



International Kootenay Lake Board of Control

2021 Annual Report to the International Joint Commission



Photograph of Kootenay River free-fall discharge through Corra Linn Dam during the Spring high-water period (credit: Fortis BC)

Kootenay Lake 2021 Summary

Throughout 2021, FortisBC operated Corra Linn Dam in a manner consistent with that prescribed by the 1938 Kootenay Lake Order.

During the 2021 spring draw down period, the lake level reached the low elevation target of 1738.63 feet (529.93 metres¹) on April 1st, which is on the required date in the Order (on or around April 1st).

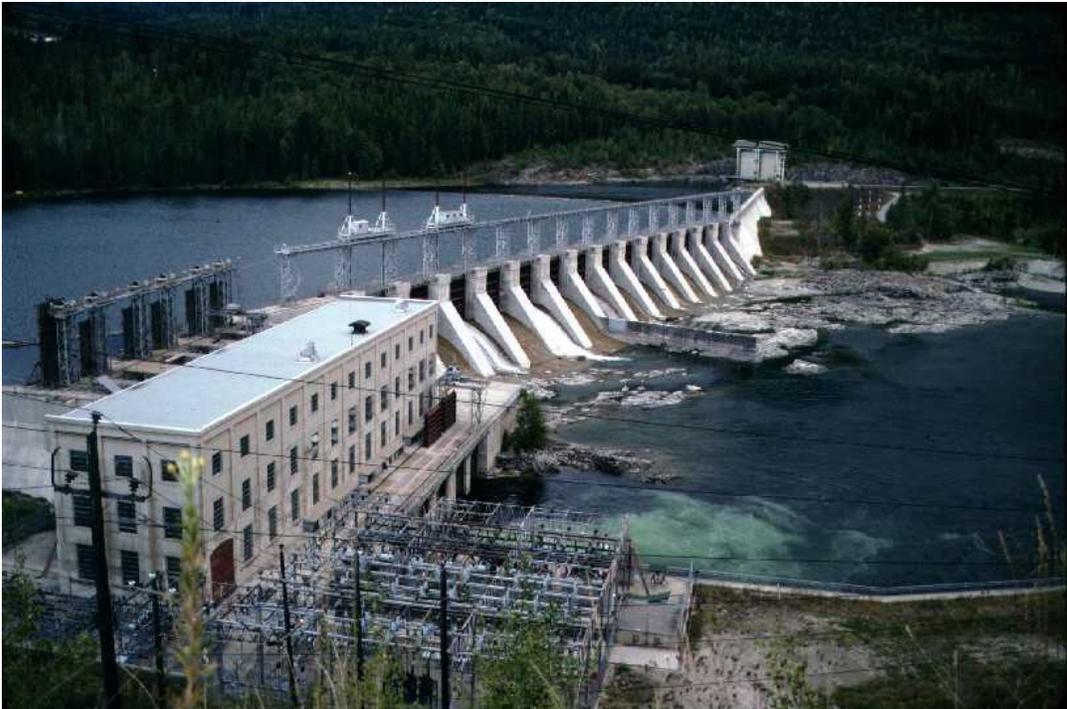
The International Kootenay Lake Board of Control determined the date of the commencement of the spring rise as April 21st, 2021. Lake levels continued to rise until reaching a maximum of 1747.33 feet (532.59 m) on June 5th. The lake drafted below elevation of 1743.32 feet (531.364 m) at Nelson on July 10th, triggering the end of the high water period. On December 3-5, the lake level at Queens Bay exceeded the IJC Rule curve, by a margin of 0.02 feet (6 mm), 0.07 feet (21 mm), and 0.02 feet (6 mm), respectively. Prior to the exceedance, Corra Linn Dam was put into freefall on December 1st, and in pre-spill condition on November 26th, indicating the applicant was in compliance of the Order. Furthermore, Grohman Narrows was the control point during this time.

Kootenay Lake discharged 17.3 million acre-feet (21.5 cubic kilometres) of water in 2021, with an average flow of 23,800 cubic feet per second (675 cubic metres per second). FortisBC made a payment of \$30,000 in July 2021 to Idaho farmers to compensate for increased pumping costs during high lake levels in 2020. A payment has yet to be made for 2021 pumping costs.

¹ All elevations are referred to G.S.C. 1928 datum.

Introduction

This Annual Report covers the operations of Corra Linn Dam (Figure 1) by the Applicant to the IJC Order (FortisBC) and the associated effects on the water level of Kootenay Lake in 2021. FortisBC operates Corra Linn Dam on the Kootenay River, approximately 22 kilometers upstream from its confluence with the Columbia River, and downstream from the West Arm of Kootenay Lake (Figure 2). FortisBC controls discharge through and around Corra Linn Dam in accordance with requirements of the Order of the International Joint Commission dated November 11, 1938. FortisBC co-operates with BC Hydro, which also manages a hydroelectric generating facility (the Kootenay Canal Project) which is hydraulically connected to the Corra Linn Dam forebay on the Kootenay River through a constructed canal.



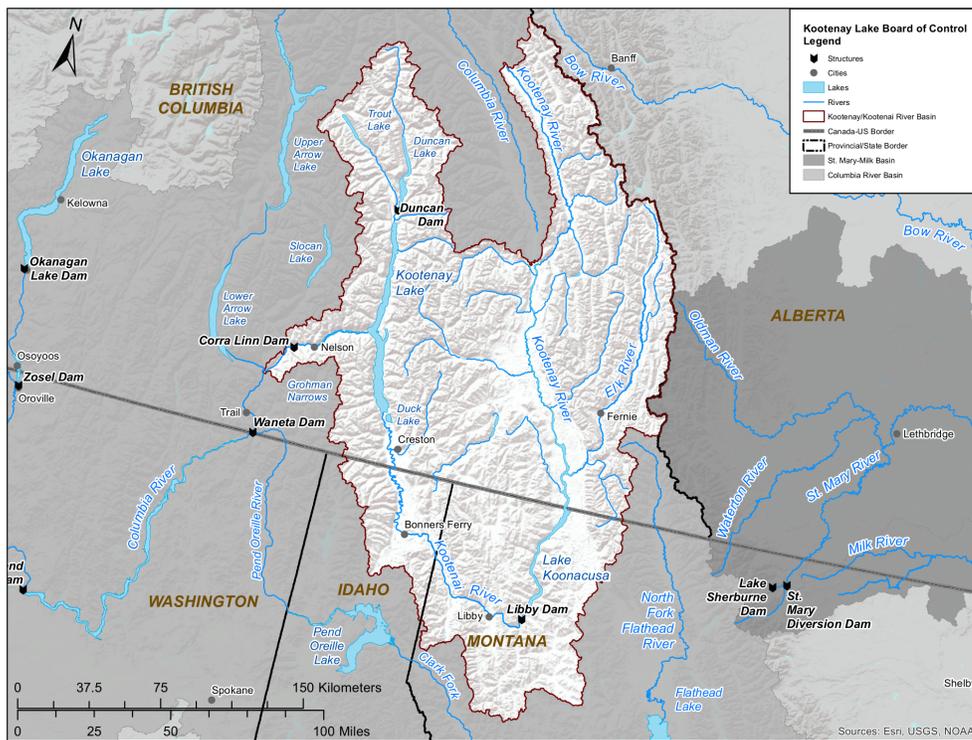


Figure 2: Kootenay System

1938 Kootenay Lake Order Sections 2(4) 2(5) and 2(6)

2(4) ...the Applicant shall be permitted to store water in the main body of Kootenay Lake to a maximum elevation of 1745.32, Geodetic Survey of Canada datum, 1928 adjustment (i.e. six feet above zero of the Nelson gauge), in accordance with the rule curve detailed in Sub-section (5).

(5) That after the high water of the spring and early summer flood and when the lake level at Nelson on its falling stage recedes to elevation 1743.32, Geodetic Survey of Canada datum, 1928 adjustment, the gates of the dam may be so operated as to retain it at said level until August 31st, and after said date, the level of the main body of the lake may be raised to elevation 1745.32, which shall be the maximum storage level until January 7, and thereafter it shall be lowered so that it shall not exceed elevation 1744 on February 1, elevation 1742.4 on March 1, and elevation 1739.32 (i.e. zero of the Nelson gauge) on or about April 1, except under extraordinary natural high inflow conditions, when sufficient gates shall be opened and remain open throughout such period of excess so as to lower the level of the main body of Kootenay Lake to the storage level at that time obtaining as above defined.

6) ...throughout the period of flood flow in each and every year, (i.e. from the commencement of the spring rise in March or April until the level of the lake at Nelson returns to elevation 1743.32, Geodetic Survey of Canada, 1928 adjustment, on the falling stage), a sufficient number of gates and sluiceways of the dam shall be opened to provide, in conjunction with the flow through the turbines, for the lowering of the main body of Kootenay Lake ... by at least the amounts ... as follows:

Discharge from Kootenay Lake under original conditions (in second feet) [vs.]	Amount of lowering to be affected on the main body of Kootenay Lake (in feet)
10,000	1.0
25,000	1.3
50,000	1.7
75,000	2.1
100,000	2.6
125,000	3.0
150,000	3.2
175,000	3.5
200,000	3.8
225,000	4.0

Board Membership

In 2021, there were two changes to the Board membership and secretariat affecting the U.S. section. U.S. section member Dr. Kyle Blasch, Idaho Water Science Director, United States Geological Survey (USGS) moved on to a different role at the USGS and resigned from his role with the Board on August 26, 2021. He was replaced as Idaho Water Science Director by Roy Bartholomay, who was subsequently nominated by the board and approved by IJC Commissioners for the Kootenay Board. In addition, Kevin Shaffer was replaced by Kenneth Brettmann as U.S. section secretary in April 2021. The Board members at the end of 2021 were as follows:

For the United States:

Colonel Alexander Bullock, District Engineer, Seattle District
United States Army Corps of Engineers, Seattle, Washington

Mr. Roy Bartholomay, Director, Idaho Water Science Center
United States Geological Survey, Boise, Idaho

For Canada:

Mr. Dave Hutchinson, Regional Chief - Hydrometric Operations BC and North
National Hydrological Services
Environment and Climate Change Canada, Vancouver, British Columbia

Mr. Ted White, Director, Water Management Branch
BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development,
Victoria, British Columbia

Board Secretariat:

Mr. Kenneth Brettmann (United States Army Corps of Engineers)
Mr. Martin Suchy (Environment and Climate Change Canada)

Lake Regulation

Figure 3 presents observed calendar-year 2021 water levels on Kootenay Lake and the elevations specified in the November 11, 1938, IJC Order.

Snowpack in the Kootenay basin was average to slightly above average at the onset of the freshet mostly because of a very wet and cooler than average February. Precipitation in other key snow building months, December, January, March, and April was mostly below average throughout the basin. Snow Water Equivalent (SWE) in the Kootenay Basin was about 110-120% of average in Canada and closer to average in U.S. A snowpack of 100-120% of normal is typically enough to present a flood threat, but not enough to guarantee a flood. In such a year, floods could happen because of intense heatwaves, and/or rain on snowmelt events. However, this year the basin was spared any flooding, with warm temperatures from April through July but very dry conditions during this period. An intense heat dome in late June resulted in record high temperatures throughout much of the basin for several days, but snowpack was sufficiently diminished by then such that rises in basin streamflow stayed below flood levels.

Water levels on Kootenay Lake were drawn down in accordance with the IJC Rule Curve, beginning in early January. The lake draft levelled off in late-March during the winter-spring drawdown period. The Board determined the commencement of the Spring Rise, the point at which the IJC Rule Curve switches from maximum lake elevation criteria to the lowering formula as stipulated in the IJC Order, to be April 21, 2021. Lake levels continued to rise until reaching a maximum of 1,747.33 feet (532.59 m) on June 5. The lake drafted below elevation 1,743.32 feet (531.364 m) at Nelson on July 10, 2021, triggering the end of the high water period. Due to a very dry summer in the basin, from mid-July until September, Kootenay Lake levels were the lowest they had been during late summer since Libby Dam was constructed. Levels started to rise significantly at the end of October.

The maximum and minimum Queens Bay water levels from FortisBC data are shown on Figure 3. Max and min stats from the Water Survey of Canada (WSC) station are located in the Appendix.

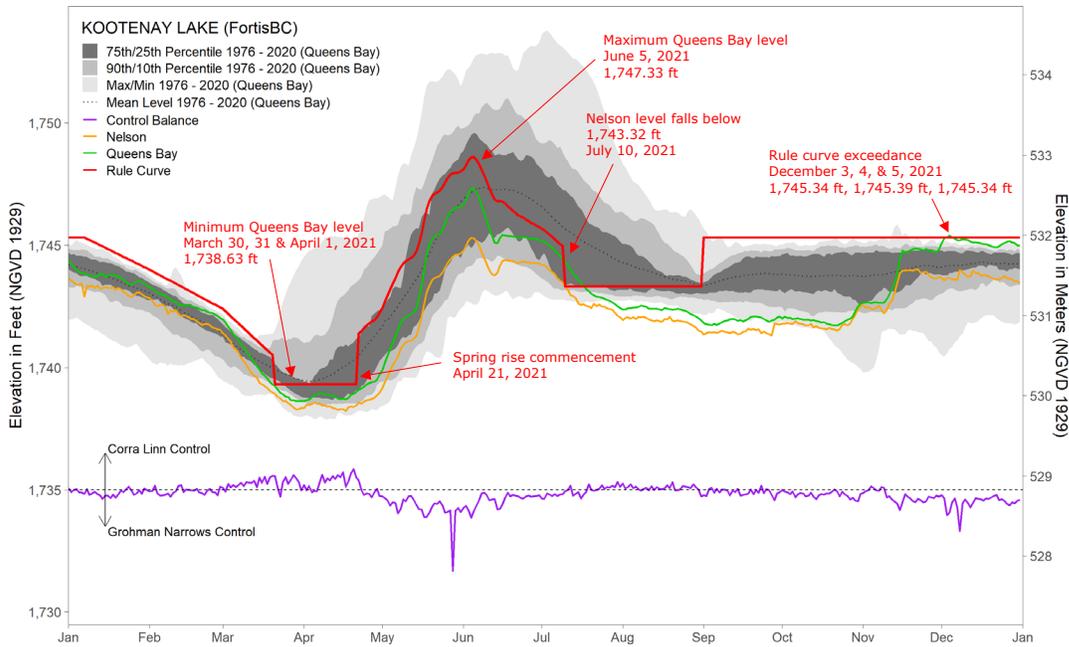
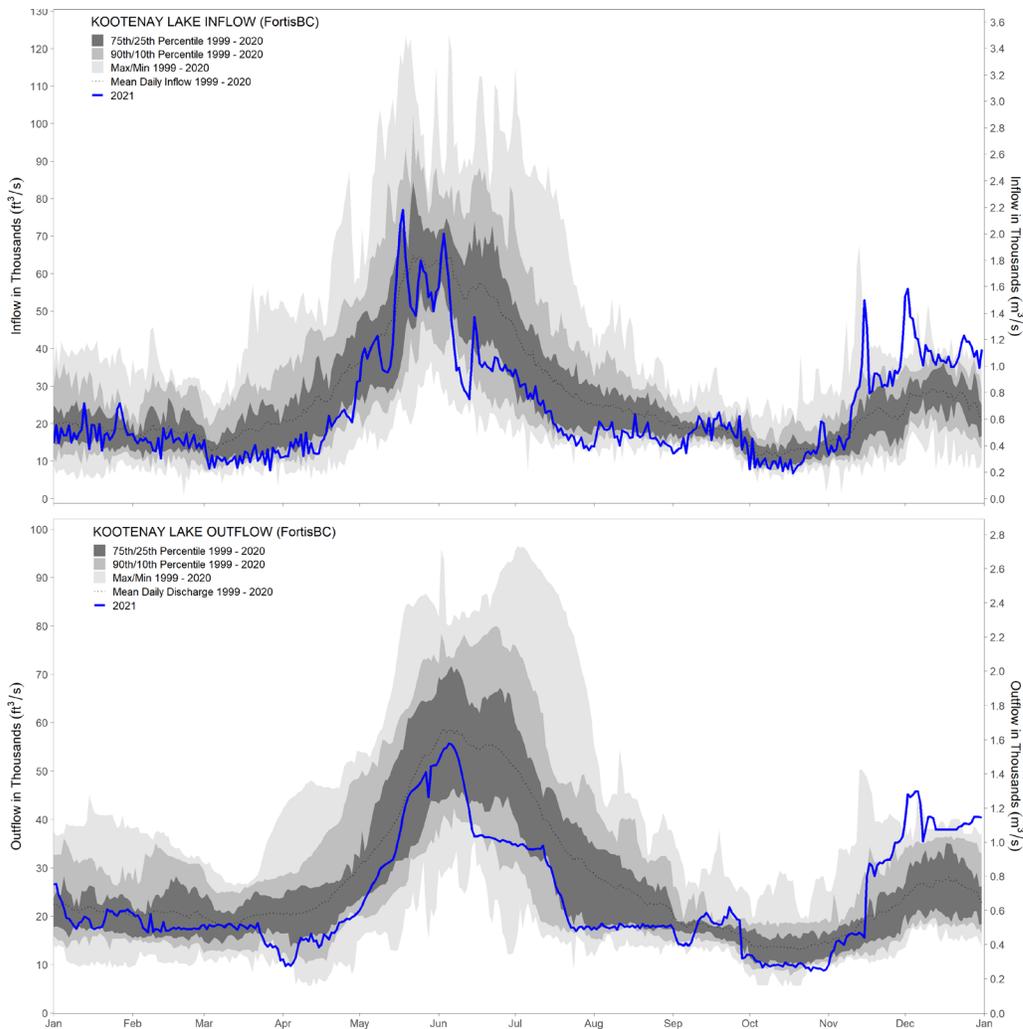


Figure 3 – Kootenay Lake at Queens Bay and Nelson 2021 hydrographs (FortisBC), historical maximum/minimum, 90th/10th and 75th/25th percentiles, daily mean, rule curve, key transition dates along with the Corra Linn Dam / Grohman Narrows control balance. When the purple line is above the black dotted line, Corra Linn Dam controls the outflow from Kootenay Lake, while anything below the black line represents lake discharge controlled by Grohman Narrows.

Kootenay Lake daily inflows and outflows for 2021 can be seen in Figure 4. Kootenay Lake discharged 17.3 million acre-feet (21.3 km³) of water this year through Corra Linn Dam and the Kootenay Canal Plant. Total lake outflow has ranged from a high of 27.4 million acre-feet (33.8 km³) in 1954 to a low of 11.2 million acre-feet km³ (13.8 km³) in 1944. Max and min stats from the FortisBC data are located in the Appendix.

FortisBC has continued to supply the Board with complete records of the regulation of Kootenay Lake as affected by the operations of Corra Linn Dam and the Kootenay Canal Plant.



Order Compliance

Rule Curve

There were no exceedances in the spring during the drawdown period. Minimum lake level was reached on April 1, 2021 (1,738.6 feet) which is in compliance with the required date of April 1st (section 2(5) of the IJC Order). Corra Linn Dam was controlling outflow from the lake at this time. The Board made the Spring Rise Declaration on April 21st, which triggered the rule curve to increase using the lowering formula. Except for a couple of days, Grohman Narrows was in control of lake outflows during the freshet period. Maximum lake level was reached on June 5th (1,743.3 feet).

On December 3, 4, and 5, the lake level at Queens Bay exceeded the IJC Rule curve, by a margin of 0.02 feet (6 mm), 0.07 feet (21 mm), and 0.02 feet (6 mm),

respectively. Prior to the exceedance, Corra Linn Dam was put into freefall on December 1st, and in pre-spill condition on November 26th, indicating the applicant was in compliance of the Order. Furthermore, lake discharge was controlled by Grohmann Narrows during this time. At all other times in 2021, the Applicant maintained the lake below the IJC rule curve.

Applicant's Payment to Farmers in the Kootenai Valley (Idaho)

According to the 1938 Order, FortisBC must pay farmers on the Kootenai Flats in Idaho up to \$3,000.00 (U.S) for additional pumping costs related to dyke seepage from higher water levels during storage periods. FortisBC has a separate agreement with the Kootenai Valley Reclamation Association for an additional pumping cost payment based on actual receipts. Payments have not yet been issued to Idaho for pumping costs in 2021 but will likely be within the range of the 2020 payment amount of \$30,000 USD, which was made in July 2021.

Board Activities

Annual Board Meeting

The Annual Board Meeting was held September 22, 2021 from 1:00 to 4:00 pm PDT. Due to the COVID-19 pandemic, the meeting was held virtually using the MS Teams platform. In addition to the Board and Secretaries, 16 additional attendees were either guests (FortisBC, BC Hydro, USGS, Global Affairs Canada, U.S. Dept. of State, ECCC) or representatives of the International Joint Commission. David Hutchinson (Canadian section Co-Chair) provided some welcoming remarks, did introductions, and reviewed the agenda.

Mr. Suchy (Canadian Section Secretary) reviewed the Applicants IJC rule curve compliance and provided a 2020-2021 hydrology year-in-review. The past year was fairly benign hydrologically and Fortis BC did not have trouble meeting the Order requirements.

Mr. Suchy presented an updated plot of historical Kootenay Lake maximum and minimum levels before and after the construction of Duncan and Libby Dams. He indicated that the peak lake level continues to be significantly lower than in the past, due to the dredging of Grohman Narrows (1940's) and, more significantly, due to the construction of the two upstream Columbia River Treaty dams, Duncan (1967) and Libby Dams (1972). The addition of flood risk reduction storage at these dams has, on average, reduced the annual peak stage of Kootenay Lake by about 6 feet.

Mr. Brettmann (US Section Secretary) reviewed Libby Dam operations. Construction of Libby Dam was allowed per the Columbia River Treaty and is operated for multiple purposes that include hydropower generation, flood control, recreation, and ecosystem needs. The reservoir was drafted per the water supply forecasts over the winter and early spring, reservoir draft was consistent with the water supply forecasts that were close to average throughout the drawdown period. The minimum elevation of Lake Koocanusa was 2,401.02 feet on April 6, 2021. Maximum inflow was about 63 kcfs and maximum outflow was 25 kcfs as part of the sturgeon

augmentation flows released from May 6 through June 3. A maximum reservoir elevation was reached on July 24 at 2453.9 feet.

Shannon Price (Operations Manager at Fortis BC) provided a review of Corra Linn Dam operations, reviewing the winter peak, spring minimum and freshet peak lake levels. The peak freshet lake elevation was near normal in 2021, compared to higher elevations in recent years. Ms. Price also indicated outflow from the dam was in freefall starting just after the declaration of spring rise (declared April 21) through early June. Ms. Price mentioned that high lake inflows occurred in late June due to the heat dome but that there were no adverse impacts to lake levels or power generation. Lastly, Ms. Price provided a project status update on the Corra Linn Spillway Gate Replacement Project.

Gillian Kong (BC Hydro) reviewed the Kootenay Basin weather and hydrologic conditions for the current water year. She indicated the northern parts of the basin were generally wetter, and it was progressively drier further south. Snowmelt was accelerated in the spring due to warmer than normal conditions with record high heat in late June. Most snow pillows ran out of snow by late June.

Ms. Kong then reviewed Duncan Dam operations. As is typical, the reservoir was drafted to near-empty and refilled to near-full in the summer. The reservoir typically drafts some in the late summer, drafts minimally in the fall during kokanee spawning, and then completes the draft in the early spring upon the completion of kokanee spawning. The maximum reservoir elevation was 1,891.8 feet in early August, 0.2 feet from full pool. BC Hydro directs water management at Corra Linn Dam and the Kootenay Canal, under an operating agreement with Fortis BC. There were no unusual operations this past year.

Ms. Kong also spoke about operations at Kootenay Lake to target a stable level of about 1,742 feet from mid-September to mid-October to protect shore spawning Kokanee in the west arm of Kootenay Lake. This operation has been put in place in suspected years of peak spawning including 2021. This operation is found to be effective but does not eliminate dewatering of Kokanee redds in the spring.

Other board business topics discussed during the meeting were the Information Paper update, Public Correspondences, an RDCK Delegation request, the possibility for Board expansion, and the frequency of Board meetings, which was expanded with additional conference calls in spring and summer. These topics were all discussed without the presence of Fortis BC and BC Hydro.

The Board was not able to complete all Business Items during the available time, and a follow-up meeting was held on November 2nd, 2021 to discuss the status of the Visualization Tool, provide an update on the IJC Dynamic Map project, the automated conditions report and most importantly the updating of the Board Work Plan.

Annual Public Meeting

The annual public meeting of the Board was held September 22, 2021. Due to the COVID-19 pandemic the meeting was held virtually using the GoToWebinar platform. The meeting was attended by 27 public attendees, the highest participation in recent years, likely due to the virtual format. In addition, 13 people attended representing

the Applicant (Fortis BC), BC Hydro, Global Affairs Canada, US. Department of State and the International Joint Commission.

The meeting was opened at 6:30 pm and provided some welcoming remarks. The Canadian chair provided an overview of the International Joint Commission framework, responsibilities, and composition. He described the duties of the Kootenay Board, outlined the history of the Kootenay Lake Order of Approval, and referenced the geographic area of the Kootenay Basin. Mr. Hutchinson detailed the main provisions of the Order, including the historical dredging of Grohman Narrows, and explained the significance of Grohman Narrows control on Kootenay Lake levels vs. Corra Linn Dam control, which reduced peak lake levels on Kootenay Lake. Mr. Hutchinson also described the repayment of additional pumping costs to farmers in Idaho.

The Canadian section secretary reviewed the Applicants IJC rule curve compliance and provided a 2020-2021 hydrology year-in-review. The past year was fairly benign hydrologically and Fortis BC did not have trouble meeting the Order requirements.

Additionally, the U.S. section secretary described how at the request of the IJC, the Kootenay Board has undertaken an information review of the existing Kootenay Order of Approval to provide a recommendation to the IJC regarding an Order review, and Martin Suchy discussed a visualization tool that the Board is gearing up to create.

The Board took questions from the audience, covering a wide range of public and Kootenay Lake stakeholder concerns and interests. Questions revolved primarily around Kokanee shoal spawning, the Information Paper, dredging of Grohman Narrows, and the possible Order Review. All questions and the Board responses are summarized in the minutes of the public meeting, which have been posted to the Board's website following approval by the board.

Board Tour

Due to the COVID-19 pandemic, the annual Board and public meetings were held virtually in 2021 and no field trip took place.

Board Appearances at IJC Semi-Annual Meetings

The Board presented a progress report virtually during the spring semi-annual IJC meeting on April 22, 2021. The spring presentation was delivered by the U.S. board member Kyle Blasch, and was attended by Canadian chair Dave Hutchinson and Canadian section member Ted White, and supported by both Board Secretaries. The presentation focused on current conditions, core responsibilities, and complementary responsibilities related to the Order. Complementary responsibilities were summarized including the Corra Linn Dam spillway gate replacement project, bathymetric mapping of the lower Kootenai River and Kootenay Lake, and the Kootenay Lake Visualization tool development. An update to the Order Information Paper was also provided; at the time it was being reviewed under contract.

The Board presented a progress report virtually during the fall semi-annual IJC meeting on October 20, 2021. The fall presentation was delivered by the Canadian Co-chair. The U.S. Co-chair Col. Alexander Bullock was represented by LTC Celio Biering, Seattle District, USACE. Board Members Ted White and Roy Bartholomay also attended, supported by both Board Secretaries. In addition to a summary of basin conditions and the Order, the presentation focused on communications and outreach activities. The board has success in communicating with the applicant and via public meetings but has room for improvement with Tribe and First Nations Outreach and the pending IWI-funded visualization tool. An update on the information paper was provided at this meeting as well; it was being reviewed by the Board.

Tracking Progress: FortisBC Corra Linn Dam spillway gate replacement

The Board has been tracking the progress of the FortisBC Corra Linn Dam spillway gate replacement project. The scope was to replace all 14 spillway gates, reinforce and paint the hoist superstructure and upgrade various components, with a projected cost of \$66.8 million (Cdn). The construction schedule was to be from June 2018 with completion in September 2021; however, the timeline has been extended to May 5 2022 as a result of delays associated with replacing the concealed components supporting spillway at certain gates. To date 10 gates are completed, 2 gates are in progress, and the remaining 2 gates are scheduled to be completed in 2022. The project enables the dam to pass the Probable Maximum Flood, even when gates are under restoration, and has not impacted FortisBC's ability to comply with the Order of Approval.

Kootenay Lake Visualization Tool

The Board submitted an International Watershed Initiative (IWI) proposal and the IJC approved it in spring 2020 for the funding a user-friendly interactive web-based visualization tool to help communicate to the public and stakeholders the drivers and seasonality of Kootenay Lake water levels, the constraints of the IJC 1938 Order of Approval Rule Curve, along with other overlapping demands. In 2021, the Board worked with the contractor to develop the Terms of Reference for contract, and plans to have the contract in place in spring 2022.

Order Information White Paper

In fall 2018, the Commissioners requested a recommendation from the Board for whether the Order of Approval warranted revisions. The Commissioners cited the age of the Order, climate change, and emergent fisheries and flood risk management concerns raised in public meetings. The Board planned a process to respond to the request: 1) gather and coalesce historical information relevant to current or future water management issues on Kootenay Lake, 2) identify knowledge gaps, 3) scope potential studies and complete stakeholder engagement to fill knowledge gaps, 4) complete identified studies with funding utilized from agency, stakeholder, and IJC sources, and 5) respond to Commissioners with a recommendation for Order revision. The Board secured a USACE contractor to collect and coalesce relevant Kootenay Lake water management information. The resulting information paper was initially reviewed in 2020 by the Board and their supporting agencies, the Applicant,

the IJC, and BC Hydro. A final version of the Paper is expected to be released in Spring 2022.

The next steps will be Board deliberations to provide a recommendation on whether the Order of Approval warrants revision. This recommendation is expected to be provided to the IJC prior to the 2022 Annual Board meeting.

APPENDIX: KOOTENAY LAKE KEY MAX AND MIN VALUES IN 2021

A. Kootenay Lake at Queens Bay (WSC station no. 08NH064)

Maximum instantaneous elevation	1747.38 ft (532.60 m) – Jun 5 12:50
Minimum instantaneous elevation	1738.52 ft (529.90 m) – Mar 31 12:35
Maximum daily mean elevation	1747.34 ft (532.59 m) – Jun 5
Minimum daily mean elevation	1738.58 ft (529.92 m) – Mar 31
Annual mean elevation	1742.78 ft (531.20 m)

The annual mean elevation was 99.9 percent of the 89-year (1932-2020) average of 1744.32 ft (531.67 m).

B. Franklin Roosevelt Lake at Grand Coulee Dam (USGS station no. 12436000)

Maximum instantaneous elevation	1289.52 ft (393.05 m) – Jul 12 09:00 - Jul 12 10:00
Minimum instantaneous elevation	1268.65 ft (386.68 m) – May 14 19:00 - May 14 21:00
Maximum daily mean elevation	1289.35 ft (392.99 m) – Jul 11
Minimum daily mean elevation	1268.93 ft (386.77 m) – May 14
Annual mean elevation	1280.59 ft (390.32 m)

C. Calculated Kootenay Lake Backwater

Maximum backwater	0.42 ft (0.128 m) – Apr 20
Minimum backwater	-1.65 ft (-0.503 m) – May 28
Annual mean backwater	-0.08 ft (-0.024 m)

D. Kootenay Lake Inflow (FortisBC)

Maximum inflow	77,000 cfs (2180.4 cms) – May 18
Minimum inflow	6,800 cfs (192.6 cms) – Oct 18
Annual mean inflow	23,896 cfs (676.7 cms)

The annual mean inflow was 89 percent of the 22-year (1999-2020) average of 26,884 cfs (761.3 cms).

E. Kootenay Lake Outflow (FortisBC)

Maximum outflow	55,700 cfs (1577.2 cms) – Jun 5
Minimum outflow	8,700 cfs (246.4 cms) – Oct 25
Annual mean outflow	23,833 cfs (674.9 cms)

The annual mean outflow was 89 percent of the 22-year (1999-2020) average of 26,889 cfs (761.4 cms).