Arrow Lakes Reservoir. Photo by Jen Walker–Larsen.

Columbia River Operations Summary

Fall 2021

This publication provides an overview of BC Hydro's operations on the Columbia River. At 2,000 kilometres long, the Columbia River is the fourth largest river in North America. The headwaters of the Columbia River are in Canal Flats, British Columbia (B.C.). The river then flows northwest through the Rocky Mountain trench before heading south through B.C. and Washington, emptying into the Pacific Ocean at Astoria, Oregon. Other major tributaries of the Columbia River in Canada include the Kootenay and Pend d'Oreille rivers.

Only 15% of the Columbia River basin lies in Canada. The Canadian portion of the basin is mountainous and receives a lot of snow producing, on average, 30 to 35% of the runoff for Canada and the United States (U.S.) combined. The river's large annual discharge and relatively steep gradient gives it tremendous potential for the generation of electricity. The hydroelectric dams on the Columbia's main stem and many more on its tributaries produce more hydroelectric power than on any other North American river.

BC Hydro's facilities in the Columbia basin include 13 hydroelectric dams, two water storage dams, and a system of reservoirs. Four of the larger reservoirs within Canada are operated according to the Columbia River Treaty and other agreements signed between Canada and the U.S.

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BC Hydro's operating agreements

COLUMBIA RIVER TREATY

The Columbia River Treaty between Canada and the U.S. was ratified in 1964. The Treaty resulted in the construction of three dams in British Columbia (the Duncan, Hugh L. Keenleyside and Mica dams) for flood control and to increase hydroelectric generating potential in both countries. The Treaty also provided for the construction of Libby Dam in the U.S. and the resulting Koocanusa Reservoir, which crosses the Canada–U.S. border.

Water stored, and then released, by Canadian reservoirs provides the U.S. with the potential to generate additional electricity. Under the terms of the Treaty, Canada receives a one–half share of the extra power generation potential in the U.S. This is called the Canadian Entitlement to Downstream Benefits and is owned by the Province of British Columbia. The Canadian Entitlement varies from year to year, but is currently about 3,990 gigawatt hours (GWh) per year of energy and 1,141 megawatts (MW) of capacity for the period between August 1, 2021 and July 31, 2022.

Since September 16, 2014, both Canada and the U.S have had the option to terminate. After extensive consultation with basin residents, the Province of British Columbia decided in March 2014 to continue with the Columbia River Treaty and to seek improvements within the existing Treaty framework. More information on the Treaty and its review process can be found at: **engage.gov.bc.ca/columbiarivertreaty**.

Other agreements

The Treaty Entities (BC Hydro, Bonneville Power Administration (BPA), and the U.S. Army Corps of Engineers) periodically negotiate and sign supplemental operating agreements when there is mutual benefit to modify the water releases specified by the Columbia River Treaty.

In September 2013, the Treaty Entities signed a short–term agreement to address some of Canada's concerns about the timing of water releases from Libby Dam (VarQ operating regime). This agreement was extended to be in effect until August 2022 and is supplemental to the Libby Coordination Agreement (signed in 2000). Under this agreement, the U.S. has committed to continued coordination with Canada to consider alternative reservoir operations to reduce flood risk in both countries (similar to the extensive collaboration that occurred during the 2012 high water event). In addition, BC Hydro will be compensated for energy losses at its Kootenay Canal operations that result from the timing of water releases from Libby Dam. The Entities have also agreed to continue working together to reach a long–term agreement.

In late 2020, the Columbia River Treaty Operating Committee signed the 2021 Non–Power Uses Agreement. This annual operating agreement allowed Arrow Lakes Reservoir releases to be reshaped between January and July 2021 to protect Canadian whitefish and rainbow trout in exchange for flow benefits for endangered U.S. salmon.

In July 2021, the Columbia River Treaty Operating Committee signed the Summer Storage Agreement. This short–term agreement allowed Arrow Lakes Reservoir releases to be delayed from July into August 2021, thereby supporting higher Arrow Lakes Reservoir levels through July. Storage under this agreement resulted in about six feet higher water levels on July 31, 2021, and otherwise, no material impact to water levels at the end of August with or without the agreement.

NON–TREATY STORAGE AGREEMENT (NTSA)

The Kinbasket Reservoir, created by the Mica Dam, is licensed by the Province of British Columbia for more storage than was required by the terms of the Columbia River Treaty. This additional water is called Non–Treaty Storage and the water can be released across the Canada–U.S. border only under agreement between BC Hydro and its U.S. partners. The current NTSA was signed by BC Hydro and BPA in 2012 and remains in effect until 2024.

The NTSA gives BC Hydro more control over reservoir levels, provides more energy benefits to B.C., and gives BC Hydro more operating flexibility to balance competing non–power interests on the Columbia system. These interests include recreational activities, wildlife habitat, and fisheries. Since the agreement was signed, BC Hydro and BPA have made good use of NTSA flexibility to reduce high and low–water impacts downstream of Arrow Lakes Reservoir and to improve power and non–power benefits for both countries.

The Columbia River downstream of Castlegar. Photo by Mary Anne Coules.

BC Hydro's Columbia operations

Snowpack and runoff

With the exception of the northern portion of the basin above Mica, snowpack in the Columbia basin this year is largely below average due to prolonged dry conditions for much of the operating year. This resulted in well below normal runoff forecast of 82% for the entire Columbia basin between April and September 2021 and 90% of normal for the Canadian portion of the basin. By comparison, the overall runoff in the Columbia basin in 2020 was 104% of normal.

Glacier–fed watersheds such as Kinbasket, Revelstoke and Duncan saw elevated runoff volumes, making up for the lack of precipitation. Watersheds that are not glacial–fed, such as Arrow and Kootenay, saw lower runoff volumes overall.

Summer heatwave

We experienced an unusual summer heatwave in June and July 2021 where temperatures reached over 40 degrees in parts of the province. BC Hydro recorded our highest ever summer peak hourly demand on June 28, 2021 when demand reached 8,568 MW. This was more than 600 MW over the previous record set on August 18, 2020 – the equivalent of turning on 600,000 portable air conditioners. The primary drivers for the increase in electricity demand were people turning to air conditioning and fans to keep cool, plus refrigeration units that had to work harder in hot temperatures to keep their contents cool.

Our hydroelectric system allows us to ramp up generation so that we can quickly meet the increase in demand, and we had sufficient power to meet this demand. As a winter peaking utility, we actually see the highest demand for power on the coldest, darkest days of the year – not in the summer.

The Columbia River in Castlegar. Photo by Mary Anne Coules.

KINBASKET RESERVOIR

Kinbasket Reservoir is created by the Mica Dam. Kinbasket Reservoir regulates discharges for both the Mica and Revelstoke dams as well as for power plants further downstream.

Kinbasket Reservoir refilled to a maximum level of 754.44 metres (2,475.2 feet) on August 23, 2020 due to above average snowpack and runoff conditions. This is 0.2 feet above the normal maximum operating level of 754.4 metres (2475 feet). The storage of additional water was approved by the Provincial Comptroller of Water Rights and remains within our water licence limits.

Kinbasket Reservoir drafted in the fall and winter as is normal. An early arctic outbreak in October 2020 and another cold snap in February 2021 led to high winter electricity demand and increased generation requirements at Mica. Persistent cool and dry weather from March to mid–April 2021 contributed to significantly more draft from the reservoir to meet energy demand. The minimum water level was 720.82 metres (2,364.9 feet) on April 19, 2021. This water level was about 0.70 metres (2.3 feet) higher than the minimum level in 2020.

From February to August 2021, reservoir inflows were about 109% of average. High inflows were due to above normal snowmelt in the spring and glacial melt in the summer, which made up for the lack of precipitation in the spring and summer months. The reservoir refilled to reach a maximum level of 752.47 metres (2,469.2 feet) on August 22, 2021. This water level was about six feet below the normal maximum operating level of 754.4 metres (2,475 feet). By comparison, the maximum water level in 2021 was about 1.83 metres (six feet) lower than the maximum level in 2020.

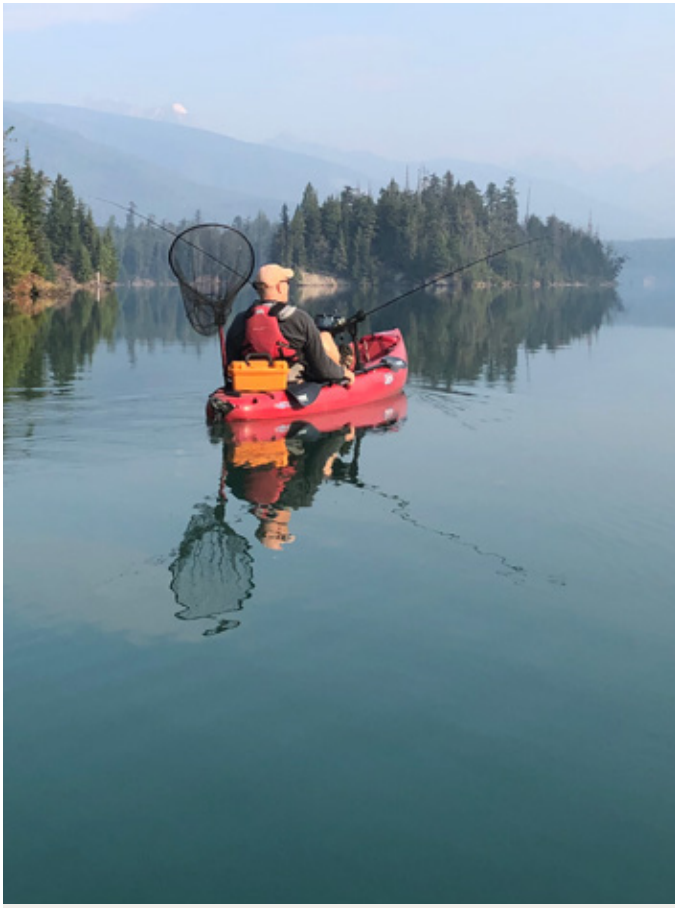
The normal licensed range for Kinbasket Reservoir is between 754.4 metres (2,475 feet) and 706.96 metres (2,319.42 feet) respectively. The reservoir can be operated up to two feet above its normal maximum level, if approved by the Comptroller of Water Rights. Kinbasket Reservoir provides seven million acre feet (MAF) of Treaty storage and five MAF of non–Treaty storage.

REVELSTOKE RESERVOIR

Revelstoke Reservoir is created by Revelstoke Dam. Revelstoke Reservoir water levels may fluctuate in response to weather patterns, inflow levels, and electricity demand. During the spring freshet and winter peak load periods, it is common to have daily fluctuations of the reservoir within 1.5 metres (five feet) of full pool. The reservoir is also periodically lowered to below its normal minimum level of 571.5 metres (1,875 feet) to meet increasing system needs for short–term generating capacity or may fill to near full pool during periods of high reservoir inflows.

During low demand and high inflow periods, water is occasionally released over the Revelstoke Dam spillway to maintain minimum flows or to maintain the reservoir water level. This year, spills were minimal and limited to only three days this operating year.

The licensed range for Revelstoke Reservoir is between 573 metres (1,880 feet) and 554.7 metres (1,820 feet). Most of the time, Revelstoke Reservoir is maintained at or above 571.5 metres (1,875 feet).



Fishing on Revelstoke Reservoir. Photo by Jen Walker–Larsen.

ARROW LAKES RESERVOIR

Arrow Lakes Reservoir is created by the Hugh L. Keenleyside Dam. Arrow releases are regulated under the Columbia River Treaty and its supplemental operating agreements. For operations to be consistent with the principles of the Treaty, under wet conditions it is necessary to store excess water so that surplus energy is not generated by downstream U.S. Columbia River projects. Conversely, under dry conditions, storage must be drafted as far as necessary to meet Treaty firm loads consistent with the principles of proportional draft.

Last year, wet conditions were prevalent across the entire Columbia basin and the observed February to September 2020 inflows into Arrow Lakes Reservoir were 107% of average. Arrow Lakes Reservoir reached a peak level of 439.7 metres (1,442.6 feet), 0.43 metres (1.4 feet) below normal full pool on July 2, 2020. The reservoir drafted in the summer to meet the provisional draft provisions of the Columbia River Treaty. As the draft began from near–full storage, Arrow Lakes Reservoir summer levels were within recreation range through Labour Day.

As inflows improved in the fall, the system came off proportional draft and Arrow Lakes Reservoir followed a typical draft across the winter to reach a minimum level of 426.5 metres (1,399.2 feet) on February 25, 2021. This is 1.71 metres (5.6 feet) lower than last year's minimum level of 428.2 metres (1,404.8 feet) reached on March 3, 2020.

From February to August 2021, reservoir inflows were only about 90% of average; exceptionally dry months were March, July and August. Arrow Lakes Reservoir refilled to a maximum level of 439.46 metres (1,441.8 feet) on July 2, 2021. This is about 0.67 metres (2.2 feet) below full pool and 0.24 metres (0.8 feet) below the 2020 maximum level.

The coordinated system began operating in proportional draft as early as July 2021 due to exceptionally dry conditions estimated in its lowest 15th percentile for the April to August runoff in the Columbia basin at The Dalles. This resulted in more water releases from Arrow Lakes Reservoir in the summer months.

The normal licensed range for Arrow Lakes Reservoir is between 440.1 metres (1,444 feet) and 49.9 metres (1,377.9 feet). The reservoir can be operated up to two feet above its normal maximum level (to 440.7 metres or 1,446 feet) if approved by the Comptroller of Water Rights. Arrow Lakes Reservoir provides 7.1 MAF of Treaty storage.

In the effort to support higher Arrow Lakes Reservoir levels in July, BC Hydro entered into an Arrow Summer Shaping Agreement with the U.S. to delay Arrow releases from July into August. This agreement resulted in about six feet higher Arrow Lakes Reservoir levels at the end of July; otherwise there was no material impact to water levels at the end of August.

Arrow Lakes Reservoir drafted relatively quickly in August as the additional water stored in July under this agreement was released. Arrow Lakes Reservoir reached 432.58 metres (1419.2 feet) on September 6, 2021 (Labour Day). Although this level is about 3.4 metres (11 feet) below average, it is well within historical ranges and were higher than levels experienced in recent dry runoff conditions in 2015 and 2016.

Arrow Lakes Reservoir. Photo by Jen Walker-Larsen.

DUNCAN RESERVOIR

Duncan Reservoir is impounded by Duncan Dam. Duncan Dam's operations help meet Treaty flood control requirements, help minimize flood risk on Kootenay Lake, and provide minimum fish flows year–round as required by the Water Use Plan.

Duncan Reservoir reached a maximum level on August 2, 2020 of 576.56 metres (1,891.6 feet). This water level was 0.12 metres (0.4 feet) below full pool. The reservoir then drafted to about 575.46 metres (1,888 feet) by Labour Day.

From September through late December 2020, Duncan Reservoir was operated to provide the flows necessary for kokanee and whitefish spawning downstream of the dam. Discharges were later increased to facilitate drafting the reservoir for Treaty flood control requirements during the winter period.

For flood risk management downstream of the Duncan Dam at Meadow Creek and on Kootenay Lake, Duncan Reservoir is normally drafted to its licenced minimum level of 546.9 metres (1,794.2 feet) each year by April or before the start of the freshet. In 2021, Duncan Reservoir reached a minimum level of 547.02 metres (1,794.7 feet) on April 29, 2021. The reservoir discharge was reduced to a minimum of three cubic metres per second (m^3/s) or 100 cubic feet per second (cfs) on May 18, 2021 to begin reservoir refill and manage the water level of Kootenay Lake.

From February to August 2021, reservoir inflows were about 104% of average. Duncan Reservoir refilled to a maximum of 576.62 metres (1,891.8 feet) on August 2, 2021. This water level is about 0.06 metres (0.2 feet) below full pool.

The normal operating range for Duncan Reservoir is between 576.7 metres (1,892 feet) and 546.9 metres (1,794.2 feet). The reservoir can be operated up to 1.2 feet above its normal maximum level (577 metres or 1,893.2 feet) if approved by the Comptroller of Water Rights. Duncan Reservoir provides 1.4 MAF of Treaty storage.

The Hugh L. Keenleyside Dam. Photo by Mary Anne Coules.

COLUMBIA RIVER FLOWS

Columbia River flows downstream of the Kootenay River confluence at Castlegar are the result of flow regulation at Hugh L. Keenleyside and other dams on the mainstem Columbia, as well as dams on the Kootenay River system. Actual discharges depend on many factors, including upstream runoff and storage operations and Treaty discharge requirements.

In 2021, as the runoff was lower than normal, there were no flood concerns on the Columbia River downstream of Keenleyside Dam. Columbia River flows are measured at the Birchbank flow measuring station downstream of the Kootenay River confluence between Castlegar and Trail. Columbia River flows peaked at about 3,228 m^3/s or 114,000 cfs on July 11, 2021. This flow was well below the peak regulated flow experienced in 2012 of 6,090 m^3/s (215,000 cfs), and the peak pre–dam flow of 10,590 m^3/s (374,000 cfs) in 1961.

BC Hydro's water licence has no minimum discharge requirements for the Columbia River downstream of Keenleyside Dam. Under the Columbia River Treaty, however, we are obliged to reduce flows to a minimum weekly average flow of 5,000 cfs under certain water conditions.

KOOCANUSA RESERVOIR

Koocanusa Reservoir on the Kootenay River is controlled by Libby Dam in Libby, Montana and operated by the U.S. Army Corps of Engineers. The reservoir backs into Canada and provides approximately five million acre feet MAF of storage.

Koocanusa Reservoir is typically drafted during the winter for Treaty flood risk management. The reservoir reached a minimum level of 732.7 metres (2,401.0 feet) on April 5, 2021, similar to last year's minimum level of 732.7 metres (2,403.9 feet) on March 30, 2020.

From February to August 2021, reservoir inflows were about 81% of average. Koocanusa Reservoir refilled to reach a maximum level of 747.95 metres (2,453.9 feet) on July 24, 2021. This water level is about 1.55 metres (5.1 feet) below full pool. Libby Dam continues to be operated under VarQ procedures for U.S. fisheries interests and flood control. The latest Libby Operating Plan provides for:

- Flows as needed during March to April to meet the April 30 flood control target;
- Minimum flows in May and June necessary to meet the flow rates and sturgeon volume objectives in the U.S. Fish & Wildlife Service Biological Opinion (BiOp) for sturgeon spawning and recruitment;
- Minimum bull trout flows as outlined in the BiOp; and,
- Augmented downstream flows for salmon after the sturgeon flow operation is completed.

Information regarding the operation of Libby Dam and Koocanusa Reservoir water levels is available from the U.S. Army Corps of Engineers online at **nws.usace.army.mil** or by calling **406 293 3421.**

The normal operating range for Koocanusa Reservoir is between 749.5 metres (2,459 feet) and 697.1 metres (2,287 feet). During periods of high downstream flood risk, the Treaty Entities may coordinate additional storage in Koocanusa Reservoir.

Koocanusa Reservoir. Photo by Sally MacDonald.

KOOTENAY LAKE

For information regarding Kootenay Lake, please contact FortisBC.

Website: **fortisBC.com**

Phone: **1 866 436 7847**

Want to stay informed of BC Hydro operations?

REGIONAL OPERATIONS UPDATE MEETINGS

BC Hydro hosts annual Operations Update meetings every spring for Columbia basin communities.

These meetings are held to:

- Listen to and learn from local residents, stakeholders, First Nations and community representatives who have an interest in the operation of the Columbia River Treaty facilities and BC Hydro facilities in the Southern Interior.
- Provide information on the operations of Columbia River Treaty facilities in Canada and other facilities that are operated in a coordinated manner on the Columbia system.
- Provide an update on BC Hydro activities.

OPERATIONS UPDATE CONFERENCE CALLS

BC Hydro periodically hosts conference calls to provide updates on our Columbia and Kootenay system operations. If you would like to receive email notifications regarding these meetings and conference calls, please contact us at **southern-interior.info@bchydro.com**.

Skunk cabbage. Photo by Jen Walker-Larsen.

BC HYDRO'S RESERVOIR LEVEL UPDATES

BC Hydro provides reservoir water level forecasts by email each week. To receive these updates, please contact **southern-interior.info@bchydro.com**.

Near real time water level information for various locations around our reservoirs is available online at: **bchydro.com/energy-in-bc/operations/transmissionreservoir-data/previous-reservoir-elevations/columbia.html**.

BC Hydro's toll-free reservoir information line **1 877 924 2444** also provides up-to-date reservoir elevation and river flow information. The recording is updated every Monday, Wednesday and Friday and includes:

- **Current Elevation Levels:** Arrow Lakes Reservoir, Duncan Dam Reservoir, Kinbasket Reservoir, Koocanusa Reservoir, Kootenay Lake, Revelstoke Reservoir, Sugar Lake Reservoir and Whatshan Lake Reservoir.
- **Current Flows:** Columbia River at Birchbank, Duncan River at the Lardeau Confluence, Shuswap River and the flow downstream from Wilsey Dam at Shuswap Falls.

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