



International Kootenay Lake Board of Control

2017 Annual Report to the International Joint Commission

This Annual Report covers the operations of Corra Linn Dam by the Applicant to the IJC Order (FortisBC) and the associated effects on the water level of Kootenay Lake in 2017. 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. 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 hydro-electric generating facility (the Kootenay Canal Project) which is hydraulically connected to the Corra Linn dam forebay on the Kootenay River through a constructed canal.



Photograph of rail bridge over the Kootenay River during the Fall low-flow period. This location is upstream of Corra Linn Dam, about mid-way between the dam and the city of Nelson BC and Corra Linn Dam. Photo: October 20, 2017 (Gwyn Graham, Environment & Climate Change Canada).

Kootenay Lake 2017 Summary

Throughout 2017, FortisBC operated Corra Linn Dam in a manner consistent with that prescribed by the 1938 Kootenay Lake Order.

The minimum instantaneous water level was observed at 22:15, PST on March 14th, 2017 at elevation 529.992 metres¹ (1738.82 feet). The Lake elevation did not reach the low elevation goal of 1739.32 feet on (or around) April 1st due to high lake inflow beyond the control of the Applicant (in compliance with the IJC Order) but the Board noted that the March 14th low level was below the April 1st target date, indicative of the efforts made by the Applicant to meet the seasonal low level target to the extent possible. The high inflow events in 2017 were the result of intense precipitation events which resulted in rainfall-driven runoff to the lake, in addition to upstream discharge from Libby Dam operations.

The Board and the Applicant jointly determined the date of the commencement of the spring rise as April 25th, 2017. The maximum instantaneous water level for the lake at Queens Bay was subsequently observed from 13:05 to 13:10 PST on June 9th at elevation 533.743 metres (1751.13 feet). Kootenay Lake discharged 27.6 cubic kilometres (22.4 million acre-feet) of water in 2017, with an average flow of 875 cubic metres per second (30,900 cubic feet per second).

Board Membership

In 2017, there were two changes to the Board membership, affecting both the U.S. and Canadian sections. Previous U.S. Section Chair, Col. John Buck, resigned from the Board in tandem with retirement from the U.S. Army Corps of Engineers, and was replaced by Col. Mark Gerald. Canadian section Board member Glen Davidson also resigned following retirement from the BC Government and was replaced by Ted White. The Board members at the end of 2017 were as follows:

For the United States:

Colonel Mark Gerald, District Engineer, Seattle District,
United States Army, Corps of Engineers, Seattle, Washington;

Dr. Kyle Blasch, Director, Idaho Water Science Center;
United States Geological Survey, Boise, Idaho.

For Canada:

Mr. Bruno Tassone, Manager (retired),
Water Survey of Canada, Vancouver, British Columbia;

Mr. Ted White, Director, Water Management Branch;
BC Ministry of Natural Resource Operations, Victoria, British Columbia.

Board Secretariat:

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

Mr. Kevin Shaffer (U.S. Army Corps of Engineers) and Mr. Gwyn Graham (Environment and Climate Change Canada) provided secretariat support to the U.S. and Canadian sections, respectively.

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

Lake Regulation

Figure 1 presents observed calendar-year 2017 water levels on Kootenay Lake and the elevations specified in the November 11, 1938 IJC Order. Water levels on Kootenay Lake showed a distinct freshet peak in 2017, corresponding to increased inflows from snow-melt in this mountainous watershed. Water levels on Kootenay Lake rose early for a brief period in mid-February due to an intense rainfall event (unusual for this time of year) and then began an early sustained rise in mid-March due to additional large rainfall events, high inflow

to Kootenay Lake and subsequent onset of higher-elevation snow-melt. During this period, upstream Libby Dam was essentially in a storage mode with inflow to Lake Kooconusa (Libby Dam reservoir) greater than the outflow, thus having a further moderating effect on the maximum lake level achieved during the 2017 freshet. The freshet ended in mid-July and Corra Linn Dam operations maintained fairly stable water levels on Kootenay Lake through the end of August and at similar levels through most of the fall storage period. Water levels were raised towards the storage maximum by early December.

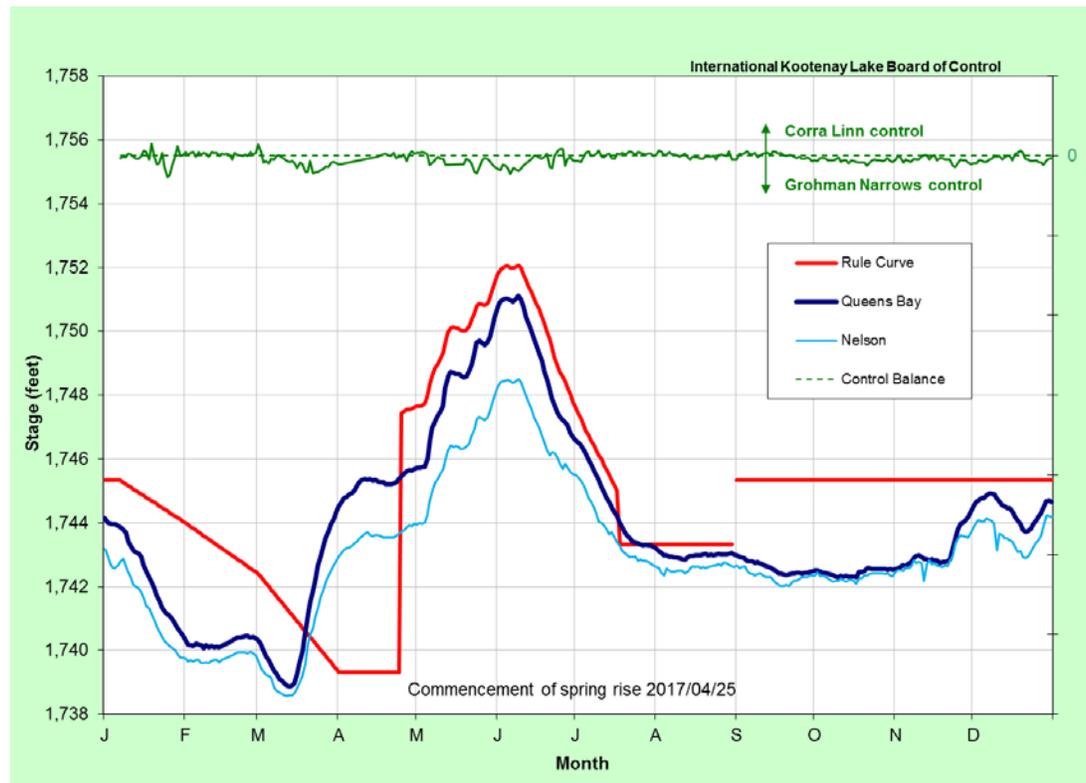


Figure 1 – Kootenay Lake Hydrograph

The maximum instantaneous water level of 533.743 metres (1751.13 feet) for the lake at Queens Bay was reached on June 9th, 2017 from 13:05 to 13:10 PST. The minimum instantaneous water level was observed on March 14th at 22:15 PST, elevation 529.992 metres (1738.82 feet). Relative to the 87-year period of record (1931 to 2017, with two years missing; 1934 and 1947), this year's maximum water level ranked 44th highest, and the minimum was the 26th lowest annual minimum. Over the period of record, water levels in the lake have ranged from a high of 537.04 metres (1761.95 feet) in 1961 to a low of 529.56 metres (1737.41 feet) in 1944.

Kootenay Lake discharged 27.6 cubic kilometres (22.4 million acre-feet) of water this year through Corra Linn Dam and the Kootenay Canal Plant, with an average flow of 875 m³/s (30,900 cfs). Relative to the 80 years of available discharge data, the annual volume of flow out of the lake was 24th highest over this period of record. Total lake outflow has ranged from a high of 33.8 km³ (27.4 million acre-feet) in 1954 to a low of 13.8 km³ (11.2 million acre-feet) in 1944. The maximum daily mean outflow was 2,280 m³/s (80,500 cfs) on June 4th, 2017. The minimum daily mean outflow of 246 m³/s (8,700 cfs) was observed on October 11, 2017.

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. FortisBC attempts to operate the lake within the optimal range of 1738.5 feet to 1749.5 feet, subject to the stipulations of the IJC Order and natural inflows.

The Board and the Applicant jointly determined the commencement of the spring rise to be 00:00 PST on April 25, 2017, the point at which the IJC rule curve switches from maximum lake elevation criteria to the lowering formula as stipulated in the IJC Order. The spring rise was declared based on sustained increases in unregulated stream hydrographs throughout the Kootenay River Basin, in response to snow-melt conditions in early April.

Compliance Summary

As shown in Figure 1, the lake level elevation did not reach the low level target of 1739.32 feet on or about April 1 (section 2(5) of the IJC Order), due to high inflows beginning mid-March that exceeded the maximum lake discharge capacity. The Board confirmed that the applicant (Fortis BC) was operating Corra Linn Dam in free-fall mode during this time and that Kootenay Lake outflow capacity was constrained by the natural channel constriction at Grohman Narrows (upstream of Corra Linn Dam) and not by the dam itself. Based on this information, the Board confirmed that operation of Corra Linn Dam was in compliance with the IJC Order.

Board Meetings

The Board held its annual and public meetings in Nelson, BC, on October 19, 2017.

Board Tour

Board members visited the newly opened Fortis BC Operations Centre near Castlegar (BC) as well as the Fortis BC Corra Linn Dam and power generation station. At both locations, the group was guided by Fortis BC staff (Jamie King and Darren McElhinney) following relevant OHS and security briefings. The new Operations Centre consolidates all elements of Fortis BC operations, including the functions of the previous control centre that was located in Warfield (near Trail, BC). At the time of the visit, the new Operations Centre had not yet been officially commissioned but Board members were able to view relevant elements of the generation and SCADA systems and observe the remote operations systems for the different FortisBC Kootenay system projects, including the Corra Linn Dam. The Centre was scheduled for official commissioning on November 8, 2018. While on site, Jamie King (Fortis BC) provided an overview of the Fortis BC – BC Hydro Kootenay Canal Plant agreement, which allows BC Hydro to divert flow through their Kootenay Canal generating station, by-passing a number of Fortis BC power plants along the Kootenay River before discharging further down the Kootenay River, but providing compensation to Fortis BC. Board members also conducted a site visit of the Corra Linn Dam on the Kootenay River, owned and operated by Fortis BC and subject to the 1938 IJC Kootenay Lake Order of Approval. Fortis BC staff guided Board members along the dam, explaining the flow control gate operations, as well as the generation/turbine plant and explained the

Corra Linn Dam upgrade project and the work that is planned for the spillway gates and dam superstructure replacement and other upgrades.



Photograph: Darren McElhinney (Fortis BC) explains the planned changes to the superstructure and flow control gates at the Corra Linn Dam to members of the IJC International Kootenay Lake Board of Control and IJC staff. Photo: October 19, 2017 (Kevin Shaffer, U.S. Army Corps of Engineers).

Annual Board Meeting

The Board reviewed previous action items and applicant compliance of the IJC Order for 2017. Kootenay Lake level followed normal drawdown conditions through winter of 2017 until mid-March, when high inflows to Kootenay Lake from a combination of high rainfall (record-breaking precipitation events in Feb and Mar 2017) and reservoir draft at Libby Dam resulted in exceedance of the IJC rule curve. As a result of these conditions, water level elevation did not reach the low water level target of 1739.32 ft. around the period of April 1st. Spring rise was declared on April 25th and Kootenay Lake water levels peaked at 1751.13 ft on June 9th. The Board reviewed upstream reservoir operations in order to the effects on Kootenay Lake levels. Duncan Dam reservoir experienced minimum levels in the middle of April (April 12) and maximum level on June 2nd, with an overall normal pattern of water level change (reservoir operations). Libby Dam (Kooconusa reservoir) experienced the minimum water level on May 5th and maximum level on June 22nd. Libby reservoir operations followed a similarly normal pattern. The Libby Dam refill started in the first week of May. VARQ discharge flows were followed with sturgeon discharge flows (pulses) from May 15-June 19.

The U.S. Board secretary, Kevin Shaffer, provided the results of analysis of high stage (water level) conditions on the Kootenai River at Porthill with

comparison to periods of high Kootenay Lake level and high discharge (reservoir operations) from Libby Dam. The analysis was conducted following information that was provided to the Board by the manager of a large Hops farm in the Kootenai River flood plain downstream of Bonners Ferry (Idaho) regarding crop impacts and economic loss when Kootenai River stage reaches 1750 ft (USGS Porthill gage). The Board sought to better understand a potential connection between the Porthill gage and the Kootenay Lake hydrograph for times when the Porthill gauge reads at or above 1750 ft. The analysis showed that water level elevations (stage) of 1750 ft at Porthill and 1745.5 ft on Kootenay Lake occur in all but the driest years (19 of last 20 years). Flow release from Libby Dam of 30 kcfs occurs in about 35 percent of recent years (7 of last 20 years; noting that this occurred annually prior to Libby Dam construction). Kevin summarized that Porthill stage elevations exceeding 1750 ft. are most closely related to Queen's Bay elevations above 1746 ft. but can occur when Queen's Bay is as low as 1744 ft (and always occur when Queen's Bay is above 1748.5 ft.). These high stage conditions at Porthill (Kootenai River) also occur with any river discharge rate above 15 kcfs and with any Libby Dam outflow rate but will always occur when Libby Dam outflow exceeds 30 kcfs. Given the frequent occurrence for the variable conditions that can influence high Kootenai River stage at Porthill, it's not clear under what specific stage or seasonal conditions the instances of significant crop damage can occur. Additional follow up discussion with the affected farm(s) may be needed.

Darren Sherbot (BC Hydro) provided information to show that the Kootenay Basin broke 5 monthly precipitation records (3 high precipitation records and 2 low precipitation records). Stream flows were identified as currently extremely low downstream of Corra Linn Dam, despite an overall 122% of normal water supply for Kootenay Lake.

Jamie King (Fortis BC) provided a presentation by the Applicant, reviewing Kootenay Lake levels in 2017 to date, Corra Linn operations and planned upgrades at the dam. Corra Linn went into free fall to manage the lake to the IJC Rule Curve during high inflow events in Nov 25 to 29 2016 (early winter) and winter Kootenay Lake level peaked at 1744.69 ft. on Dec 28th before draw down commenced. Corra Linn entered free fall on March 2, 2017 and drafted the lake to 1738.88 ft on March 13th but with increased Libby Dam discharge from March 15-19th and high natural inflows in the second half of March, the IJC Rule curve was exceeded as of March 20th although the dam maintained IJC compliance by remaining in free fall through this period.

Jamie indicated that the BC Utilities Commission (BCUC) had approved the \$63 million Spill Gate Replacement Project in February 2017. The scope of the Project is:

- Replacement of 14 existing spillway gates to meet the seismic and flood withstand recommendations of the BCDSR and CDSG;
- Reinforcement of the existing towers and bridges to meet seismic and flood withstand recommendations of the BCDSR and CDSG;
- Replacement of the existing hoists; and
- Replacement of the some of the existing embedded parts (gate guides, sill etc.)
- Construction is anticipated to begin in July 2018 and end in 2021.

Wayne Jenkinson (IJC Canadian Section – Ottawa) provided an overview of Water Level and Water Management visualization models (and similar

animation/graphical tools) that have been adopted by the Rainy-Lake of the Woods Board and Lake Ontario Board to better inform public knowledge of IJC water management activities and rules. There is IJC interest in having the International Kootenay Lake Board of Control develop a similar Kootenay Lake Water Level Visualization Model to better show how Corra Linn Dam and Grohman Narrows can affect water levels on Kootenay Lake.

The board received no correspondence in 2017.

Annual Public Meeting

For the Board's public meeting (held on the evening of October 19th), an overview of the IJC Order and the related compliance requirements for operation of Corra Linn Dam were provided by Bruno Tassone (Chair, Canadian section). Canadian Board secretary Gwyn Graham provided a summary of hydrologic conditions in 2017 affecting Kootenay Lake levels, including upstream operations at Duncan and Libby Dams (CRT operations). The Kootenay Lake hydrograph (showing the IJC rule curve) along with explanation of the Libby Dam discharge effect showed that Corra Linn Dam was in compliance with the IJC rule curve in 2016.

The public meeting was attended by approximately 16 people, including local residents and IJC representatives. There was a lengthy question and answer period covering a wide range of public and Kootenay Lake stakeholder concerns and interests. These questions and the Board responses are summarized in the minutes of the public meeting, located on the Board's website.

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. A number of years ago, Fortis BC made 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 2017 (for pumping costs in 2016) but will likely be within the range of the 2016 payment amount of approximately \$30,000 (USD).



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