



Revelstoke Flats. Photo by Jen Walker-Larsen.

Columbia River Operations Summary

Spring 2022

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 to generate 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 11 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.



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 B.C. (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 Kootenay Reservoir, which crosses the Canada–U.S. border.

Water stored and then released by the Canadian reservoirs provides the U.S. with the potential to generate additional electricity, as well as to increase flood protection. 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 and is currently about 3,980 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 the Treaty, provided that either country provides ten years' notice of its intent to terminate. After extensive consultation with basin residents, the Province decided in March 2014 to continue with the Columbia River Treaty and 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 an agreement, reviewed annually, to address some of Canada's concerns about the timing of water releases from Libby Dam, known as the VarQ operating regime. This agreement was extended to be in effect until August 2021 and is supplemental to the Libby Coordination Agreement that was signed in 2000. Under the new 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, 2017, and 2018 high water events. In addition, BC Hydro is compensated for energy

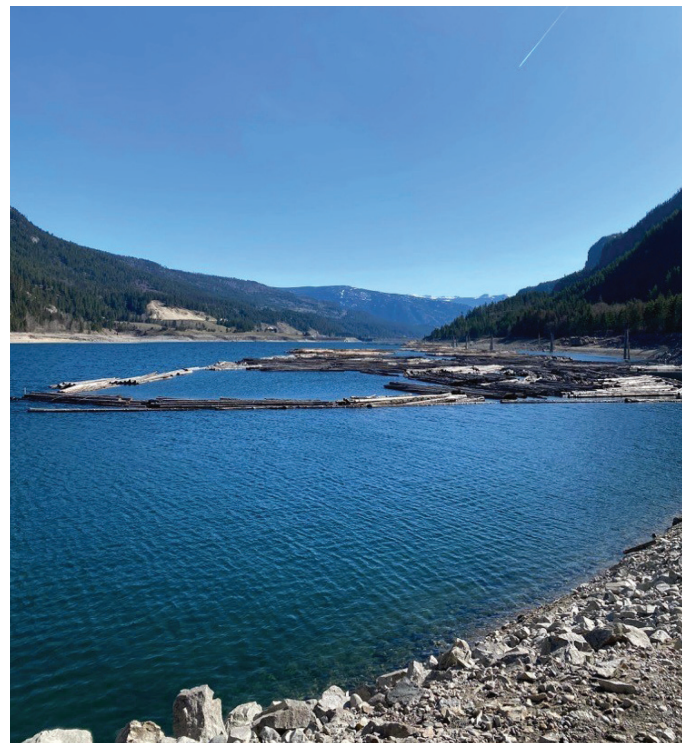
losses at its Kootenay Canal operations that result from the timing of water releases from Libby Dam.

In December 2021, the joint Canada–United States Treaty Operating Committee signed the 2022 Non–Power Uses Agreement. This annual operating agreement modifies Arrow Lakes Reservoir releases between January and July 2022 to protect Canadian whitefish in exchange for flow benefits for endangered U.S. salmon.

NON-TREATY STORAGE AGREEMENT (NTSA)

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

The new 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 the impacts of high and low water levels downstream of Arrow Lakes Reservoir and to improve power and non–power benefits for both countries.



Arrow Lakes Reservoir. Photo by Sue Heaton–Sherstobitoff.

BC Hydro's Columbia operations

Much of the region's summer and winter generating potential depends on precipitation and snowpack levels. Due to much above normal snowpack and precipitation since the fall of 2021, predominantly in the Upper Columbia basin, the runoff for the Columbia basin between April and September 2022 is currently forecast to be between 101 and 116% of normal but below normal at 96% at The Dalles due to drier conditions in the Lower Columbia. By comparison in 2021, the actual runoff at The Dalles was 82% of normal.

KINBASKET RESERVOIR

Kinbasket Reservoir regulates discharges from both the Mica and Revelstoke Generating Stations, as well as for generating stations further downstream. Kinbasket Reservoir refilled fully in 2020 due to above average snowpack and runoff conditions. It reached a peak water level of 752.61 metres (2,469.2 feet) on August 22, 2021. This water level was about 5.8 feet below the normal maximum operating level of 754.4 metres (2,475 feet).

Kinbasket Reservoir is typically drafted across the fall and winter period to meet loads and system requirements. A prolonged arctic outbreak from mid-December through the first week of January and another cold snap in February led to increased generation from Mica. Otherwise, electricity demand was relatively light in the fall. The minimum level for Kinbasket Reservoir this year is forecast to be 717.8 metres (2,355 feet) by the end of April, 26 feet below average.

Under the *Water Sustainability Act* and the *Utilities Commission Act*, the Comptroller of Water Rights is responsible for the regulation of BC Hydro's water licenses. The licensed operating range for Kinbasket Reservoir is between 706.96 metres (2,319.42 feet) and 754.4 metres (2,475 feet). Kinbasket Reservoir can be operated at up to two feet above its normal maximum water level, if approved by the Comptroller of Water Rights. Kinbasket Reservoir provides 7 million acre feet (MAF) of Treaty Storage and 5 MAF of Non-Treaty Storage, for a total storage of 12 MAF.

Due to several atmospheric river events resulting in unprecedented precipitation in the fall and winter, snowpack in the Columbia basin is currently at or near record high accumulations for this time of year. High snowpack is expected to result in high inflows for the February to September 2022 Water Supply Forecast, currently forecast to be 116% of average. Although the reservoir is forecast to be lower than average levels in April, the reservoir is expected to refill to within 3.0 metres (10 feet) of normal full pool level this summer due to the high inflow forecast. Depending on the rate of snowmelt and rainfall amounts during freshet, we may store additional water in Kinbasket Reservoir and raise the water level up to 0.3 metres (1 foot) above its normal full pool level.



Kinbasket Reservoir. Photo by Guy Martel.

REVELSTOKE RESERVOIR

Revelstoke Reservoir was created by Revelstoke Dam. Revelstoke Reservoir levels may fluctuate in response to weather patterns, inflow levels and generation requirements. During the spring freshet and winter peak electricity load periods, it is common to have daily fluctuations of the reservoir within 1.5 metres (5 feet) of full pool.

The reservoir may be periodically lowered below its normal minimum level of 571.5 metres (1,875 feet) to meet system needs for short-term generating capacity or energy, maintenance requirements, or may fill to near full pool during periods of high reservoir inflows.

The licensed operating range for Revelstoke Reservoir is between 554.7 metres (1,820 feet) and 573 metres (1,880 feet). At most times, the reservoir is maintained at or above 571.5 metres (1,875 feet).



Revelstoke Flats. Photo by Jen Walker-Larsen.



Seven Mile Dam and Generating Station. Photo by Martin Gedig.

ARROW LAKES RESERVOIR

Arrow Lakes Reservoir was created by the Hugh L. Keenleyside Dam. Arrow discharges are regulated under the Columbia River Treaty and its supplemental operating agreements.

The observed February to September 2021 inflows into Arrow Lakes Reservoir was only 89% of average. Arrow Lakes Reservoir refilled to reach a peak level of 439.7 metres (1,441.8 feet), 0.67 metres (2.2 feet) below normal full pool on July 2, 2021 but drafted relatively quickly after to meet the provisional draft provisions of the Columbia River Treaty due to unprecedented heatwave in late June through July and consecutive months of near record low precipitation basin wide.

Under dry conditions, the coordinated system operated in proportional draft in the summer and fall resulting in more water releases from Arrow Lakes Reservoir. Conversely, under wet conditions, less water releases are required. As inflows improved in October 2021, the system came off proportional draft and Arrow Lakes Reservoir followed a typical draft across the winter. Arrow reservoir reached its minimum level of 426.42 metres (1,399.0 feet) on March 12, 2022, similar to last year's minimum level of 426.5 metres (1,399.2 feet) that was reached on February 25, 2021.

Snowpack in the Arrow Lakes Reservoir basin is currently well above average. The current inflow forecast into Arrow Lakes Reservoir for the period from February to September 2022 is at 113% of average, well above the 2021 observed runoff at 89% of average. Based on this forecast, the reservoir is currently expected to refill to near full pool in early July 2022.

The normal licensed operating range for Arrow Lakes Reservoir is between 419.9 metres (1,377.9 feet) and 440.1 metres (1,444 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.



Arrow Lakes Reservoir. Photo by Sue Heaton–Sherstobitoff.

DUNCAN RESERVOIR

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

In 2021, the Duncan Reservoir refilled very close to its normal full pool level, reaching a maximum level of 576.6 metres (1,891.8 feet) on August 2, 2021. This water level was 0.06 metres (0.2 feet) below full pool. The reservoir then drafted to about 575.46 metres (1,888 feet) by August 31, 2021 and stayed near this level until Labour Day.

From September through late December 2021, 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.

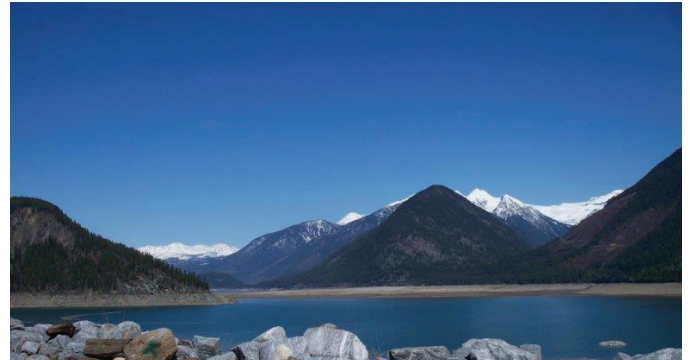
For flood risk management downstream of the Duncan Dam at Meadow Creek and on Kootenay Lake, Duncan Reservoir is normally drafted to its licensed minimum level of 546.9 metres (1,794.2 feet) each year by April or before the start of the freshet.

Snowpack in the Duncan basin is currently well above average. The inflows into Duncan Reservoir for the period from February to September 2022 are forecast to be 113% of average, well above the 2021 observed runoff at 104% of average. Based on the current inflow forecast, Duncan Reservoir is expected to fill to full pool by late July 2022.



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

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



Duncan Reservoir. 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, storage operations, and Treaty discharge requirements.

In 2021, there were no flood concerns on the Columbia River downstream of Hugh L. Keenleyside Dam. Columbia River flows are measured at the Birchbank flow measuring station downstream of the Kootenay River confluence between Castlegar and Trail. River flows peaked at about 3,230 cubic metres per second (m³/s) or 114,000 cubic feet per second (cfs) on July 11, 2021. This flow was well below the peak regulated flow experienced in 2012 of 6,090 m³/s (215,000 cfs), and the peak pre-dam flow of 10,590 m³/s (374,000 cfs) in 1961.

The 2022 inflows into the reservoirs and peak Columbia River flows at Birchbank are forecast to be above average in June/July, but below flood concerns although actual flows will depend on the timing and volume of runoff. During periods of high downstream flood risk, BC Hydro may store one to two feet of additional water at the upstream storage projects to reduce peak flows for flood management.

KOOCANUSA RESERVOIR

Koocanusa Reservoir on the Kootenay River is controlled by Libby Dam in Libby, Montana and is operated by the U.S. Army Corps of Engineers. The reservoir backs into Canada and provides approximately 5 MAF of storage.

Koocanusa Reservoir reached a maximum level of 747.9 metres (2,453.9 feet), which is 1.55 metres (5.1 feet) below its full pool of 749.5 metres (2,459 feet), on July 24, 2021. Koocanusa Reservoir continues to be operated under VarQ procedures for U.S. fisheries' interests and flood control.

The inflows into Koocanusa Reservoir from April to August 2022 are currently forecast to be 115% of average based on the USACE April official runoff forecast, compared to 80% of average runoff in 2020. Koocanusa Reservoir is typically drafted during the winter for Treaty flood risk management. Due to well above normal snowpack and forecast runoff this year, more draft is required for flood risk management. The reservoir reached a minimum level of 720.41 metres (2,363.6 feet) on February 28, 2022, about 11.4 metres (37 feet) below last year's minimum level of 731.8 metres (2,401.0 feet) on April 5, 2021. Provision of sturgeon flows will be required this spring and will depend on the May inflow forecast.

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

The normal operating range for Koocanusa Reservoir is between 697.1 metres (2,287 feet) and 749.5 metres (2,459 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

Every year we host meetings and open houses throughout the Columbia and Kootenay regions to:

- Listen to and learn from local residents, stakeholders, Indigenous 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.

This year, we will be hosting our annual Operations Update meetings in May and June by conference call or virtually due to the COVID-19 pandemic:

East Kootenay Operations Update Meeting

Wednesday, May 11
12:00 p.m. to 1:30 p.m. Mountain Time

Columbia Operations Update Meeting

Tuesday, June 14
6:30 p.m. to 8:00 p.m. Pacific Time

Duncan Operations Update Meeting

Tuesday, June 21
6:30 p.m. to 8:00 p.m. Pacific Time

To register, please contact Dave Cooper at david.cooper@bchydro.com.



Koocanusa Reservoir. Photo by Sally MacDonald.

Water levels for our reservoirs can be found on our website that provides near real-time data: [bchydro.com/energy-in-bc/operations/transmissionreservoir-data/previous-reservoir-elevations.html](https://www.bchydro.com/energy-in-bc/operations/transmissionreservoir-data/previous-reservoir-elevations.html).

BC Hydro's toll-free reservoir information line:
1 877 924 2444

- BC Hydro's toll-free reservoir information line provides up-to-date reservoir water level and river flow information. The recording is updated every Monday, Wednesday and Friday and provides:
- Current water levels: Arrow Lakes Reservoir, Duncan Dam Reservoir, Kinbasket Reservoir, Koocanusa Reservoir, Kootenay Lake, Revelstoke Reservoir, Sugar Lake Reservoir and Whatshan Lake Reservoir.
- Current river flows: Columbia River at Birchbank, Duncan River at the Lardeau Confluence, Shuswap River and the flow downstream from Wilsey Dam at Shuswap Falls.

Questions? Please contact:

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