Appendix C

Kootenay System Operations

Operation of the Kootenay River system is complicated as it is administered by several different jurisdictions and the hydroelectric facilities are owned by different agencies/companies.

As shown in Figure 1, the Kootenay River originates in the Rocky Mountains not far from Field, BC. The river flows south, within a few km of the source of the Columbia River at Canal Flats, and then continues south into Koocanusa Reservoir, formed behind Libby Dam in Montana, United States. From Libby, the Kootenay River turns west and north, and re-enters British Columbia near the community of Creston, flowing into the south arm of Kootenay Lake. In the northern part of the Kootenay basin, the Duncan River is joined by the Lardeau River just downstream from Duncan Dam, and then flows into the north arm of Kootenay Lake. Water from the north and south arms of Kootenay Lake then flows through the west arm of the lake and past the Corra Linn Dam near Nelson (as well as other dams) en route to the Columbia–Kootenay confluence at Castlegar.

The components of this system and various agreements/orders that regulate flows are described in this Appendix.

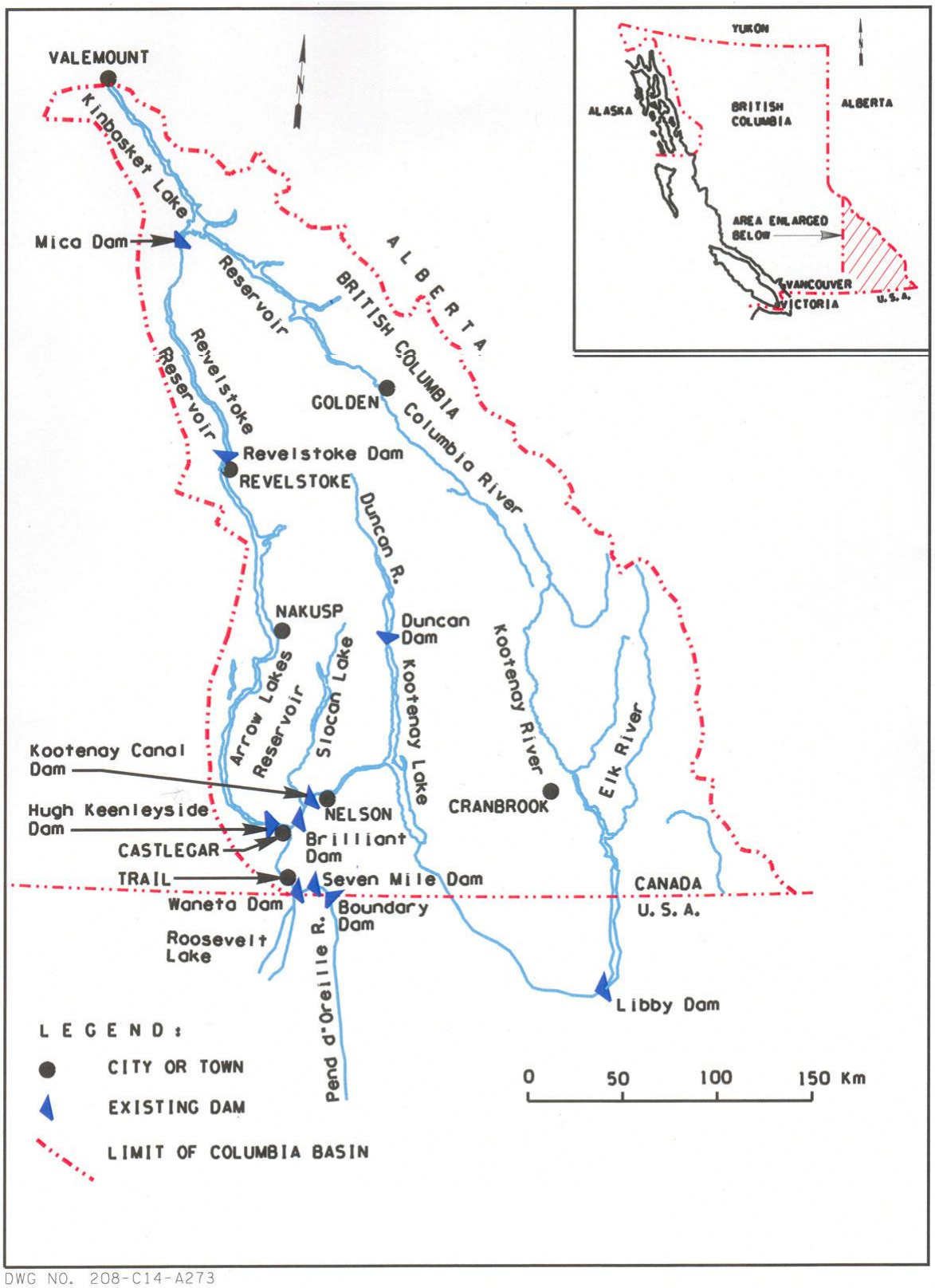

Figure 1: Kootenay and Columbia Region

1.0 Coordination of Libby Operations

Background

Under the terms of the Columbia River Treaty, Canada permitted the U.S. to build the Libby Dam on the Kootenai River (U.S. spelling) in Montana. The dam was completed in 1973 and the reservoir, flooding approximately 70 kilometres into Canada, filled for the first time in 1974. The reservoir was named Koocanusa for Kootenay, Canada and the U.S.A. Under the Treaty, the US must coordinate Libby's operation with Canada. This obligation continues whether the Treaty continues or is terminated. Operations of Libby Dam until the early 1990's were managed to optimize power generation and flood control in the two countries.

In the early 1990's, the U.S. Army Corps of Engineers (owner of the dam), responding to U.S. regulatory agency concerns, began to operate Libby in a manner designed to benefit downstream sturgeon spawning in the Kootenay River and salmon in the lower Columbia. Less water was released from Libby during the fall and winter and more water released during the spring and summer. This operation resulted in power losses, including additional spill and reduced seasonal value, at downstream Canadian hydropower plants on the Kootenay River system. The Canadian Entity objected to this unilateral operating change. The dispute was set aside with the signing of the Libby Coordination Agreement.

Libby Coordination Agreement

The Libby Coordination Agreement was signed on February 16, 2000 as an entity agreement under the Columbia River Treaty between the Canadian Entity (BC Hydro) and the U.S. Entity (Bonneville Power Administration and U.S. Army Corps of Engineers). The Libby Coordination Agreement allows the U.S. Entity to operate Libby dam to meet U.S. fisheries laws and provides options for Canada to self-compensate for the resulting loss of power production.

Canada has the option to release water from the Arrow Lakes Reservoir ("Arrow Provisional Draft") and receive the resulting power generated at U.S. federal plants during periods of high power value. Canada then re-stores the water and returns the power to the U.S. during times of lower power value, with the value difference being the net compensation to Canada. Under the Libby Coordination Agreement, Canada also obtains some non-power benefits, including more favourable Treaty requirements on Arrow discharges during January, which helps to protect mountain whitefish spawning, and an option to exercise an Arrow-Libby "storage swap" when beneficial to Canada. Such a "storage swap" has been used in several years to improve recreational conditions for the communities on Koocanusa Reservoir.

Variable Flow (VARQ)

Until 2002, Libby dam operations continued to observe the "Standard Flood Control" regime that had been in place since dam operations began. However, in response to the 2000 Biological Opinion, under the U.S. Endangered Species Act, Libby began operating to an interim alternative flood control procedure known as "Variable Flow" or "VARQ". In most water years, the Libby dam discharges less water during the fall-winter period under the VARQ regime (compared to the Standard regime) and more water during the spring/summer to benefit downstream fish. As a result, Libby operations under the VARQ flood control regime have resulted in further power losses in Canada and slightly higher frequencies of peak water levels on Kootenay Lake and on the Columbia River downstream of Castlegar.

In June 2008, the U.S. Entity permanently adopted the VARQ flood control regime for Libby which, while still providing significant energy benefits and flood protection for Canada, does so at a reduced

level compared to the terms expected by Canada when it ratified the Columbia River Treaty. The Canadian Entity notified the U.S. that compensation would be required for the reduced levels. The Columbia River Treaty Operating Committee has made some good progress on this issue, but has not yet reached final agreement.

Current Operations

Libby has 5 million acre-feet (MAF) of active storage, which translates into a 172 ft draft if the reservoir is emptied. Across the fall, the reservoir is drafted 2 MAF (48 ft) by Dec 31. Typically, to optimize power operations, the Libby discharge is at the minimum 4 kcfs from 1 Oct to mid-Nov and then fairly high discharges (weekly load-factored) from mid-Nov through late December. Then in January, the reservoir continues drafting to stay on the flood control curve in average or high snow pack years. In low snow pack years the flood control curve rises such that, even with the Libby discharge set to minimum, the reservoir cannot fill to reach its Flood Control level until April or later.

Figure 2 provides both the Standard Flood Control curves and the VarQ curves. The VarQ curves are generally higher than standard flood control curves, except under very high runoff conditions, and result in higher Koocanusa levels between January and July.

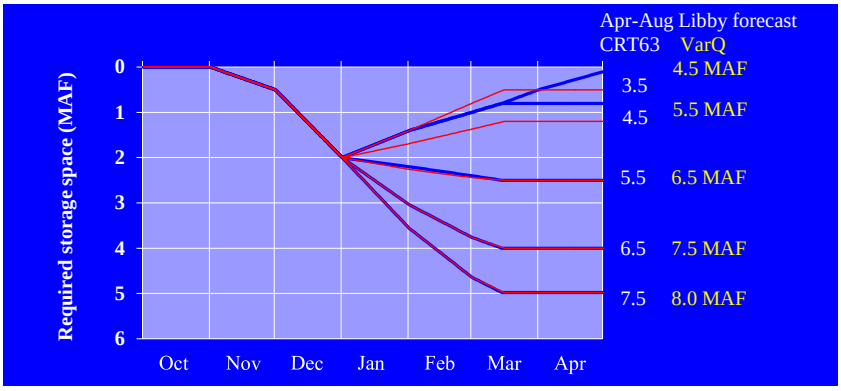

Figure 2: Libby Standard and VarQ Flood Control Curves

May through July is the reservoir refill period. The reservoir level rate-of-rise depends on the shape of the freshet and how quickly the snowpack melts. During this period, the extra water stored in the reservoir for fisheries needs is released for sturgeon and bull trout spawning in the Kootenay River between Libby and Kootenay Lake. The volume released for fish changes with runoff volume, and in low water years (when the Libby runoff forecast is less than 4.8 MAF) there is no specified flow release for sturgeon. During refilling of the reservoir, the U.S. Army Corps of Engineers aims to maintain sufficient flood control space for the forecast runoff to come. At times daily changes are made to Libby's discharge to control the refill. Typically, the U.S. Army Corps of Engineers aims to have the reservoir about 10 to 15 ft below full-pool on Jun 30. The reservoir then typically peaks within the top 5 to 10 ft in mid July. In low water years the reservoir won't reach this range.

During August and September, the Libby operation is designed to continue protecting bull trout in the Kootenay River and to assist downstream salmon migration in the lower Columbia River in the

US. In the top 80% of runoff years, the reservoir level target is 10 ft from full on Sept 30[1]. In the lowest 20% of runoff years, the reservoir level target is 20 ft from full on Sept 30. This operation is a change from what occurred from the 1990's through 2007, when the reservoir was drafted to 20 ft from full by 31 August in all water years.

The above seasonal description of Libby operations demonstrates how the US operation of Libby is highly constrained by US fish operations under the Biological Opinion that are required by US domestic law. Essentially the reservoir is operated as high as possible (limited by the VARQ flood control curve) during the period between late December and April to provide maximum water for sturgeon, bull trout, and salmon.

Duncan Operations

As a Columbia River Treaty Dam, the 1.4 MAF of storage at Duncan is operated to meet Treaty requirements; however, Canadian flex under the Treaty is utilized to adjust the operation of Duncan for maximum Canadian benefits. Discharges from Duncan may diverge from Treaty Storage Regulation, provided discharges from Arrow are adjusted to make up the difference. Duncan dam does not have power generation at the facility, but the storage operation provides power benefits for the Canadian dams downstream on the Kootenay River as well as flood control benefits for Kootenay Lake, Kootenay River, and the Columbia River from the Kootenay confluence downstream.

BC Hydro owns Duncan Dam and the water license to store and divert water. As part of license requirements, BC Hydro undertook the Duncan water use planning process from 2000 to 2004, involving government agencies, First Nations, local residents and other interest groups. The goal was to find a better balance between competing uses of water, such as domestic water supply, fish and wildlife, recreation, heritage and electrical power generation. The process developed recommendations on how incremental changes to operations at Duncan might have positive impacts on a variety of different interests. In some circumstances benefits were achieved through physical works in lieu of changes to operations. Recommendations also included monitoring programs and information gathering for future decision making.

In December 2007, the provincial Comptroller of Water Rights approved the Duncan Water Use Plan, which included $13 million for monitoring studies and physical works, and issued BC Hydro with the Implementation Order. Review of the Duncan Water Use Plan is scheduled for 2018.

Operating conditions agreed to in the Duncan Water Use Plan include:

- Reach full pool (576.4 m and 576.7 m), if water conditions permit, between 1 and 10 August. After full pool is reached or after 10 August, decrease reservoir elevation to 575.5 m and maintain within 0.3 m of this level until 5 September. The reservoir elevation targets do not take priority over maintaining minimum flows in the Lower Duncan River;
- Year round minimum discharge of 2.6 kfs (73 m^3/s)
- Normal maximum year-round discharge of 10 kcfs (283 m^3/s) (maximum discharge through the low level outlets)
- Maximum flow targets in the Duncan River downstream of the Lardeau River confluence that vary throughout the year ranging from a low of 73 m^3/s in October to 400 m^3/s from 16 May – 31 July.

[1] For the period 2011-2013, the US is constructing side-channel sturgeon habitat at Bonners Ferry, so are targeting 10 ft below full on 31 Aug and then releasing minimum flow during Sept to aid the construction work.

In order to reserve sufficient water to meet the minimum flow requirements in the Lower Duncan River during March to May before the freshet starts, BC Hydro requested and obtained a permanent variance to the February end of month Duncan Treaty flood control level, raising it by 2.45 m. The US Army Corp of Engineers issued the permanent variance on March 8, 2010.

The Water Use Plan and BC Hydro's water licence provide the overall conditions for operating Duncan dam. The Duncan water use planning process was not constrained by the Treaty operations as discharges from Arrow were adjusted to make up the difference at the US border and these minor impacts on Arrow reservoir were accounted for in the Duncan WUP.

Kootenay Lake operation under the International Joint Commission

Water levels in Kootenay Lake are regulated by the International Joint Commission (IJC) under the "Kootenay Lake Order." The IJC is a bi-national organization established by the Boundary Waters Treaty of 1909. After reviewing representations from Canada and the U.S., the order governing storage in Kootenay Lake was issued in 1938 to West Kootenay Power and Light Company to operate Corra Linn dam, which regulates the lake levels. The IJC formed the Kootenay Lake Board of Control to monitor adherence to the order and resolve any problems relating to the order.

This Order is now held and administrated by FortisBC, the current owner of Corra Linn Dam. FortisBC also holds the water licence for one-half of Kootenay Lake storage. The other half is held by Brilliant Power Corporation (a Columbia Power Corporation/Columbia Basin Trust joint venture that owns the Brilliant Dam).

Kootenay Lake Operations

The 1938 order specifies upper operating limits for the elevations of Kootenay Lake throughout the year. It stipulates an orderly drawdown of Kootenay Lake in preparation for the spring runoff such that the elevation does not exceed 1739.32 feet[2] on or about April first. During the high spring/summer flows, the allowable lake elevation is calculated using a lowering formula from the natural lake elevation that would have occurred under original outlet conditions existing before the excavation of Grohman Narrows. Groman Narrows is a hydraulic constriction that limits discharge from the lake. In spring and throughout the summer the Corra Linn forbay is lowered to maximize the discharge from the lake.

At the end of the summer, for agricultural interests, the 1938 Order also specifies that once the lake elevation falls below 1743.32 feet, as measured at the Nelson gauge, it should be held below this elevation until August 31. Between September 1 and January 7, the maximum elevation is 1745.32 feet.

The Columbia River Treaty requires that the operation of Libby be consistent with the Kootenay Lake Order. Prior to 2007, it was normal practice for the Treaty entities to reduce discharges from Duncan and/or Libby in March-April if needed to allow Kootenay Lake to draft below its IJC Order level of 1739.32 ft. However, in some years, this practice "trapped water" in the upstream reservoirs which then reduced their ability to provide flood risk management for Kootenay Lake during the spring freshet. The current agreed operation allows BC Hydro and the US Army Corp of Engineers to draft the upstream reservoirs as needed for flood control and other purposes and this operation has been shown to reduce flood peaks for Kootenay Lake. The IJC and Kootenay Lake Board of Control have

[2] as measured by the lake elevation gauge at Queens Bay

confirmed that the IJC Order for Kootenay Lake governs only the operation of Corra Linn dam and does not constrain the operation of the upstream Libby and Duncan dams.

Kootenay Canal Power Plant, River Plants and the Canal Plant Agreement

The regulation of flows on the Kootenay River provided by Duncan and Libby made additional generation on the Kootenay River economic. BC Hydro built the Kootenay Canal project in parallel with the existing Corra Linn, Upper Bonnington, Lower Bonnington and South Slocan hydroelectric projects. New generation at the Kootenay Canal project came online in 1975/76.

This more efficient BC Hydro owned project was coordinated with the existing projects under the terms of the Canal Plant Agreement - a "one-operator" co-ordination agreement. Under the terms of this agreement, BC Hydro directs the operation of all the projects[3] and retains the actual generation of all the projects. In return the Entitlement Parties (Cominco, FortisBC and CPC/CBT) receive a specified amount of electricity (capacity and energy) referred to as the Canal Plant Agreement entitlement.

While BC Hydro is responsible for planning the overall operations of the Canadian Dams in the Kootenay system, the plant owners are responsible to ensure the operation of their plants is consistent with their water license and other obligations. FortisBC is responsible for compliance with the Kootenay Lake IJC order, coordinating the maintenance of Entitlement Parties dams and generating facilities, and passage of flood flows down the Kootenay River.

Operating of the Kootenay Canal Project and the river plants is relatively straightforward. Water exiting Kootenay Lake Reservoir is preferentially diverted to the Kootenay Canal plant instead of the less efficient river plants. At all times a minimum flow of 5000 cfs is maintained in the Kootenay River and through the river plants. For much of the year, the Kootenay Canal plant is used as a peaking plant to meet high loads in the morning and evening. During the spring, there is always a surplus of water beyond the generating capability that is spilled at the river plants.

Brilliant Dam

The Brilliant Dam is located downstream of Kootenay Canal and the river plants, and just upstream of the Kootenay-Columbia confluence at Castlegar. The facility is owned by a joint venture between Columbia Power Corporation and Columbia Basin Trust, who also completed the Brilliant Expansion project in 2007. The Brilliant Dam has a small head pond that is used for daily shaping of the generation.

[3] The Canal Plant Agreement covers all the hydroelectric facilities owned by Cominco, FortisBC and Columbia Power Corporation/Columbia Basin Trust on the Kootenay River and Waneta on the Pend d'Oreille River