we cover this in the QA, but I think we should keep this in the SNs as well.

Would you mind putting that back in please?

Many thanks!  
Roari

Roari Richardson  
Senior Ministerial Advisor  
**Minister of Energy, Mines and Low Carbon Innovation**  
C: 250-883-1370  
E: [roari.richardson@gov.bc.ca](mailto:roari.richardson@gov.bc.ca)  
Pronouns: he/him

---

**From:** MacLaren, Les EMLI:EX <[Les.MacLaren@gov.bc.ca](mailto:Les.MacLaren@gov.bc.ca)>  
**Sent:** October 19, 2021 10:05 AM  
**To:** Richardson, Roari EMLI:EX <[Roari.Richardson@gov.bc.ca](mailto:Roari.Richardson@gov.bc.ca)>; Mihlar, Fazil EMLI:EX <[Fazil.Mihlar@gov.bc.ca](mailto:Fazil.Mihlar@gov.bc.ca)>  
**Cc:** Wieringa, Paul EMLI:EX <[Paul.Wieringa@gov.bc.ca](mailto:Paul.Wieringa@gov.bc.ca)>; De Champlain, Rhonda EMLI:EX <[Rhonda.DeChamplain@gov.bc.ca](mailto:Rhonda.DeChamplain@gov.bc.ca)>; Jang, Monica EMLI:EX <[Monica.Jang@gov.bc.ca](mailto:Monica.Jang@gov.bc.ca)>; Robb, Amanda EMLI:EX



<Amanda.Robb@gov.bc.ca>

**Subject:** Revised TB Speaking Notes for Site C

Roari/Fazil

Attached are the revised Speaking Notes for Treasury Board this afternoon based on the discussion with the Minister at the pre-brief this morning.

Les

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Withheld pursuant to/removed as

s.12 ; s.13

Page 695 of 716

Withheld pursuant to/removed as

s.12 ; s.13 ; s.19

Page 696 of 716 to/à Page 700 of 716

Withheld pursuant to/removed as

s.12 ; s.13

## **EMLI FOI EMLI:EX**

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**From:** MacLaren, Les EMLI:EX  
**Sent:** November 4, 2021 2:07 PM  
**To:** Mihlar, Fazil EMLI:EX  
**Cc:** Wieringa, Paul EMLI:EX; Sopinka, Amy EMLI:EX; Jang, Monica EMLI:EX; McCann, Meghan EMLI:EX  
**Subject:** Site C and Powerex V3.pptx  
**Attachments:** Site C and Powerex V3.pptx

Hi Fazil

Attached is a deck for the PO briefing on Tuesday at noon. It has been approved by Chris O and Tom Bechard.

Meghan, please add the meeting to Amy's and my calendars.

Happy to address any questions.

Les



# Site C and Powerex

Prepared for: Premier's Office

Date: November 9, 2021

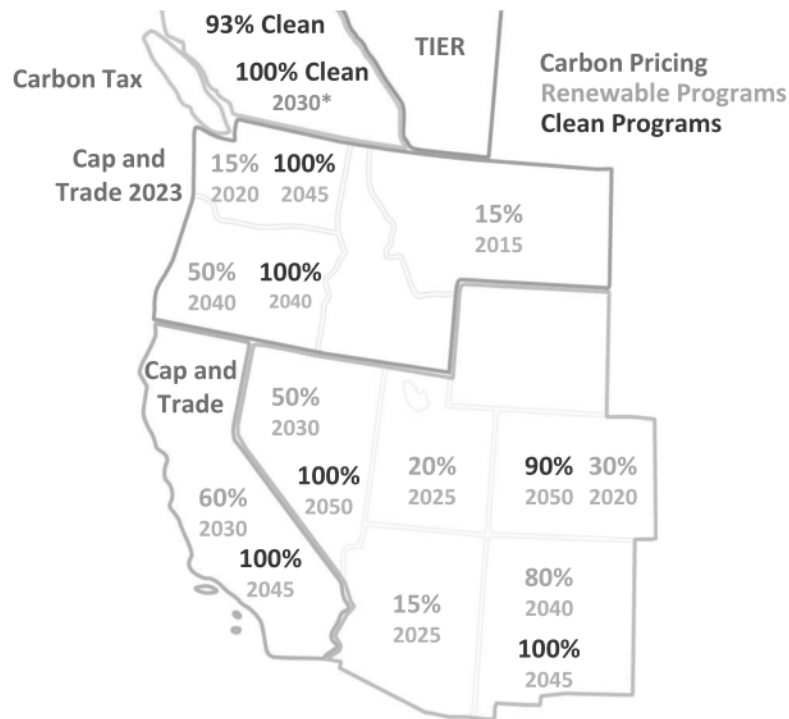
Prepared by: Ministry of Energy, Mines and Low Carbon Innovation and Powerex



## Today's presentation:

- Electricity Market Changes
- Future sales opportunities and benefits
- BC Hydro surplus
- Powerex supply portfolio and forward sales opportunity

# Environmental Policy Driven Changes



## Environmental Policy Continues To Drive Changes In Western Grid and Market Prices:

- More wind and solar
- Continued retirements of coal and gas
- Battery development and installations
- Demand growth through electrification

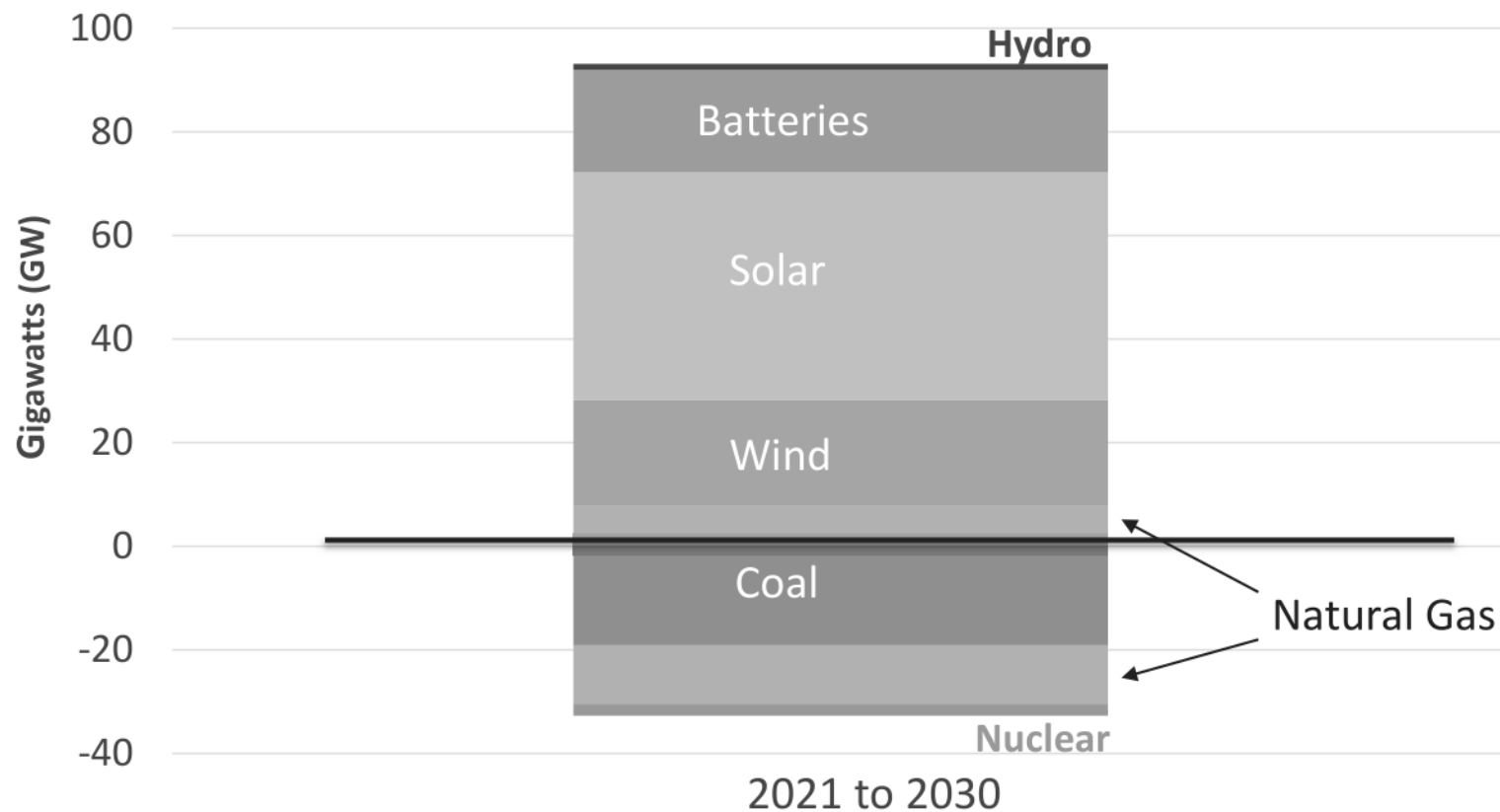
## Next 25 Years:

Forecast 4% annual demand growth for clean and renewable energy (based on legislated program demand)

\* CleanBC Roadmap to 2030



## U.S. West and B.C. cumulative installed capacity changes

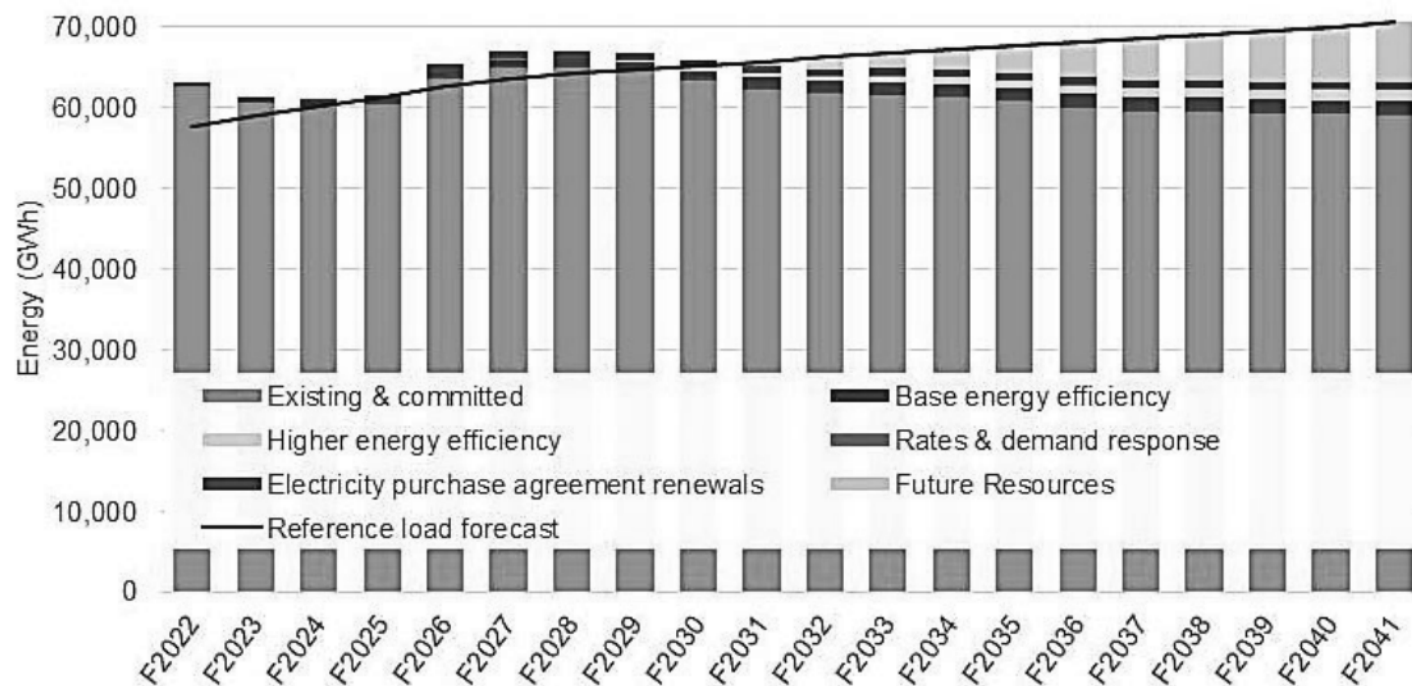


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s.13

## BC Hydro Load Resource Balance - Energy



- From the draft Integrated Resource Plan, BC Hydro expects to be in a energy surplus position until about 2031
- This surplus includes Site C's 1,100 MW of clean capacity when it is brought into service in December 2025



## Electrification Plan

- BC Hydro will invest over \$260 million to advance electrification in BC with a target of adding 3,100 gigawatt-hours of electricity demand in the next five years.

s.13

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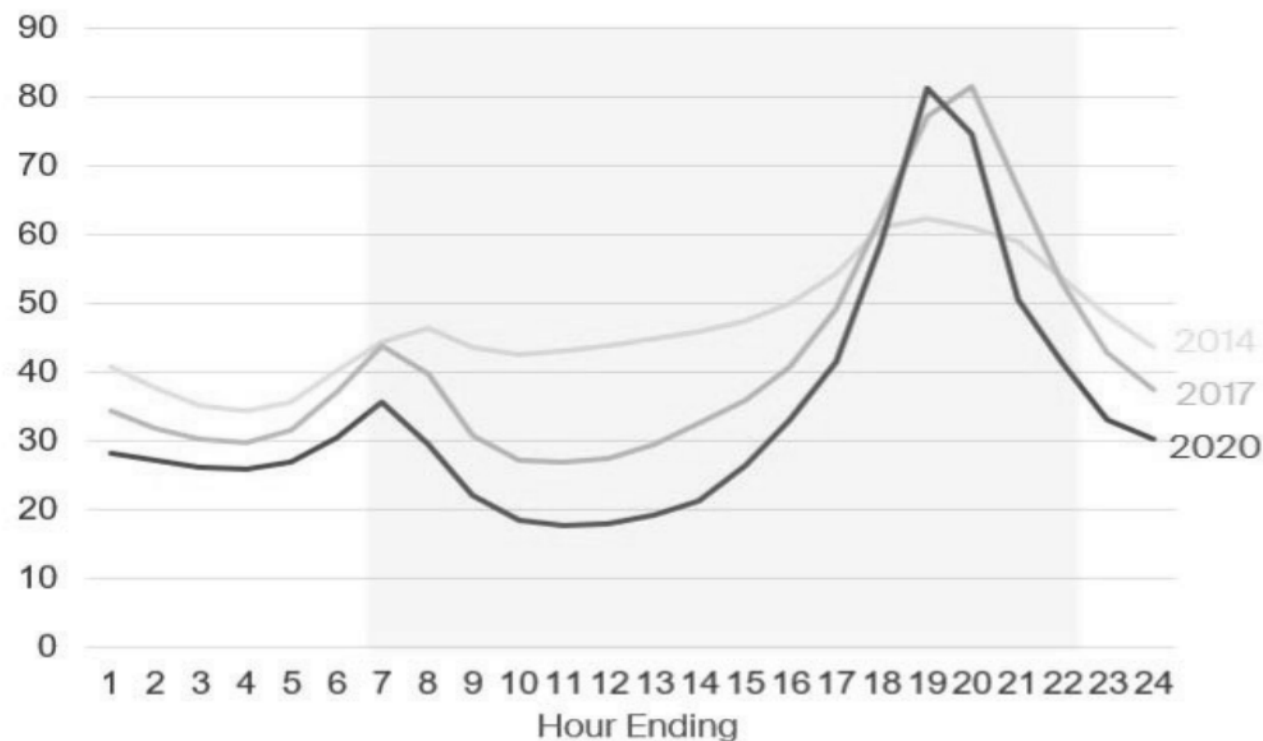
s.13



# Questions?

## Electricity Market Changes – Hourly Pricing

Southern California Price (Average \$US/MWh)



- Mid-day solar energy is lowering peak prices and now they can be lower than off-peak hours



## Where are market prices going: 2022-2030+

Price Driver	Direction of Impact
Additions of solar and wind generation to meet policy	↓
Retirements of dispatchable capacity	↑
Pace of electrification	↑
Technology improvements	↓
Weather conditions	?
Under normal conditions	↓
Under stressed market conditions (i.e., extreme weather events)	↑

- Impossible to predict market prices in any future period
  - Market prices will likely remain volatile both within and between years
  - Diversifying market exposure between the forward and spot market prices can smooth volatility

Source: IHS North American Power Outlook / December 2020: Pacific Northwest, B.C., California, Desert Southwest



## EMLI FOI EMLI:EX

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**From:** Sopinka, Amy EMLI:EX  
**Sent:** November 8, 2021 9:33 AM  
**To:** McCallion, Amy  
**Cc:** Stokvis, Cheryl; MacLaren, Les EMLI:EX; Wieringa, Paul EMLI:EX  
**Subject:** RE: Final edit of materials for presentation on 9th  
**Attachments:** Site C and Powerex V3.pptx

Amy M,

Attached is the final version of the presentation for the 9<sup>th</sup>.

AS

---

**From:** McCallion, Amy <Amy.McCallion@bchydro.com>  
**Sent:** November 8, 2021 9:15 AM  
**To:** Sopinka, Amy EMLI:EX <Amy.Sopinka@gov.bc.ca>  
**Cc:** Stokvis, Cheryl <Cheryl.Stokvis@bchydro.com>  
**Subject:** Final edit of materials for presentation on 9th

**[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.**

Hi Amy S! Can I get the final copy of the materials for the presentation tomorrow? Doug wants to make sure he has the latest.

Thanks,  
Amy

---

**Amy McCallion, JD**  
**Corporate Secretary to Board of Directors**  
she/her/hers

**BC Hydro**  
333 Dunsmuir St  
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**Direct:** 604 623 4234  
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