Shuswap River Water Use Plan

Environmental Synthesis Report

- **SHUMON-1 Sugar Lake Inflow Monitoring**
- **SHUMON-2 Sugar Lake Shoreline Monitoring**
- **SHUMON-3 Flood Risks Middle-Shuswap River Monitoring**
- **SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring**
- **SHUWORKS-1 Wilsey Dam Flow Physical Works**

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Final Report

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Executive Summary

The Shuswap River Water Use Plan (WUP) was initiated in March 2000 and finalized in December 2002. In 2005, the Comptroller of Water Rights (CWR) issued an Order in response to the WUP under the *Water Act* that included the undertaking of four monitoring projects ("monitors") and one physical works project. The *Water Act* was replaced by the *Water Sustainability Act* in February 2016; however Orders and water licences continue to be valid and are governed by the new *Water Sustainability Act*.

The five projects were conducted from 2005 to 2015 to assess inflow forecasting method, shoreline erosion, and archaeology values in Sugar Lake Reservoir, as well as potential flood abatement and minimizing fisheries risks related to flow disruptions in Shuswap River below Sugar Lake Dam and Wilsey Dam.

This document was prepared as part of the WUP Order Review process. It summarizes the outcomes from the monitoring projects and outlines whether the management questions have been addressed.

The WUP Order Review process includes two stages with two core deliverables:

- Stage 1: The Environmental Synthesis Report (ESR – this report); and
- Stage 2: The WUP Order Review Report.

The purpose of the WUP Order Review is to determine whether the ordered facility operational constraints and the physical works in lieu of operation changes are achieving the specific environmental and social objectives identified in the WUP.

Both the draft ESR and draft WUP Order Review Report are shared with government agencies, First Nations and key stakeholders for review and comment. Input received during the reviews is assessed and the reports are updated as appropriate. All feedback received during the review process is documented. See Appendix 2 for a log of communications between BC Hydro and external parties. See Appendix 3 for specific comments and responses received regarding the draft ESR. The reporting process will enable BC Hydro to advise the CWR how the Order and its conditions may be concluded, clarified, modified, or confirmed for future operations.

The four monitors are as follows:

- SHUMON-1 Sugar Lake Inflow Monitoring: A ten year study of inflows to improve inflow forecasting ability.
- SHUMON-2 Sugar Lake Shoreline Monitoring: A one year study on the potential effect of a lower reservoir elevation on erosion potential.
- SHUMON-3 Flood Risks Middle-Shuswap River Monitoring: A one year study to monitor the relationship between flows and flooding from Wilsey Dam to Mabel Lake.
- SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring: A four year study to monitor the effects of Sugar Lake Reservoir operations on archaeological sites located in the drawdown zone and shoreline erosion areas.

The one physical works project was:

- SHUWORKS-1 Wilsey Dam Flow Physical Works: A project to reduce the potential for impact on fishery values by minimizing the risk of downstream flow disruptions that result from bypass valve reliability.

The four Shuswap River WUP monitoring studies are complete and have provided answers to management questions, determined the benefits achieved by WUP operations, and provided implications of the project outcomes on the WUP operations (see Table E - 1 for a summary of results). This information will be used to guide the Shuswap WUP Order Review process and future changes to the WUP Operation, if required.

SHUMON-1 utilized the data from the Eagle Creek gauging station, which was found to be valuable in supporting inflow forecasting. SHUMON-2 found that shoreline erosion at the current Sugar Lake full pool varied around the reservoir rim, that 74% of the shoreline is at low risk of erosion, and operating to a lower reservoir elevation may reduce shoreline erosion potential in the higher erosion risk areas. SHUMON-3 concluded that based on the results of the monitoring program, overbank flooding was observed to occur at a combined discharge (i.e., discharge from Wilsey Dam, Bessette Creek and other unregulated local tributaries) lower than hypothesized by the WUP Consultative Committee.

The final study (SHUMON-4) was an archaeological assessment study with investigations throughout the drawdown zone of Sugar Lake. Fifteen new archaeological sites were recorded, and all of the sites visited within the drawdown zone have been impacted by erosion. Any recommendations arising from the Water Use Plan Order Review (WUPOR) for direct archaeological site management were provided to BC Hydro's Reservoir Archaeology Program (RAP)[1], as these activities fall under the purview of the *Heritage Conservation Act*.

The Wilsey Dam flow physical works project (SHUWORKS-1) was successful. Based on two years of monitoring to assess the effectiveness of the flow bypass upgrades completed under this project, the number of flow disruptions at Wilsey Dam was reduced to zero during the post construction monitoring period (Table E - 2).

[1] Through the RAP, BC Hydro works with the Archaeology Branch of the B.C. Ministry of Forests, Lands and Natural Resource Operations and affected First Nations to assess and manage impacts to protected archaeological sites in the active erosion zone of the reservoir.

Table E - 1 Summary of objectives, management questions, outcomes, and operational implications for the Shuswap River WUP monitoring projects

Project	Objectives	Management Questions	Response	Implications/Conclusions
SHUMON-1 Sugar Lake Inflow Monitoring	To improve inflow forecasting ability for the Sugar Lake Reservoir by increasing the capability of an existing gauging station located on the Eagle River.	No specific management questions were outlined in the Terms of Reference.	Data from the Eagle River Water Survey of Canada (WSC) gauging station near Malakwa correlates extremely well (r-value of 0.99) with Sugar Lake Reservoir inflows throughout the year. Data from this gauging station is used as an index to support inflow forecasting and data quality control for Sugar Lake Reservoir.	BC Hydro provides funding to maintain this gauge as part of the ongoing BC Hydro hydrometric monitoring program for Sugar Lake.
SHUMON-2 Sugar Lake Shoreline Monitoring	To reduce uncertainty related to the extent of shoreline erosion and flooding[2] that will likely occur at the Sugar Lake Reservoir over the long-term from operating the reservoir at a maximum elevation of 601.72 m relative to 601.52 m.	1. Does operating the reservoir at full pool (601.72 m) cause extensive shoreline erosion? 2. Would operating the reservoir below full pool (at 601.52 m) significantly reduce shoreline erosion over the long-term?	1. At the current full supply reservoir elevation (601.72 m), 74% of the shoreline is at low risk of erosion, 20% is at moderate risk of erosion, and 6% is at high risk of erosion. 2. Operating to a lower reservoir elevation of 601.52 m is expected to reduce shoreline erosion potential in the higher erosion risk areas.	The majority of the shoreline has a low risk of erosion potential at the current full supply reservoir level of 601.72 m. Operating to a lower reservoir elevation of 601.52 m may further reduce erosion potential in the higher erosion risk areas. Note that the current WUP Order specifies a target freshet reservoir elevation in order to mitigate the potential effects of high inflows and erosion. See section 4.2.
SHUMON-3 Flood Risks Middle-Shuswap River Monitoring	The primary objective was to reduce uncertainty related to the discharge rate at which flooding begins in the middle Shuswap River.	1. What are the key areas where flooding is a concern along the middle Shuswap River? 2. At what discharge does flooding begin in the middle Shuswap River?	1. Existing information on flooding in the middle Shuswap River identified three areas with the highest risk of flooding. 2. Flooding begins at key areas of the middle Shuswap River at flows of 229 m^3/s (combined	Based on the results of the monitoring program, overbank flooding was observed to occur at a discharge lower than the hypothesized 232 m^3/s. If operationally feasible to reduce the risk of flooding, maintain

[2] BC Hydro was Ordered to study the effects of Sugar Lake Reservoir elevations on erosion. Since there is a probability that freshet targets specified in the WUP Order may not be met during higher than average inflow years (thereby causing a flood condition which could impact erosion potential), the Consultative Committee recommended that the study focus on shoreline erosion, not on the overall impacts of flooding. See section 4.2 for details on study scope, results and conclusions.

Project	Objectives	Management Questions	Response	Implications/Conclusions
		3. During a single flood event, what is the relation between discharge from Sugar Lake Dam, discharge at Wilsey Dam, and the extent of flooding?	discharge of Wilsey Dam, Bessette Creek and other unregulated local tributaries). 3.Flows from Sugar Lake Dam and subsequent release at Wilsey Dam combined with unregulated inflows from Bessette Creek (the largest contributor of unregulated streamflow below Wilsey) that result in a discharge of ≥229 m^3/s below Bessette Creek are expected to result in a flood event for key areas of middle Shuswap River.	flows from Sugar Lake Dam below 229 m^3/s within the middle Shuswap River. This needs to take into consideration the combined flows from the Wilsey Dam and Bessette Creek (unregulated) and the ability of BC Hydro to balance other water management priorities on the system.
SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring	Collect information on archaeological site locations, conditions and the effects of reservoir operations within the drawdown zone of the Sugar Lake Reservoir. Identify archaeological site locations suitable for long-term erosion monitoring. Monitor selected archaeological sites.	Rather than management questions, this program focused on the overall objectives of SHUMON-4.	Fifteen new archaeological sites were recorded. Five of the six previously recorded sites were revisited as well as eight of the ten previously identified areas of archaeological potential. All of the sites visited within the drawdown zone have been impacted by erosion. Aside from erosion, the greatest impact to sites is the unauthorized collection of artifacts. Two erosion monitoring stations were established at documented archaeological sites.	Archaeological sites continue to be affected by erosion and the movement of sediments. Reservoir operations which include water level fluctuations were observed to cause erosional impacts to archaeological sites within the drawdown zone. On-going, targeted, unauthorized collection of artifacts has an impact on the integrity of sites. Reservoir operations which include sustained periods of low water levels can provide unrestricted access to archaeological sites rendering them vulnerable to unauthorized artifact collection.

Table E - 2 Summary of objectives, source requirements and completion timeline for the Shuswap River WUP physical works projects

Project	Objectives	Source Requirements	Completion
SHUWORKS-1 Wilsey Dam Flow Physical Works	Investigate sources of flow disruptions at Wilsey Dam, identify options for changing existing works or installing new works that will further reduce flow disruptions and submit report on findings to Comptroller of Water Rights.	Clause 6 of *Water Act* Order Section 88.	An investigation was completed to report on sources of flow disruptions and options for mitigation. Modifications were completed to the control system and hydraulics of the existing flow bypass system. Two-year post-construction monitoring was then completed in 2012 to assess the effectiveness of the upgrades. The results of the monitoring indicated that flow disruptions as a result of the bypass not working correctly had dropped to zero within the two-year post-construction period.

Acknowledgements

This document and related monitoring projects were funded by BC Hydro Water Licence Requirements Shuswap River Water Use Plan. BC Hydro would like to thank the following First Nations and consultants for their contributions to the project: Okanagan Indian Band, Okanagan Nation Alliance, Splats'in, Focus Corporation, Millennia Research Limited, Summit Environmental Consultants Limited and WSP Group.

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1.0 CONTEXT

The Shuswap River Water Use Plan (WUP) was initiated in March 2000 and finalized in December 2002. In 2005, the Comptroller of Water Rights (CWR) issued an Order in response to the WUP under the *Water Act* that included the undertaking of four monitoring projects ("monitors") and one physical works project. The *Water Act* was replaced by the *Water Sustainability Act* in February 2016; however Orders and water licences continue to be valid and are governed by the new *Water Sustainability Act*.

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The specific objectives of this report are to:

1. Provide a summary of the objectives, activities, and results for each of the four monitors and one physical works;
2. Relate monitor findings to the objectives of the Shuswap River WUP and provide any updates to these project findings from other work conducted after the projects were completed;
3. Where management questions were not addressed, identify the data gaps that persist; and

4. Summarize the implications of study outcomes as they may pertain to future operating decisions in the WUP Order Review.

The four monitors included:

- **SHUMON-1 Sugar Lake Inflow Monitoring**: A ten-year study of inflows to improve inflow forecasting ability.
- **SHUMON-2 Sugar Lake Shoreline Monitoring**: A one-year study on the potential effect of a lower reservoir elevation on erosion potential.
- **SHUMON-3 Flood Risks Middle-Shuswap River Monitoring**: A one-year study to monitor the relationship between flows and flooding from Wilsey Dam to Mabel Lake.
- **SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring**: A four-year study to monitor the effects of Sugar Lake Reservoir operations on archaeological sites located in the drawdown zone and shoreline erosion areas.

The CWR also included in the Order the completion of a physical works project for anticipated benefits to fish habitat (Comptroller of Water Rights, 2005). The one physical works project was:

- **SHUWORKS-1 Wilsey Dam Flow Physical Works**: A project to reduce the potential for impact on fishery values by minimizing the risk of downstream flow disruptions that result from bypass valve reliability.

2.0 PROJECT BACKGROUND

2.1 Hydroelectric Facilities

BC Hydro's Shuswap Falls and Sugar Lake hydroelectric project is located on the Shuswap River, east of Vernon in the southern interior of British Columbia.

The facilities can be reached by secondary road off Highway 6 between the Okanagan and Columbia Valleys.

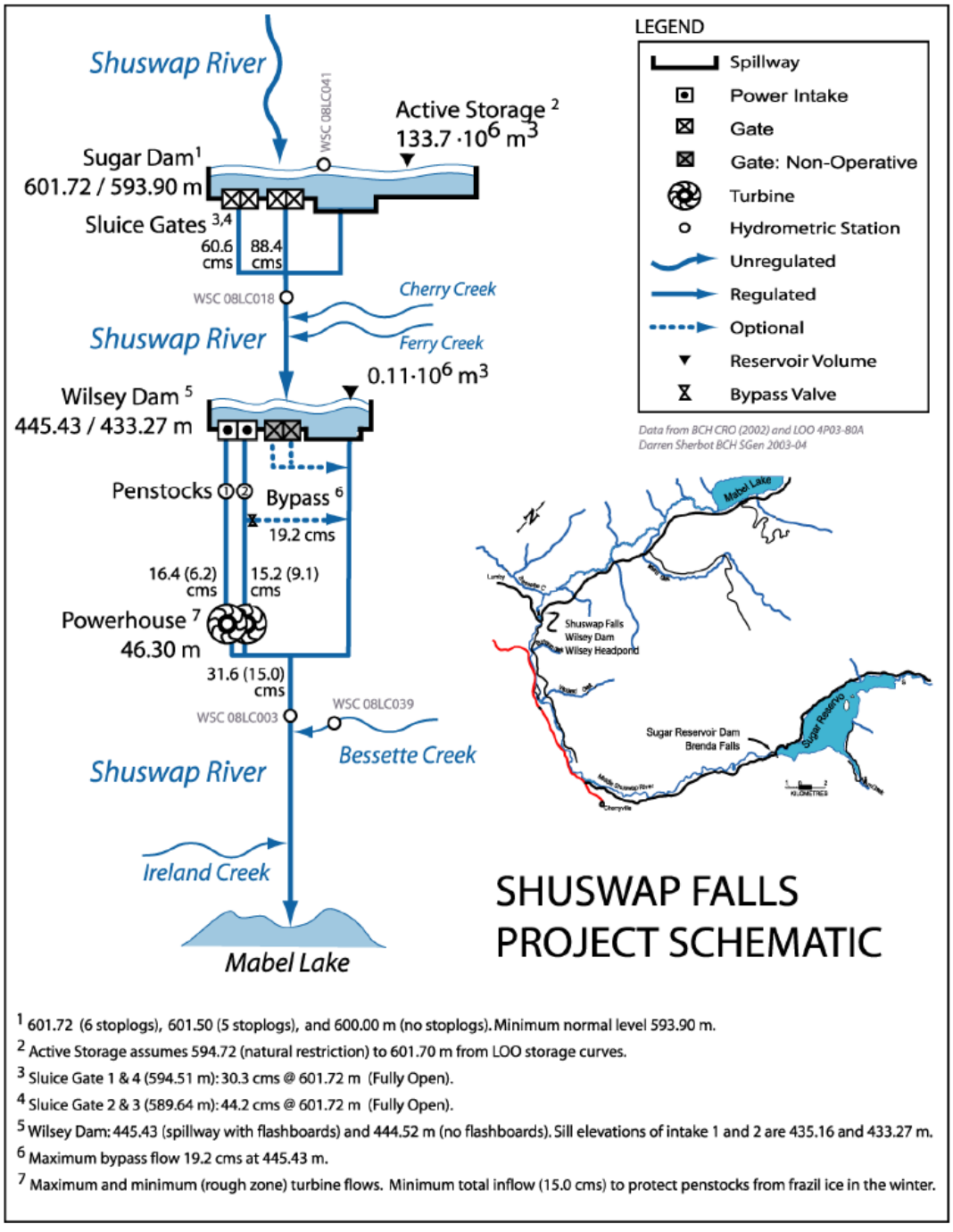
The Shuswap Falls and Sugar Lake project consists of Wilsey Dam and headpond at Shuswap Falls, and Sugar Lake Dam and Reservoir located 35 km and 70 km respectively east of Vernon on the Shuswap River.

These hydroelectric developments include the following components and local inflow sources:

- Sugar Lake Dam impounds inflows from the upper Shuswap River at its headwaters forming Sugar Lake Reservoir over the original lake. All releases from Sugar Lake Dam discharge into the middle Shuswap River.
- Downstream from Sugar Lake Reservoir, local inflows, primarily from Cherry and Ferry creeks, combine with the Sugar Lake Dam discharges to provide inflow to Wilsey Dam forebay.
- Wilsey Dam, spillway, headpond, and powerhouse are approximately 29 km downstream of the Sugar Lake Dam on the Shuswap River. All releases from Wilsey Dam are discharged into the lower Shuswap River that subsequently

flows into Mabel Lake, along with unregulated inflows from other tributaries (such as Bessette and Ireland Creeks).

Figure 2-1 Site map of Shuswap Falls and Sugar Lake Hydroelectric Facility[3]



[3] Note that at the time of writing of this report Turbine Unit 1 was not in service.

Table 2-1 Shuswap Project general information. Referenced from BC Hydro website (April 2018) and Facility Asset Plan (2014), and facility *Water Act* Licences

Dam Name	Sugar Lake Dam
Year of Completion	1929
Dam Type	Concrete buttress dam
Dam Use	Storage and regulation of Shuswap Falls Generating Station
Dam Height	13 m
Spillway Type	Overflow
Max. Discharge Capacity of Spillway	880 m^3/s
Generating Station	Shuswap Falls
Nameplate Capacity	6 MW
Storage	148 hm^3
Reservoir Name	Sugar Lake
Reservoir Area at Max. Normal Level	2100 ha
Water Course	Shuswap River
Drainage Area	1113 km2
Reservoir Operating Range	589.64 m – 601.72 m
Upstream Project	N/A
Downstream Project	Wilsey Dam
Nearest City	Vernon, BC

Dam Name	Wilsey Dam
Year of Completion	1929
Dam Type	Concrete arch dam
Dam Use	Regulation of Shuswap Falls generating station
Dam Height	30 m
Spillway Type	Overflow
Max. Discharge Capacity of Spillway	700 m^3/s
Generating Station	Shuswap Falls
Nameplate Capacity	6 MW
Storage	165.6 hm^3
Reservoir Name	Wilsey (Headpond)
Reservoir Area at Max. Normal Level	N/A
Water Course	Shuswap River
Drainage Area	876 km^2
Reservoir Operating Range	434.52 m - 445.43 m (Headpond)
Upstream Project	Sugar Lake Dam
Downstream Project	N/A
Nearest City	Vernon, BC

3.0 SHUSWAP RIVER WUP PROCESS

The Shuswap River WUP process was implemented over a two-year period starting in March 2000 which followed the Water Use Plan Guidelines developed by the Province (Province of British Columbia 1998). The process created the following outputs (in chronological order):

- Shuswap River WUP: Report of the WUP Consultative Committee (BC Hydro 2003) – documentation of the structured decision making process which evaluated operating alternatives against objectives presented by the WUP Consultative Committee, and documentation of uncertainties that would define the study project for implementation following WUP approval.
- Shuswap River WUP (BC Hydro 2005) – submitted by BC Hydro to the CWR as the summary of operating constraints and implementation commitments, to be appended to its Water Licences.
- Shuswap River Facility Order (Comptroller of Water Rights 2005) – the *Water Act* Order issued by the CWR to implement the WUP as a condition of the four licences (Final *Water Act* Licences 120948, 120949, 120950 and 120951) associated with the Shuswap projects.
- Water Licence Requirements (WLR) Terms of Reference (TOR), (BC Hydro 2006-2011) – for four monitors and one physical works ordered by the CWR; management questions and methodologies were prepared to address the specific uncertainties defined in the WUP and submitted to the CWR for Leave to Commence.
- Project progress and annual watershed reports – reports summarizing annual data collection results for ordered projects were prepared and watershed activities were summarized each year in a watershed report and submitted to the CWR.

All reports are available on BC Hydro's WUP website:

https://www.bchydro.com/about/sustainability/conservation/water_use_planning/southern_interior/shuswap_sugar_lake.html

The operating conditions for Shuswap River Hydroelectric System ordered by the CWR are shown in Table 3-1. The Consultative Committee felt there was uncertainty of the benefits associated with operating conditions and effects of the WUP (BC Hydro 2005). The following categories of uncertainty were addressed by the four monitoring and one physical works project:

- Inflow surveillance as it influences operational planning;
- Sugar Lake Reservoir operating levels as they influence shoreline erosion;
- Operations of Sugar Lake and Wilsey dams as they influence downstream flooding;
- Archaeological investigations; and
- Sources of flow disruptions at Wilsey Dam during tripping events, and options for reducing flow disruptions to mitigate impacts to fish.

Table 3-1 Operating conditions of the WUP Order for the Shuswap Falls and Sugar Lake hydroelectric system (Comptroller of Water Rights 2005)

System Component	Constraint	Time of Year	Purpose
Sugar Lake Reservoir (Clause 1)	Licenced full supply level of El. 601.72 m and licenced minimum operating level of El. 589.64 m.[4] Attain reservoir elevation of 600.61 m or greater; Attain reservoir elevation 601.22 m or greater; The reservoir will be drawn down to 596.00 m or lower; Achieving the above elevations is secondary to meeting minimum flows below Wilsey Dam as specified in condition 4 of the Order (see below 'Wilsey Dam and Shuswap Generating Facility').	All year June 1 – July 31 August 1 – August 31 Between April 1 and May 1 All year	Permits boat ramp access at Kokanee Resort Lodge. Storage of spawning and incubation flows for the fall and winter months. Reduce the risk of flooding downstream as a result of the potential for high inflows during freshet.
Sugar Lake Dam (Clause 2)	Release a minimum flow of 5 m^3/s from Sugar Lake Dam. When inflows are less than 5.0 m^3/s and the reservoir is lower than 594.70 m, all inflows shall be released	All year	Minimum flows to protect rearing and spawning habitats for key salmonids
Sugar Lake Dam Ramp Rates (Clause 3)	Operate Sugar Lake Dam to meet the ramp rates specified in Schedule A of the Order (See Table 3-2 below).	See Table 3-2 below	Target ramp rates to manage the variability of inflows in the system, equipment limitations, uncertainties around the stage/discharge relationships between the Water Survey of Canada gauge and the LLO gates, and flow release mechanism to meet flows downstream of Wilsey Dam.

[4] Final Water Licence 120951.

System Component	Constraint	Time of Year	Purpose
Wilsey Dam and Shuswap Generating Facility (Clause 4)	Sufficient water shall be released from Wilsey Dam and powerhouse to provide the following minimum flows as measured at Water Survey of Canada (WSC) Hydrometric Gauge 08LC003 (below Wilsey Dam): • 16 m^3/s • 13 m^3/s If the above flows cannot be met, minimum flow releases shall be equal to the sum of local inflows to Wilsey Dam plus available discharge from Sugar Lake Dam.	August 15 – December 31 January 1 – August 14	Minimum flows to protect rearing and spawning habitats for key salmonids

Table 3-2 Maximum Ramp Rates for Sugar Lake Dam (Schedule A, Comptroller of Water Rights 2005)

Maximum Ramping Rates[5]		Hourly Down Ramp Rate of Change of Stage (cm/hr)		Hourly Up Ramp Rate of Change of Stage (cm/hr)	Daily Down Ramp Rate of Change of Stage (cm/day)	Daily Up Ramp Rate of Change of Stage (cm/day)
Period	**Salmonid Life Stage**	**Day**	**Night**	**Day/Night**		
April 1 – July 31	Emergence	2.5	2.5	5.0	15	15
August 1 – September 30	Rearing	2.5	5.0	5.0	15	15
October 1 – March 31	Over Winter	0	5.0	5.0	15	25% of the previous day's discharge

[5] Rate determination based on gate discharge curves, reservoir level, and planned gate position changes. Actual downstream changes may be +/-50% the planning criteria.

The following projects were ordered to address the data gaps and uncertainties in the Shuswap River WUP and to assess whether anticipated benefits from changes made under the WUP were actually achieved. Results from these projects are reviewed upon completion as part of BC Hydro's WUP Order Review process, and the results are used and considered along with other values to support decisions about whether further changes may be considered during the WUP Order Review.

The required projects were implemented under BC Hydro's Water Licence Requirements program according to the following Terms of References:

- SHUMON-1 Sugar Lake Inflow Monitoring
- SHUMON-2 Sugar Lake Shoreline Monitoring
- SHUMON-3 Flood Risks Middle-Shuswap River Monitoring
- SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring
- SHUWORKS-1 Wilsey Dam Flow Physical Works

All WUP Terms of Reference, including any revisions and addenda are reviewed by agencies and circulated to First Nations for review and comment prior to submission to the Comptroller of Water Rights.

4.0 ORDERED MONITORING PROJECT SUMMARY

4.1 SHUMON-1 Sugar Lake Reservoir Inflow Monitoring

4.1.1 Project Summary

Table 4-1 SHUMON-1 Sugar Lake Reservoir Inflow Monitoring Project Summary

Objective	Management Questions	Response	Implications/Conclusions
To improve inflow forecasting ability for the Sugar Lake Reservoir by increasing the capability of an existing gauging station located on the Eagle River.	No specific management questions for this project were specified in the TOR.	The Eagle River Water Survey of Canada (WSC) gauging station near Malakwa correlates extremely well (r-value of 0.99) with Sugar Lake Reservoir inflows through provision of hourly, real-time data that is used to predict inflow trends. Data from this gauging station is used as an index to support inflow forecasting and data quality control for Sugar Lake Reservoir.	BC Hydro provides funding to maintain this gauge as part of the ongoing BC Hydro hydrometric monitoring program for Sugar Lake.

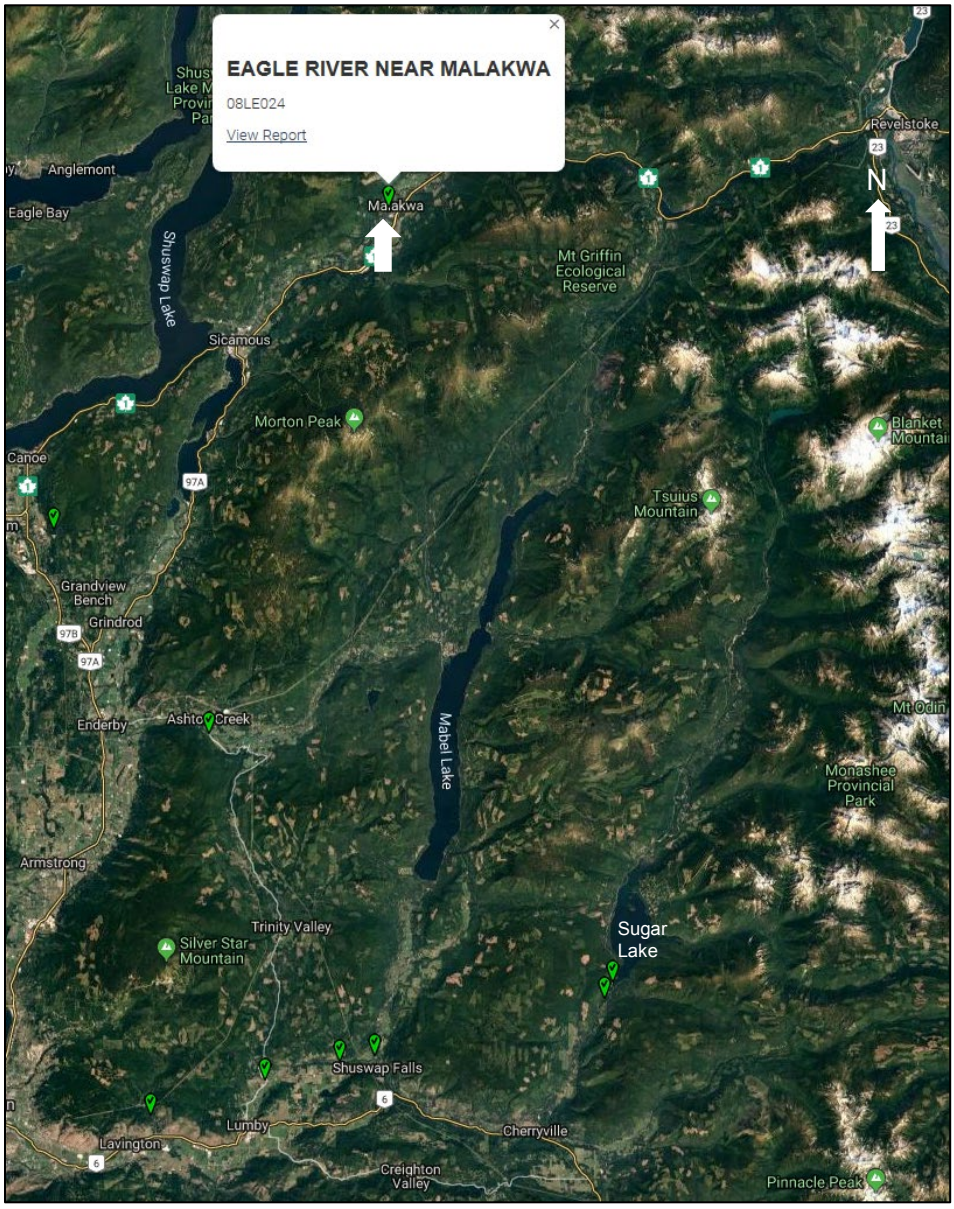
4.1.2 Project Approach

The SHUMON-1 monitor was conducted from 2005 to 2015 by BC Hydro. BC Hydro funded the operation and maintenance of the Water Survey of Canada gauge on the Eagle River near Malakwa (WSC station #08LE024, see Figure 4-1 below). The final report was completed by BC Hydro and summarized results for the study period. The report is available on BC Hydro's WUP website:

https://www.bchydro.com/about/sustainability/conservation/water_use_planning/southern_interior/shuswap_sugar_lake.html

The general approach to this monitor was to fund the operation of the WSC station and utilize the data captured from the gauge to improve inflow forecasting.

Figure 4-1 Location of the Eagle River gauge near Malakwa

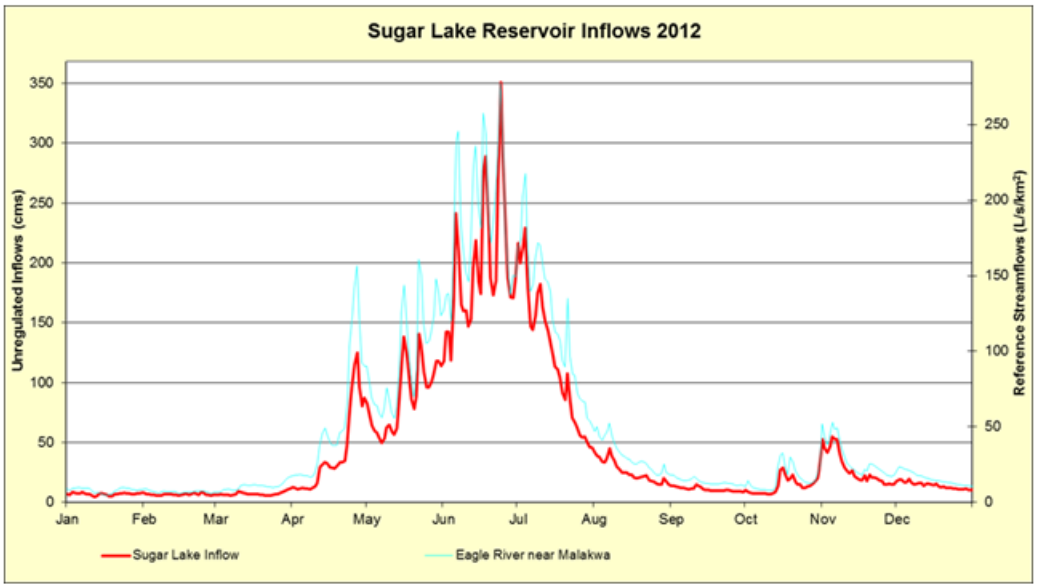


4.1.3 Interpretation of Data

Inflow into Sugar Lake Reservoir is calculated based on the changes in reservoir storage, and discharge from the reservoir (as recorded at the Shuswap River at a gauge located at the Sugar Lake Reservoir outlet). However, calculating reservoir inflow fluctuations can be affected by wind and other environmental factors, which can induce short-term changes in recorded reservoir levels.

Supplementary data from streamflow gauges provide an important tool to runoff forecasters for predicting trends in hourly real-time inflows and for quality control of historical inflow data. Another local stream can be used as an index stream to verify local inflows. Ideally, a streamflow gauge that correlates well with reservoir inflow data is used for these applications. The Eagle River gauge station near Malakwa, which has provided supplementary data to BC Hydro since 2005, correlates extremely well (r-value of 0.99, example from 2012 shown in Figure 4-2 below) with Sugar Lake Reservoir inflows throughout the year, and provides hourly, real-time data. These data are used to predict inflow trends and is supplementary to Sugar Lake Reservoir inflow calculations. No other gauge is considered to provide an adequate level of correlation for Sugar Lake Reservoir.

Figure 4-2 Eagle River and Sugar Lake Reservoir Inflow Correlation



4.1.4 Conclusions

Data from the Eagle River gauge station near Malakwa have been shown to be very valuable in supporting inflow forecasting and historical inflow data quality control for Sugar Lake Reservoir. BC Hydro provides funding to maintain this gauge as part of the ongoing BC Hydro hydrometric monitoring program for Sugar Lake.

4.2 SHUMON-2 Sugar Lake Reservoir Shoreline Erosion

4.2.1 Project Summary

Table 4-2 SHUMON-2 Sugar Lake Reservoir Shoreline Erosion Project Summary

Objective	Management Questions	Result	Implications/Conclusions
To reduce uncertainty related to the extent of shoreline erosion and flooding[6] that will likely occur at the Sugar Lake Reservoir over the long-term from operating the reservoir at a maximum elevation of 601.72 m relative to 601.52 m.	1. Does operating the reservoir at full pool (601.72 m) cause extensive shoreline erosion? 2. Would operating the reservoir below full pool (at 601.52 m) significantly reduce shoreline erosion over the long-term?	1. At the current full supply reservoir elevation (601.72 m), 74% of the shoreline is at low risk of erosion, 20% is at moderate risk of erosion, and 6% is at high risk of erosion. 2. Operating to a lower reservoir elevation of 601.52 m is expected to reduce shoreline erosion potential in the higher erosion risk areas.	The majority of the shoreline has a low risk of erosion potential at the current full supply reservoir level of 601.72 m. Operating to a lower reservoir elevation of 601.52 m may further reduce erosion potential in the higher erosion risk areas. Note that the current WUP Order specifies a freshet target reservoir elevation in order to mitigate the potential effects of high inflows and erosion.

4.2.2 Project Approach

The SHUMON-2 monitor was conducted from 2006 to 2007. The monitor was completed by Summit Environmental Consultants Limited. The final report summarized results from the single study year and addressed the management questions listed above. The report is available on BC Hydro's WUP website:

https://www.bchydro.com/about/sustainability/conservation/water_use_planning/southern_interior/shuswap_sugar_lake.html

This study focused on erosion, rather than flooding[6]. High inflows (flooding) and erosion were not considered to be an issue by property owners when the reservoir was maintained below an elevation of 601.52 m (BC Hydro 2002, p. 4-5). The current WUP Order includes freshet target reservoir elevations below both the current full supply reservoir elevation of 601.72 m and the reservoir elevation of 601.52 m that was reviewed by the WUP Consultative Committee in order to mitigate the potential effects of high inflows (flooding) and erosion during the high inflow season (see Table 3-1 for details on the Order requirements). However, the operating alternative recommended by the WUP Consultative Committee and included in the WUP Order did not apply constraints on full

[6] BC Hydro was Ordered to study the effects of Sugar Lake Reservoir elevations on erosion. Since there is a probability that freshet targets specified in the WUP Order may not be met during higher than average inflow years (thereby causing a flood condition which could impact erosion potential), the Consultative Committee recommended that the study focus on shoreline erosion, not on the overall impacts of flooding.

supply reservoir level in order to allow BC Hydro to effectively manage downstream flow conditions when necessary, particularly during the potentially high inflows that can occur during freshet. There was uncertainty by the WUP Consultative Committee about the possible extent of erosion from the current full supply reservoir elevation of 601.72 m relative to a potential lower elevation of 601.52 m reviewed by the WUP Consultative Committee. Therefore, the WUP Consultative Committee recommended that shoreline erosion be examined to reduce this uncertainty.

The monitoring approach relied primarily upon qualitative assessments made by experienced professionals, supported by field observations and photographs. The monitoring design was constrained by the WUP Order operations, thus it was not feasible to measure annual erosion rates at reservoir elevations other than those that occurred by chance under WUP operations during the study period.

The general approach to this monitor included pre-field preparation of an orthophoto base map of Sugar Lake Reservoir using aerial photos and a preliminary review of background materials. Field work involved navigation of the perimeter of the reservoir by boat during low water elevations (598.042 to 598.057 m) and at higher elevations (601.560 to 601.570m). Navigation of the reservoir perimeter included noting physical characteristics of the shoreline and recording of notes and photographs. Post-field work entailed mapping erosion potential which was defined as how close the shoreline was to its "final equilibrium state"[7] (p. 7, Summit 2007) and was based on eight factors utilized to assess erosion potential which were defined as:

1. Exposure to prevailing winds from the south and/or southeast;
2. Fetch (or distance) over which waves could develop;
3. Planform of shoreline (shape of shoreline, as seen from above);
4. Shoreline profile;
5. Materials (sediment type);
6. Vegetation;
7. Woody debris; and
8. Anthropogenic factors (i.e., human disturbance).

Results included a map (see Appendix 1) of Sugar Lake Reservoir divided into 59 segments, each with roughly uniform exposure and fetch to prevailing winds, similar shoreline configuration, and substrate and vegetation cover. The potential for erosion of each segment was then analyzed at both reservoir elevations.

4.2.3 Interpretation of Data

A major cause of shoreline erosion is wave action resulting from large, infrequent storms, particularly when the reservoir is near the full supply elevation (601.72 m). This scenario is most probable during the spring freshet season where high inflows from snowmelt can combine with heavy rainfall events. This

[7] This is considered to be the state when the shoreline assumes a stable profile after reservoir inundation. This state is highly dependent the factors listed here.

study assessed erosion potential both at the current full supply reservoir elevation of 601.72 m and at an alternative reservoir elevation of 601.52 m (0.2 m less than the current licenced full supply reservoir elevation). This study did not assess actual erosion rates.

Answers to Management Questions

1. *Does operating the reservoir at full pool (601.72 m) cause extensive shoreline erosion?*

   At the current full supply reservoir elevation (601.72 m,), 74% of the shoreline is at low risk of erosion, 20% is at moderate risk of erosion, and 6% is at high risk of erosion. While the proportion of shoreline with moderate or high erosion potential is not considered extensive (26%), much of this type of shoreline fronts private property or recreationally developed areas (such as campsites on Crown land). There are less than 10 private property owners along the shoreline of the Sugar Lake Reservoir, and eight that hold a Licence of Occupation on Crown land.

2. *Would operating the reservoir below full pool (at 601.52 m) significantly reduce shoreline erosion over the long-term?*

   Operating to a lower reservoir elevation of 601.52 m is expected to reduce shoreline erosion potential. Assuming a 0.20 m reduction in the full supply reservoir elevation to 601.52 m, it is estimated that there would be a 1,140 m decrease in the length of shoreline with high potential for erosion (representing 3% of the total shoreline length). For shoreline with a moderate potential for erosion there would be a 4,440 m decrease is estimated (representing 8% of the total shoreline length). This elevation reduction results in an estimated total of 11% of shoreline with high or moderate erosion potential (from 26%).

4.2.4 Conclusions

The majority of the shoreline is at a low risk of erosion potential. Reducing full supply reservoir elevation by 0.2 m would reduce erosion potential of moderate and high potential from 26% of the shoreline to 11% of the shoreline and may reduce actual erosion rates. The current WUP Order specifies a freshet target reservoir elevation below the full supply reservoir elevation (601.72 m) during the freshet season in order to mitigate the potential effects of high inflows and erosion. See Table 3-1 for details of the Order requirements.

4.3 SHUMON-3 Flooding Risks in the Middle Shuswap River

4.3.1 Project Summary

Table 4-3 SHUMON-3 Flooding Risks in the Middle Shuswap River Project Summary

Objective	Management Questions	Response	Implications/Conclusions
The primary objective was to reduce uncertainty related to the discharge rate at which flooding begins in the middle Shuswap River.	1. What are the key areas where flooding is a concern along the middle Shuswap River? 2. At what discharge does flooding begin in the middle Shuswap River? 3. During a single flood event, what is the relation between discharge from Sugar Lake Dam, discharge at Wilsey Dam, and the extent of flooding?	1. Existing information on flooding in the middle Shuswap River identified three areas with the highest risk of flooding. 2. Flooding begins at key areas of the middle Shuswap River at flows of 229 m^3/s (combined discharge of Wilsey Dam, Bessette Creek and other local unregulated tributaries). 3. Flows from Sugar Lake Dam and subsequent release at Wilsey Dam combined with inflows from Bessette Creek (the largest unregulated contributor of unregulated streamflow below Wilsey) that result in a discharge of ≥229 m^3/s below Bessette Creek are expected to result in a flood event for key areas of middle Shuswap River.	Based on the results of the monitoring program, overbank flooding was observed to occur at a discharge lower than the hypothesized 232 m^3/s. If operationally feasible to reduce the risk of flooding, maintain flows from Sugar Lake Dam below 229 m^3/s within the middle Shuswap River. This needs to take into consideration the combined flows from the Wilsey Dam, Bessette Creek (unregulated) and the ability of BC Hydro to balance other water management priorities on the system.

4.3.2 Project Approach

On May 26, 2006, in order to begin to understand the extent of flooding of lands adjacent to the Middle Shuswap River, a helicopter survey was conducted by BC Hydro at a discharge at Wilsey Dam between 240 m^3/s and 245 m^3/s. The survey was conducted from Wilsey Dam to the head of Mabel Lake and identified areas of significant overbank flooding. Upon review of the survey (i.e., the film footage) and observations of overbank flooding of a farm near Cherryville, the WUP Consultative Committee estimated that flooding begins when discharge past Wilsey Dam reaches 232 m^3/s.

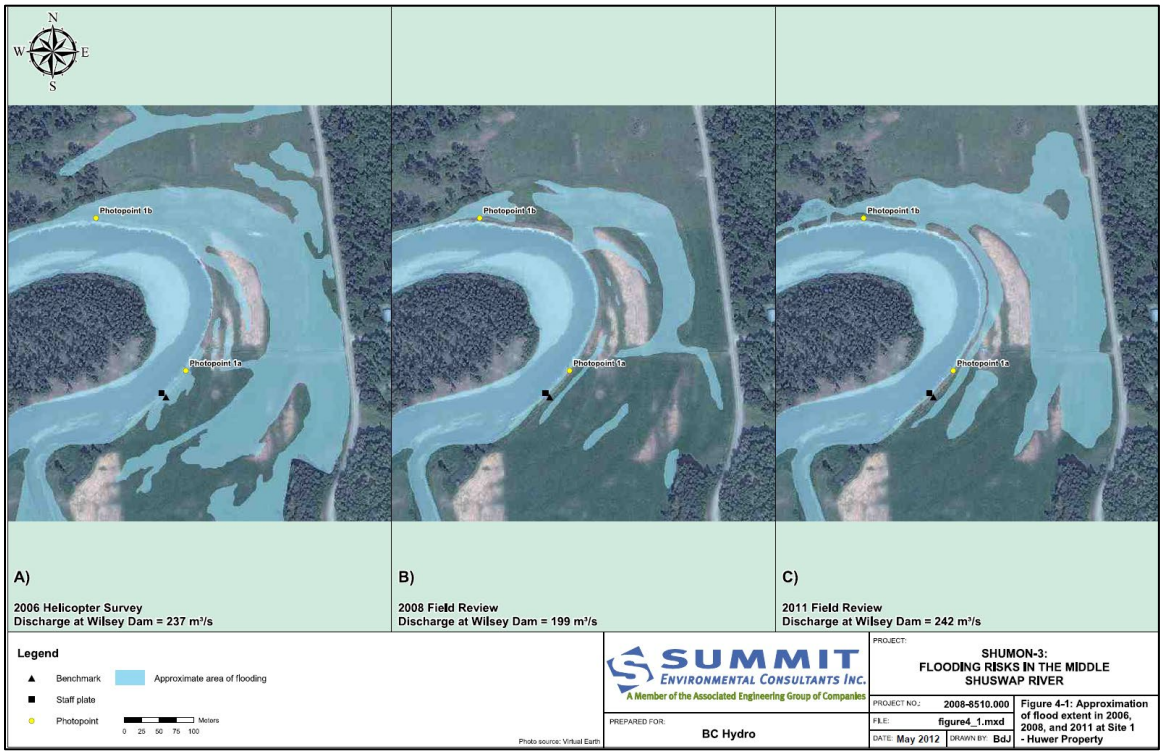
The SHUMON-3 monitor was conducted from 2008 to 2011. The monitor was completed by Summit Environmental Consultants Limited, with participation from

Splats'in. Splats'in provided technical and administrative input, as well as a field technician. The final report summarized results and addressed the management questions listed above. The report is available on BC Hydro's WUP website:

https://www.bchydro.com/about/sustainability/conservation/water_use_planning/southern_interior/shuswap_sugar_lake.html

The general approach was to assess flood conditions at three sites in the middle Shuswap River through installation of a permanent benchmark, photo point, and staff gauge. Additionally, topographic surveys were completed (Summit 2012) and hydrometric data was collected from the network of hydrometric stations along the middle Shuswap River and Bessette Creek. The three sites selected were deemed to be at risk following a review of all relevant hydrologic, geologic, and topographic information for the middle Shuswap, including the results of the helicopter survey. Sites were evaluated in the field six times from 2008 to 2011 as well as the extent of flooding in 2008 and 2011. High enough flows to reach the potential for flooding did not occur in 2009 or 2010; however, site visits were conducted to check equipment and survey the three study sites. A high enough flow to reach flood potential occurred in May 2008 and June 2011.

Figure 4-3 Approximation of flood extent in 2006, 2008 and 2011 at Site 1



4.3.3 Interpretation of Data

The three key management questions of the WUP monitoring study in flooding in the middle Shuswap River are discussed below.

Answers to Management Questions

1. *What are the key areas where flooding is a concern along the middle Shuswap River?*

Existing information on flooding in the middle Shuswap River identified three areas with the highest risk of flooding. These three sites identified as having flood concerns during the 2006 floods were re-assessed in 2008 and 2011 during high water periods. Overbank flooding was observed at all three sites, however the extent of flooding at Site 1 was considerably less in 2011 as compared to 2006 due to bank stabilization work completed in the area.

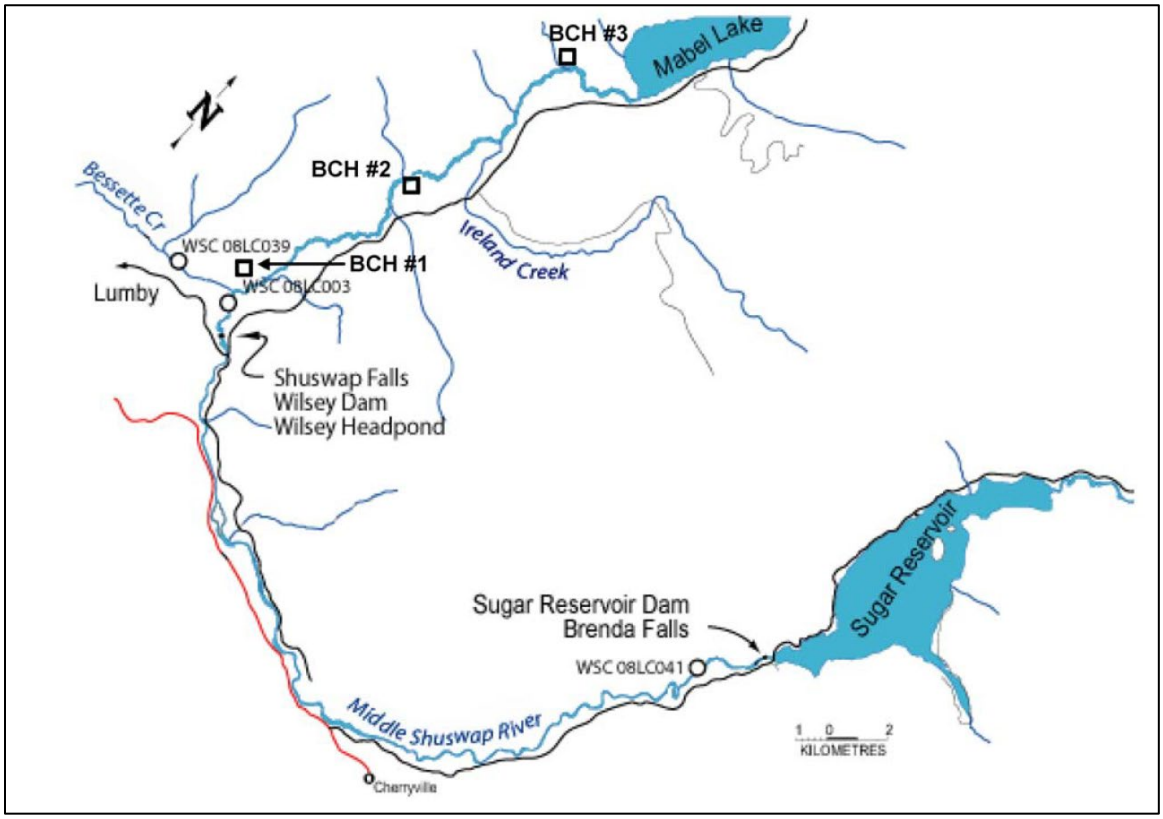
2. *At what discharge does flooding begin in the middle Shuswap River?*

Flooding begins at key areas of the middle Shuswap River at flows of 229 m^3/s (combined discharge of Wilsey Dam, Bessette Creek (unregulated) and other local tributaries). During the 2008 field program, the flooding was estimated to begin at 234 to 239 m^3/s, comprised of 200 m^3/s at Wilsey Dam, 29 m^3/s at Bessette Creek and an estimated 5 to 11 m^3/s from other non-monitored tributaries. Since Bessette Creek is the only monitored unregulated tributary, observations indicate that flooding begins during a total discharge of 229 m^3/s which includes a combination of discharge at Wilsey Dam and Bessette Creek. This estimate considers the additional potential contributions of the non-monitored tributaries.

3. *During a single flood event, what is the relation between discharge from Sugar Lake Dam, discharge at Wilsey Dam, and the extent of flooding?*

Flows from Sugar Lake Dam and subsequent release at Wilsey Dam combined with inflows from Bessette Creek (the largest contributor of unregulated streamflow below Wilsey) that result in a discharge of equal to our greater than 229 m^3/s below Bessette Creek are expected to result in a flood event for key areas of middle Shuswap River. This discharge estimate is 1.01% lower than assumed during the WUP (232 m^3/s), meaning that an additional 1.3 days/year, on average, were flooded during the 1974 to 2000 period than estimated for the WUP.

Figure 4-4 Map of the Middle Shuswap River with locations of Wilsey Dam and Bessette Creek



4.3.4 Conclusions

The study terms of reference links the outcomes of the SHUMON-3 study with:

a) Future planning process that seeks to reduce flooding risks in the middle Shuswap River; and

b) Improving the ability to alert affected landowners of when flooding is expected.

The outcome of the study shows that there are approximately 1.3 days of flooding per year more than were anticipated at the time of the WUP, and that flooding begins at 229 m^3/s (combined flows of Wilsey Dam and Bessette Creek), rather than the 232 m^3/s (a difference of 1.01%) estimated by the WUP Consultative Committee.

If operationally feasible to reduce the risk of flooding, maintain flows from Sugar Lake Dam below 229 m^3/s within the middle Shuswap River. This needs to take into consideration the combined flows from the Wilsey Dam, Bessette Creek (unregulated) and the ability of BC Hydro to balance other water management priorities on the system.

With the flow information from the real-time Bessette Creek Water Survey of Canada gauge (#08LC039), and the forecasted flows from Sugar Lake Dam, it may be possible to inform landowners when flooding might be expected. The number of hours or days ahead of the flooding that can be predicted remains variable and is not expected to change as a result of further studies. The

characteristics of each weather system that creates high inflows will determine the rate of water elevation rise in Sugar Lake Reservoir and dictate how quickly combined flows from Sugar Lake Dam and Bessette Creek (unregulated) will reach the 229 m^3/s threshold.

4.4 SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring

4.4.1 Project Summary

As specified in the Shuswap River WUP, the archaeological program was intended to implement archaeological site erosion monitoring assessments focused on the effects of normal reservoir operations on archaeological resources situated within the drawdown zone of Sugar Lake reservoir.

This three-year monitoring study of archaeological resources located in the drawdown zone was conducted over four years from 2012 to 2015. Two monitoring stations were established for the study. In addition, a total of 67 hectares of the inundation zone were surveyed and fifteen new archaeological sites were recorded, five of the six archaeological sites recorded prior to this study were revisited, and eight of ten areas identified as having archaeological potential were surveyed.

Table 4-4 SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring Project Summary

Objective	Management Questions	Response	Implications
Collect information on archaeological site locations, conditions, and the effects of reservoir operations, within the drawdown zone of the Sugar Lake Reservoir. Identify archaeological site locations suitable for long-term erosion monitoring.[8] Monitor selected archaeological sites.	Rather than management questions, this program focused on the overall objectives of SHUMON-4.	Fifteen new archaeological sites were recorded. Five of the six previously recorded sites were revisited as well as eight of the ten previously identified areas of archaeological potential. All of the sites visited within the drawdown zone have been impacted by erosion. Aside from erosion, the greatest impact to sites is the unauthorized collection of artifacts. Two erosion monitoring stations were established at archaeological sites.	Archaeological sites continue to be affected by erosion and the movement of sediments. Reservoir operations which include water level fluctuations where wave action occurs within a larger zone were observed to cause erosional impacts to archaeological sites within the drawdown zone. On-going, targeted, unauthorized collection of artifacts has a significant impact on the integrity of sites. Reservoir operations which include sustained periods of low water levels can expose archaeological sites to unauthorized artifact collection.

4.4.2 Project Approach

A preliminary inspection of portions of the Sugar Lake Reservoir drawdown zone was undertaken in May 2001, as part of the WUP (French 2001). The 2001 inspection resulted in the identification of three previously undocumented archaeological sites and indicated that additional unrecorded archaeological sites may exist within the drawdown zone. The 2001 study also suggested that erosion related to reservoir operations is affecting archaeological sites within the drawdown zone.

An erosion monitoring program was recommended by the WUP Consultative Committee to provide a better understanding of the impacts of BC Hydro operations on the Sugar Lake Reservoir shoreline and affected resources (including archaeological sites). The WUP Consultative Committee examined three archaeology issues at the reservoir including:

1) Protecting Indigenous heritage from unauthorized collection of artifacts;
2) Protecting soil layers from shoreline erosion; and
3) Providing opportunity for archaeology study during low reservoir periods.

Subsequently, the Comptroller of Water Rights (CWR) clarified that only non-intrusive heritage work could be included in an Order issued under the *Water Act*,

[8] Areas suitable for monitoring were defined by their setting in areas with observable effects directly related to reservoir operations, presence of archaeological materials or features on the surface, and accessibility.

thereby excluding any study that would require a permit under the *Provincial Heritage Conservation Act*.

The purpose of the SHUMON-4 Archaeology Monitoring Program was erosion monitoring and a non-intrusive inventory of portions of the drawdown zone to inform two WUP archaeological objectives: protection of sites from erosion; and protection of sites from unauthorized collection of artifacts.

The SHUMON-4 work was completed by Millennia Research Limited. Splats'in provided logistical support and arranged for field personnel for the project. Okanagan Indian Band arranged for a field worker for the project, and the Okanagan Nation Alliance Fisheries office arranged for a boat and operator in Year 4 of the project. Annual reports were compiled each year. The final report summarized results for the study period and addressed the three issues listed above. To protect sensitive information regarding the archaeological sites identified, examined or visited during the course of this study, copies of the archaeological reports compiled for this project are not posted publicly.

Program work was planned for the early spring when water levels were low and the drawdown zone could be accessed. The program included both inventory and monitoring components. The inventory was conducted to document the location, condition, and relative significance of archaeological sites and to collect information on unauthorized collection of artifacts within the reservoir drawdown zone. The objective of the monitoring work was to quantitatively measure the effects of erosion caused by reservoir operations on archaeological features, artifact and sediments.

In Year 1 of the study, areas were prioritized for survey and two archaeological sites were selected for erosion monitoring stations. In Years 2 to 4, an archaeological site inventory was conducted within the reservoir drawdown zone and erosion data was collected at the established monitoring stations. Surveys were conducted by a three to four person archaeological crew spaced approximately five to seven meters apart. Transects were recorded with a hand held GPS and the extent of newly identified archaeological sites was recorded based on the extent of archaeological materials or features observed on the exposed ground surface. A total of 67 hectares of the inundation zone were surveyed, 13 hectares shy of the 80 hectare target outlined in the TOR for the project. During the inventory 15 new sites were recorded and five of six previously recorded sites were revisited.

The archaeological sites with monitoring stations were chosen based on information collected during the survey work regarding the relative complexity of the archaeological sites and ease of access for the use of LiDAR equipment. At each station artifacts or monitoring points within the station limits were recorded in field notes, photographed with object, type, material, modifications, and if fully exposed artifacts were measured and weighed. Artifacts that were partially exposed were recorded in situ and not weighed or measured. The locations of monitoring points were recorded using RTK and the spatial data of each monitoring station was recorded using a LiDAR scan. The information recorded in Year 1 and in subsequent years allowed archaeologists to relocate and identify monitoring points in future years and track movement of objects over time. Measurements taken had a 5 to 8 cm margin of error.

The two monitoring stations were monitored in Years 1 and 2. Due to access issues in Year 3, only one of the stations able to be visited. Therefore, the other station was visited in Year 4 so a third year of data could be recorded. The data collected from the monitoring stations allowed for some analysis of erosion and accretion rates.

4.4.3 Interpretation of Data

All archaeological sites visited within the drawdown zone have been subject to erosion. Some impacts are the direct result of erosion from wind and wave action across the drawdown zone. As the water recedes, wind and waves erode a larger area of the bank. Impacts from vehicles and weathering related to water erosion of artifacts was noted where observed.

Unauthorized collection of artifacts is also having an impact on archaeological sites. According to Millennia Research (2016), this activity appears to be the most intensive in the early spring when the water level is low. Some of the collecting activity is opportunistic, one-time occurrences, while other specific areas of the reservoir are targeted for repeated visits by unauthorized collectors. Unauthorized collection typically results in selective removal of what would typically be the highest-significance, diagnostic artifacts (artifacts with characteristics that can be attributed to a time period and/or cultural group) from the site.

4.4.4 Conclusions

Erosion at archaeological sites visited during the study is relatively slight overall (Millennia 2016); however, sites within the reservoir continue to be compromised due to sediment movement and erosion. The integrity of sites is further impacted by on-going, targeted collection of artifacts. Collection of artifacts is possible during periods of low water levels when archaeological sites are exposed. While the objective of this study was not to prevent illegal collection of artifacts, it is recognized that this is an issue. Any recommendations arising from the Water Use Plan Order Review (WUPOR) for any direct archaeological site management will be provided to BC Hydro's Reservoir Archaeology Program (RAP)[9], as these activities fall under the purview of the *Heritage Conservation Act*.

5.0 ORDERED PHYSICAL WORKS SUMMARY

5.1 SHUWORKS-1 Wilsey Dam Flow Physical Works

5.1.1 Project Summary

Shuswap Falls Generating Station and Wilsey Dam are located on the Shuswap River. The Generating Station had a history of unplanned flow outages that caused impact to fish and fish habitat. Flow disturbances occur downstream of Wilsey Dam when a generation unit trips causing a sudden reduction in flow. A bypass valve is operated to minimize the downstream flow disruptions until flows can be routed through the spillway. Historically, bypass valve operation was not always reliable.

[9] Through the RAP, BC Hydro works with the Archaeology Branch of the B.C. Ministry of Forests, Lands and Natural Resource Operations and affected First Nations to assess and manage impacts to protected archaeological sites in the active erosion zone of the reservoir.

The objective of this project was to minimize the impact on fishery values by reducing the probability of downstream flow disruptions that result from the bypass valve not operating correctly. This was achieved by modifying the control scheme to open the Unit 2 bypass valve in the event of a Unit 1 trip and upgrading the hydraulic system to increase the reliability of opening the bypass valve (BC Hydro 2009). See Figure 2-1 for an overall schematic.

Table 5-1 SHUWORKS-1 Wilsey Dam Flow Physical Works Project Summary

Project Objective/Requirement	Source of Requirement	Completion Status
Investigate sources of flow disruptions at Wilsey Dam, identify options for changing existing works or installing new works that will further reduce flow disruptions and submit report on findings to CWR.	Clause 6 of *Water Act* Order Section 88.	Completed April 2007: • Report on sources of flow disruptions and options for mitigation submitted to Comptroller of Water Rights.
Modifications to the hydraulic system of the bypass valve were recommended to increase reliability.	Clause 6 of the *Water Act* Order Section 88. Leave to Commence for physical works on bypass valve (May 2007).	Completed November 2008: • Modifications to the controls to open the Unit 2 bypass valve in the event of a Unit 1 trip. • Upgrades to the hydraulic system to increase the reliability of opening the bypass valve. • Replacement of the forebay control system. • Implementation of alarm system visible to BC Hydro operators at Control Centre.
Two-year post construction monitoring to assess effectiveness of bypass valve upgrades	Clause 6 of the *Water Act* Order Section 88. Leave to Commence for monitoring study of effectiveness (May 2007).	Completed 2012: • The number of flow disruptions as a result of bypass valve not operating correctly was zero during the post-construction monitoring period.

5.1.2 Project Approach

To accomplish the above objective, BC Hydro completed the following key phases and activities. During the planning phase of this project it became clear to BC Hydro that significant efficiencies could be found by integrating existing BC Hydro work with the work required by the WUP Order. Summit Environmental Consultants Inc. completed the post construction compliance monitoring report (Summit 2012).

5.1.2.1 Identification / Feasibility Phase

BC Hydro (2006) reported on the sources of flow disruptions at Wilsey Dam and identified options for mitigating flow disruptions on April 12, 2007. Flow disruptions (as outlined in the 2006 report) were those that are a result of the bypass valve not operating correctly, reducing the quantity of water being

discharged into the river during a generating unit trip. The 2006 report outlined a number of options for reducing flow disruptions ranging from doing nothing to changing plant operations to provide a continuous spill.

The report recommended modifications to the control system and the hydraulic system of the Shuswap Unit 2 bypass valve to make it more reliable. On May 11, 2007, the CWR accepted the report and provided BC Hydro leave to commence for the bypass valve physical works and two years of post-construction monitoring.

5.1.2.2 Definition Phase

In addition to the bypass valve modifications identified in the feasibility report and approved by the CWR for construction, BC Hydro identified supplementary work (completed with other internal funds) to improve overall system performance with respect to maintaining fish flows downstream of the facility. The original scope was to integrate the additional control logic for the bypass valve. A condition assessment of the bypass valve control system resulted in a recommendation to completely replace the existing non-standard control system. It was also recommended to integrate intake trash rack clogging alarms, hydraulic ram malfunction control alarms, and provide BC Hydro's Control Centre with visibility for these new alarms.

5.1.2.3 Implementation / Completion Phase

The following outlines the original and supplementary scope items, all of which were successfully completed in 2008:

- Hydraulic transient modeling and testing for the Unit 2 penstock under the most severe conditions and in order to determine the control logic required to open the Unit 2 bypass valve in the event of a Unit 1 trip and with the simultaneous operation of Unit 2;
- Installation of the control logic required to open the Unit 2 bypass valve in the event of a Unit 1 trip;
- Installation of a new Programmable Logic Controller and integrated control alarms to indicate intake trash rack clogging, and a "ram–stuck" control scheme for the new hydraulic system;
- Installation of communications equipment to provide visibility of alarms to the BC Hydro Control Centre; and
- Commissioning and documentation of the new control system.

5.1.2.4 Sustainment / Ongoing Maintenance

Not included as part of SHUWORKS-1 scope, but BC Hydro completes weekly inspections of the bypass system including controls as part of routine work. Ongoing maintenance on the bypass valve is completed as required.

5.1.3 Project Outcomes – Compliance

BC Hydro monitored water levels at several locations along the Middle Shuswap River between April 2009 and March 2011 to assess effectiveness of bypass valve upgrades (Summit 2012). Results from the post-construction monitoring

report indicate that the number of disruptions were reduced to zero during the post-construction monitoring period as a result of this works project.

Most recently, in 2016, there were two unplanned flow reductions. The control logic for the bypass value has been adjusted to include the current range of operational conditions with Unit 1 being currently out of service.

6.0 SUMMARY OF CONCLUSIONS

Table 6-1 Summary of Conclusions

Project	Implications/Conclusions
SHUMON-1 Sugar Lake Inflow Monitoring	BC Hydro provides funding to maintain this gauge as part of the ongoing BC Hydro hydrometric monitoring program for Sugar Lake.
SHUMON-2 Sugar Lake Shoreline Monitoring Project	The majority of the shoreline has a low risk of erosion potential at the current full supply reservoir level of 601.72 m. Operating to a lower elevation of 601.52 m may further reduce erosion potential in the higher erosion risk areas. Note that the current WUP Order specifies a target freshet reservoir in order to mitigate the potential effects of flooding and erosion.
SHUMON-3 Flood Risks Middle-Shuswap River Monitoring	Based on the results of the monitoring program, overbank flooding was observed to occur at a discharge lower than the hypothesized 232 m^3/s. If operationally feasible to reduce the risk of flooding, maintain flows from Sugar Lake Dam below 229 m^3/s within the middle Shuswap River. This needs to take into consideration the combined flows from the Wilsey Dam and Bessette Creek (unregulated) and the ability of BC Hydro to balance other water management priorities on the system.
SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring	Archaeological sites continue to be affected by erosion and the movement of sediments. Reservoir operations which include water level fluctuations were observed to cause erosional impacts to archaeological sites within the drawdown zone. On-going, targeted, unauthorized collection of artifacts has a significant impact on the integrity of sites. Reservoir operations which include sustained periods of low water levels can provide unrestricted access to archaeological sites rendering them vulnerable to unauthorized artifact collection.
SHUWORKS-1 Wilsey Dam Flow Physical Works	An investigation was completed to report on sources of flow disruptions and options for mitigation. Modifications were completed to the control system and hydraulics of the existing flow bypass system. Two-year post-construction monitoring was then completed in 2012 to assess the effectiveness of the upgrades. The results of the monitoring indicated that flow disruptions as a result of the bypass not working correctly had dropped to zero within the two-year post-construction period.

7.0 REFERENCES

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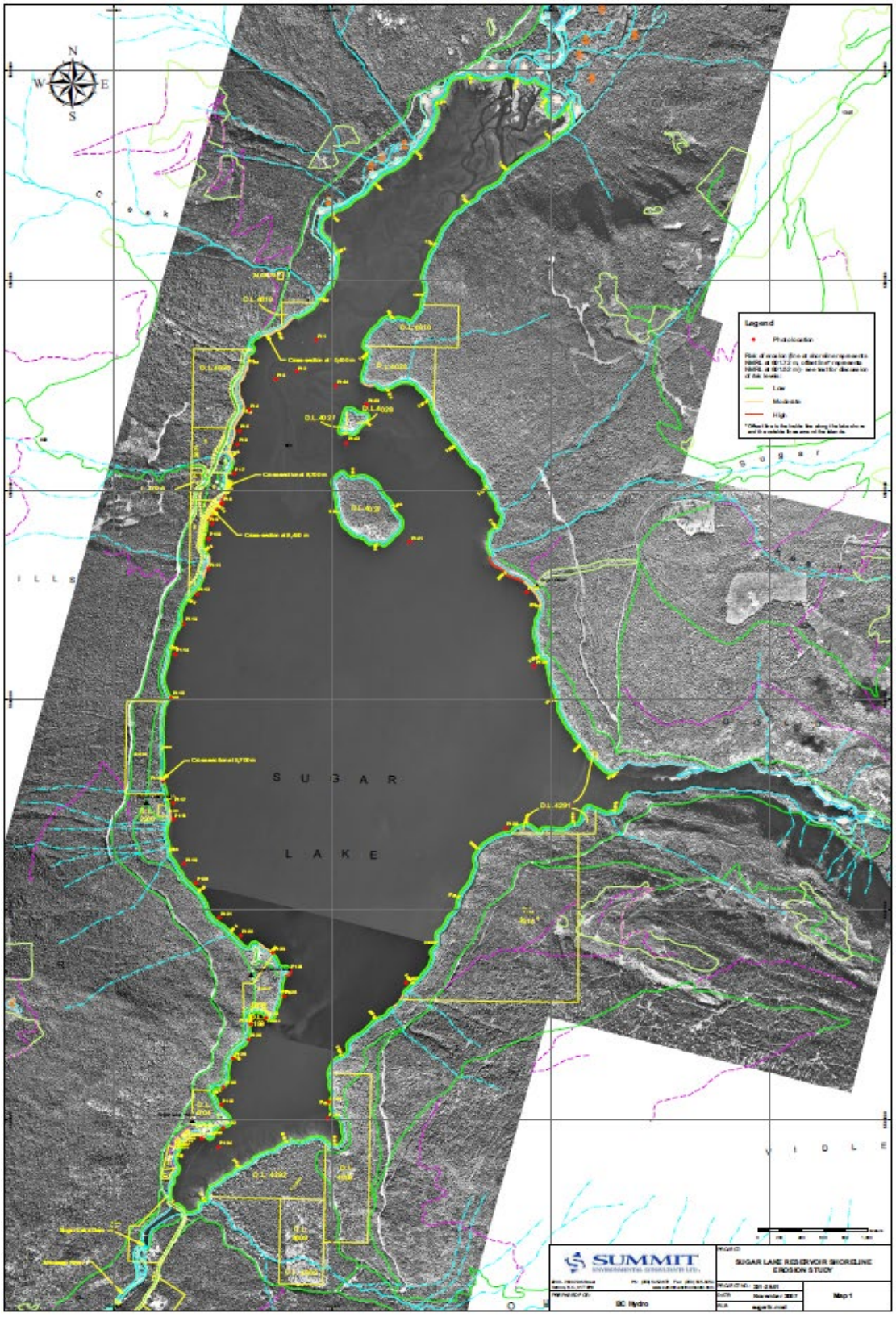
Appendix 1 – Sugar Lake Reservoir Shoreline Erosion Assessment Map



Appendix 2 - External Communication Log

The Draft Environmental Synthesis Report was shared with government regulatory agencies, First Nations and key stakeholders for review and comment. Appendix 2 contains the record of external communications with these groups. Note that this communication log includes in-person meetings, key emails, and teleconferences, but does not include all of the email communication throughout the process.

Key stakeholders were notified via email, including past Consultative Committee members, local business owners, currently elected officials, and property owners. No comments were received from any of the key stakeholders.

Government agency representatives included Fisheries and Oceans Canada (DFO), the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), and the Canadian Wildlife Service (CWS).

First Nations representatives included Okanagan Indian Band (OKIB) and the Okanagan Nation Alliance (ONA), and Secwépemc.

Shuswap Water Use Plan Order Review - External Communication Log

Date	Communication to:	Communication from:	Topic	Communication Format
27-Nov-18	ONA, OKIB*	BC Hydro	Water Use Plan Order Review introduction and Shuswap Water Use Plan refresher	Meeting
29-Nov-18	Agencies**	BC Hydro	Pre-screen review of the Shuswap Environmental Synthesis Report (SHU ESR)	Email
11-Dec-18	BC Hydro	DFO	Comments from DFO during the pre-screen review	Email
17-Dec-18	Secwepemc	BC Hydro	Water Use Plan Order Review introduction and Shuswap Water Use Plan refresher	Meeting
15-Jan-19	DFO	BC Hydro	BC Hydro response to DFO pre-screen comments	Email
07-Feb-19	Key Stakeholders***, Agencies, ONA, OKIB, and Secwepemc	BC Hydro	Beginning of formal review period and invitation to provide comments on the SHU ESR	Email
21-Feb-19	ONA, OKIB	BC Hydro	SHU ESR review	Telephone conference
12-Mar-19	ONA, OKIB	BC Hydro	SHU ESR review	Meeting
15-Mar-19	Secwepemc	BC Hydro	SHU ESR review	Meeting
06-May-19	BC Hydro	DFO	DFO provided comments from their review of the SHU ESR	Email
16-May-19	DFO	BC Hydro	BC Hydro response to DFO review comments	Email
28-Jun-19	ONA, OKIB	BC Hydro	SHU ESR review	Meeting
19-Sep-19	ONA, OKIB	BC Hydro	SHU ESR review and WUPOR pause discussion	Meeting

* First Nations representatives included ONA, OKIB, and Secwepemc

** Agency representatives included DFO, FLNROD, and CWS

*** A complete list of key stakeholders is noted below

Role	Affliation
Consultative Committee members	Kingfisher Environmental Interpretive Centre Society
	Residents and landowners (3 total)
	North Okanagan Naturalists Club
	Mable Lake Community Club
Local business	Sugar Lake Bistro and Lodge
	Sugar Lake Recreational Properties
Elected officals	Mayor of Lumby
	RDNO - Area E Director
	RDNO - Area D Director and Chair
	MLA Vernon Monashee
Property owners	Residents and landowners (16 total)

Appendix 3 - External Comments and Responses

Comments received from Okanagan Indian Band (OKIB), Okanagan Nation Alliance (ONA), and Fisheries and Oceans Canada during their review of the draft Environmental Synthesis Report (ESR), along with BC Hydro's responses, are included in Appendix 3.

BC Hydro, OKIB and ONA met to discuss their comments and our responses throughout the review process. For ease of reading, each comment and/or response thread has been consolidated into one comment and one response.

Appendix 3 also includes a letter (dated October 10, 2019), from OKIB and ONA to BC Hydro which includes comments related to the draft ESR content. The letter also includes comments on other matters, including concern with pausing the Water Use Plan Order Review after Stage 1, and recommendations for Stage 2.

BC Hydro provided a letter response to OKIB and ONA on December 13, 2019. This response letter has not been included as it focusses on the pausing of the Shuswap WUPOR and Stage 2 of the WUPOR, rather than the content of the draft ESR itself.

Commenter	Section of Report	Subject/Management Question	Comment	BC Hydro Response	BC Hydro Action (as required)
ONA	Title Page	Authorship	Indicate that all authors are BC HYDRO	Yes, we will make this change.	Reflected in final ESR.
ONA	Executive Summary	Legislation	Initial comment: Include year of Water Sustainability Act (WSA), Feb 2016, therefore should go through WUP and Orders following the new WSA. Follow-up to BC HYDRO response: Will BC HYDRO provide document(s) that states water licenses (Orders) are grandfathered under the Old Water Act?	Yes, we will make this change - will clarify that the former Water Act was replaced by the Water Sustainability Act which was brought into force Feb 29, 2016. The Water Act was replaced by the Water Sustainability Act in February 2016; however Orders and water licences continue to be valid and are governed by the new Water Sustainability Act through the legislative change.	Edit made to the ESR. Additional clarification provided.
ONA	Executive Summary	Wildlife Values	Initial comment: No study on benefits or impacts to Wildlife values, should be added for future work, or assessed through a desktop method (i.e. FWCP reports) Follow-up to BC HYDRO response: Sure, what is good for fish is good for fish eating wildlife, however changes in habitat due to flow changes and reservoir changes (i.e. erosion) is still largely ignored and still a major data gap in this ESR. Refer to CC process, but the CC process was limited and focused on private lands. Still need to review and look at wildlife values, not ignore it. Wildlife values should have been assessed during the process. This is a data gap that needs to be brought to Step 2 of the WUPOR.	Wildlife values were discussed during the CC process. The overall objective for wildlife was to maintain biodiversity and ecological function in the Shuswap system. The CC report states that considering the small size of the reservoir in comparison to inflows, it was recognized early on that the ability to affect wildlife through changes in operations was very limited. The report also states that the opinion of a professional wildlife biologist was such that judgements regarding what is best for fish across both the reservoir and the river could serve as a proxy measure for benefits to wildlife dependent on fish for food. The opinions of the biologist around habitat were very tentative and dropped before the final round of trade-offs. Status Quo operation was deemed best for potential impacts to wildlife.	Consider in Step 2 of WUPOR.
ONA	Executive Summary	SHWORKS-1	Not discussed in Executive Summary, should give a paragraph on results and conclusions of this work.	Yes, we will make this change.	Reflected in final ESR.
ONA	Executive Summary	SHUMON-1	Initial comment: Every estimate should include level of confidence and uncertainty. Follow-up to BC HYDRO response: Note that the level of confidence and uncertainty needs to be provided for all studies that provide estimates (SHUMON 1-4, SHUWORKS 1).	Yes, we will make this change in the project section.	Reflected in final ESR. Additional edit made to other studies.
ONA	Executive Summary	SHUMON-4	This study is complete, update text to identify whether recommendations were provided to RAP.	Yes, we will make this change.	Reflected in final ESR.

ONA	Executive Summary	Table E - 1, SHUMON-2	Initial comment: Objectives-no mention of flooding affects Follow-up to BC HYDRO response: What is the maximum freshet seasonal target reservoir elevation for Sugar Lake? If the CC recommended only an erosion study be done, then flooding needs to be removed from ESR. Therefore ONA sees this (flooding) as a data gap. Need to describe it at lake level and area between etc.	Yes, the study looked at erosion potential only, not flooding days. The term "flooding" was used to describe high inflow events (i.e., heavy rain/storms when the reservoir is at full supply level). The study was intended to focus on the potential effects of these high inflow events on shoreline erosion. Strong wind/wave action can also contribute to shoreline erosion. Note that the current WUP Order (Table 3-1 in the ESR) specifies a reservoir draw down level (596.00 m or lower) during April in anticipation of freshet. In the summer there are target reservoir elevation for recreational values and to ensure enough storage to meet minimum flows for fish in the fall and winter. Our operating procedures currently specify a target elevation below the licensed full supply reservoir elevation (601.72 m) in order to provide a small buffer from high inflows. Regarding the rationale behind the study, the primary remaining concern was the uncertainty regarding erosion of property, particularly during high inflow ("flood") periods, so the CC recommended that an erosion study be included in the WUP. The study proceeded according to the TOR. We will clarify this in the document.	Reflected in final ESR.
ONA	Executive Summary	Table E - 1, SHUMON-2	Initial comment: WUP project appears predominantly focused on erosional effects to private properties and not related to any fish and wildlife effects. Future wildlife work is needed to help address operational options—questions about which operation provides the best wildlife habitat over the long-term, what amount of habitat and what type would be lost or gained for each operation, and which species would benefit most/be impacted most by each operation? Operational options, i.e. lower reservoir, may also lead to re-growth of plant communities (roots and berries) historically used in area for sustainable food supply. Follow-up to BC HYDRO response: Yes, we see this as a data gap in the WUP and should be included in Step 2 of the WUPOR.	The scope of this study was restricted to potential erosion effects. Please see comment response in row 6 for a discussion of the wildlife component assessed by the CC. We would like to confirm that ONA is identifying a potential gap in the WUP in terms of wildlife values.	Consider in Step 2 of WUPOR.
ONA	Executive Summary	Table E - 1, SHUMON-2 Management Question 2: Would operating the reservoir below full pool (at 601.52 m) significantly reduce shoreline erosion over the long-term?	Initial comment: "Operating to a lower maximum pool elevation of 601.52 m may reduce erosion potential. "--Need to identify what operational changes are realistic, i.e. not just recommendations but something operational BC HYDRO can actually implement. Follow-up to BC HYDRO response: OK. Should be included in Step 2. In light of the uncertainty of Step 2 what are the short and long term management and protection steps that BC HYDRO will follow?	Agree, this can be considered as we move into the WUPOR. Operations will be discussed in the next stage of the review, and realistic operations proposed if needed.	Consider in Step 2 of WUPOR.

ONA	Executive Summary	Table E - 1, SHUMON-2 Management Question 2: Would operating the reservoir below full pool (at 601.52 m) significantly reduce shoreline erosion over the long-term?	Initial comment: MQ#2-Would operating reservoir below full pool reduce erosion over the long-term? Comment: study was only one year so some concerns about assessing long-term effects. Follow-up to BC HYDRO response: The TOR process is limited in scope, data gaps are seen, i.e. flooding was not part of TOR. No information (numbers) provided for the terms "extrapolated" "expected" "may reduce" etc. Would like to see the information provided in Step 2. Objective includes flooding but no management question regarding flooding, CC process appears to be flawed as limited input etc.	This study proceeded according to TOR, assessed erosion potential, and answered mgmt. questions. We felt results could be extrapolated to long term.	Consider in Step 2 of WUPOR.
ONA	Executive Summary	Table E - 1, SHUMON-2 Management Question 2: Would operating the reservoir below full pool (at 601.52 m) significantly reduce shoreline erosion over the long-term?	Initial comment: Response-Operating to a lower max pool elevation of 601.52m…Comment: are you operating at this level whenever you are able to? Follow-up to BC HYDRO response: Is the "new" max elevation operations going to be 601.52?	The licenced range of the reservoir is 589.64m-601.72m (full supply level). Reservoir elevations are primarily managed in accordance with the inflows, and delivering on ordered requirements such as fish flows and generating power. We target operations in Sugar Reservoir below full supply level in order to provide room for potential sudden, high inflows in order to help manage downstream flood potential.	We will continue to target operations below full supply level to manage flood risk however this does not change our licenced maximum level.
ONA	Executive Summary	Table E - 1, SHUMON-3 Management Question 2: At what discharge does flooding begin in the middle Shuswap River?	Initial comment: Implications-overbank flooding to occur at discharge lower than the hypothesized 232 m3/s. Comment: is there a new operating order based on this new knowledge? When does this occur throughout the year? Does going from 232 to 229 affect fish? Follow-up to BC HYDRO response: BC HYDRO can you confirm new operating flows (<229m3/s) are in Operating order. Request that these questions Move into Stage 2 for follow up.	Notifications when river discharges reach the flood threshold could be considered in Stage 2. Internal operating procedures already contain notification requirements when discharge from Sugar Dam exceeds 200 cms. River flows of 229m^3/s are only reached during high inflow situations outside of BC Hydro's control. The intent of this study was to determine when overbank flooding begins in the Middle Shuswap River, and whether BC Hydro operations at Sugar could be adjusted to minimize flood impacts. Prevention of overbank flooding is of benefit to fish.	Provided additional information via meeting September 19, 2019.

ONA	Executive Summary	Table E - 1, SHUMON-3	Initial comment: These series of questions are designed to look at flooding and erosion risk to people's property. Need to turn this around and look at the fisheries and wildlife benefits that would be gained or lost from various operational flows. Objective should be to reclaim habitat in high risk areas lost to agricultural development. Regained habitats would return wildlife and provide roots/berries for sustainable food supply. Follow-up to BC HYDRO response: ONA is identifying that there is a gap in the WUP regarding wildlife values (including habitat).	Please see comment response in row 6 for a discussion of the wildlife component assessed by the CC. We would like to confirm that ONA is identifying a potential gap in the WUP in terms of wildlife values. If so, it will be considered in Stage 2.	Consider in Step 2 of WUPOR.
ONA	Executive Summary	Table E - 2, SHUWORKS-1	*Completion-2012.* Comment: can you add more detail as to what was completed?	Yes, we will make this change	Reflected in final ESR.
ONA	Context	Wildlife Values	This has not been assessed, take out of first paragraph.	Please see comment response in row 6 for a discussion of the wildlife component assessed by the CC. We will clarify this in the document.	Reflected in final ESR.
ONA	Context	SHUMON-2	Initial comment: Should have looked at shoreline erosion and flooding risk at the lower max elevation also. Follow-up to BC HYDRO response: What is the assessment process, we can't find it in the report. There are assumptions that "operating to a lower maximum pool elevation of 601.52 m is expected to reduce shoreline erosion potential" We still see this as a data gap that was missed under the TOR. We would like to further discuss in Stage 2.	This study did assess what the erosion potential would be at the lower MRNL of 601.52m. The study proceeded according to the TOR. We will clarify this in the document.	Reflected in final ESR.
ONA	Context	"…assessed the anticipated benefits to recreation and fisheries values…"	This is not clearly stated in the Executive Summary i.e. The "anticipated benefits". Also, wildlife values mentioned here and should be removed.	Agree and we will clarify the Executive Summary. Please see comment response in row 6 for a discussion of the wildlife component assessed by the CC. We will clarify this as well in the document.	Reflected in final ESR.
ONA	SHUMON-3 Flooding Risks in the Middle Shuswap River	4.3.2 Project Approach, SHUMON - 3	Paragraph indicates that Splatsin worked with Summit Environmental Consultants. What did Splatsin actually do??	Agree, we will clarify in the document. The proposal for the work was submitted in conjunction with Splatsin, and stated that Splatsin would provide technical and administrative input, and a field technician to work with Summit in the field and to complete a number of office technical tasks. The final report indicates that this occurred.	Reflected in final ESR.
ONA	Project Background	2.1 Hydroelectric Facilities, Inflows	Discuss major input between dam and Mabel Lake.	Editorial comment. We will clarify that while not part of the hydroelectric facilities, there are significant tributaries downstream (i.e. Bessette Creek).	Reflected in final ESR.
ONA	Project Background	Figure 2-1, Powerhouse part of figure	Should update figure as one turbine not working.	Editorial comment. Added footnote to figure.	Reflected in final ESR.
ONA	Project Background	Table 2-1, units of storage for Wilsey dam	Is this the correct unit to measure storage volume?	This is a typo - we will fix	Reflected in final ESR.
ONA	Shuswap River WUP Process	Editorial	"~~ for~~ (four) monitors and (one) physical work ordered by the CWR	This is a typo - we will fix	Reflected in final ESR.
ONA	Shuswap River WUP Process	Clarifications about uncertainties defined in the WUP consultative process	All uncertainties or just specific ones.	The study Terms of Reference for SHU were intended to address the specific uncertainties identified in the WUP. We will clarify this bullet.	Reflected in final ESR.

ONA	Shuswap River WUP Process	Table 3-1, Sugar lake Reservoir, Wording addition	Achieving the above elevations is secondary to meeting min flows (16 m^3/s) below Wilsey Dam	Yes, we will make this change. There are two minimum flows downstream of Wilsey, depending on the time of year.	Reflected in final ESR.
ONA	Shuswap River WUP Process	Table 3-2, Sugar lake Dam Ramp Rates, Comment under Purpose	"uncertainties around the discharge relationships…". Show the relationships.	Agree, we will clarify in the document.	Reflected in final ESR.
ONA	SHUMON-1 Sugar Lake Reservoir Inflow Monitoring	Table 4-1 Project Summary, Response	Forecast versus actual, how closely related?	Agree, we will clarify in the document.	Reflected in final ESR.
ONA	SHUMON-1 Sugar Lake Reservoir Inflow Monitoring	Table 4-1 Project Summary, Implications	How exactly does gauging station at Eagle support inflow forecasting?	Agree, we will clarify in the document. The Eagle River gauge provides hourly real-time data, which is used to predict inflow trends and is supplementary to the inflow calculations.	Reflected in final ESR.
ONA	SHUMON-1 Sugar Lake Reservoir Inflow Monitoring	Figure 4-1	Show gauge location on the map.	Yes, we will make this change	Reflected in final ESR.
ONA	SHUMON-1 Sugar Lake Reservoir Inflow Monitoring	4.1.3 Interpretation of Data	Initial comment: "No other gauge is considered to provide an adequate level of correlation for Sugar Lake Reservoir"--should it have its own gauge then? Follow-up to BC HYDRO response: Can BC HYDRO provide/add the numbers that support the correlation of the Eagle River Gauge to the inflows for Sugar Lake Reservoir within the ESR text.	There is a gauge on the Shuswap River at the outlet of Sugar Lake Reservoir, measuring the discharge from the reservoir. Inflows are calculated based on changes in reservoir water levels and the discharge. The Eagle River gauge provides hourly real-time data, which is used to predict inflow trends and is supplementary to the inflow calculations. Based on this information, we have concluded an additional gauge is not required. Additionally, the intent of this study was to confirm that we could use Eagle River gauge as a tool to predict what will happen in Sugar.	Reflected in final ESR
ONA	SHUMON-1 Sugar Lake Reservoir Inflow Monitoring	4.1.4 Conclusions	Initial comment: Eagle River stn shown to be very valuable--who did the comparison analysis? Follow-up to BC HYDRO response: Can BC HYDRO provide/add the numbers that support the correlation of the Eagle River Gauge to the inflows for Sugar Lake Reservoir within the ESR text.	Agree, we will clarify in the document. Comparisons were completed by BC Hydro staff.	Reflected in final ESR.
ONA	SHUMON-2 Sugar Lake Reservoir Shoreline Erosion	4.2.1 Project Summary, Table 4-2	Initial comment: add more questions: 3. flooding; 4. wave action at full pool. Follow-up to BC HYDRO response: These are outstanding questions that need to be taken to Step 2.	The management questions for the monitoring studies were established in the TORs for the studies and thus we are not able to add management questions within the ESR. If there are outstanding questions, they will be brought to Step 2 of the WUPOR. We will track this question.	Consider in Step 2 of WUPOR.
ONA	SHUMON-2 Sugar Lake Reservoir Shoreline Erosion	4.2.1 Project Summary, Table 4-2 Management Question 2: Would operating the reservoir below full pool (at 601.52 m) significantly reduce shoreline erosion over the long-term?	Initial comment: 2. Operating to a lower max pool is expected to reduce erosion potential---how/why will this happen? Follow-up to BC HYDRO response: Was there a physical assessment or a professional opinion? Need to see edit to confirm if our comment has been addressed.	Agree, we will clarify in the document. One factor that has the potential to cause erosion is wave action resulting from large, infrequent storms, particularly when the reservoir is near its full pool.	Provided additional information via meeting on September 19, 2019

ONA	SHUMON-2 Sugar Lake Reservoir Shoreline Erosion	4.2.1 Project Summary, Table 4-2	Initial comment: "may reduce erosion potential": therefore study to confirm assumptions. Follow-up to BC HYDRO response: These are outstanding questions/uncertainties that need to be taken to Step 2.	The management questions for the monitoring studies were established in the TORs for the studies and thus we are not able to add management questions within the ESR. If there are outstanding questions, they will be brought to Step 2 of the WUPOR. We will track this question.	Consider in Step 2 of WUPOR.
ONA	SHUMON-2 Sugar Lake Reservoir Shoreline Erosion	4.2.2 Project Approach	"final report summarized results from the single study year and addressed the management questions listed above"--No it didn't, still some questions.	BC Hydro considers the management questions to be answered. Edits have been made to the document in effort to clarify the study scope, and thought process behind how the study was structured. If there are outstanding questions, they will be brought to WUPOR and considered in Step 2.	Reflected in final ESR.
ONA	SHUMON-2 Sugar Lake Reservoir Shoreline Erosion	4.2.2 Project Approach	Initial comment: "The potential for erosion of each segment was then analyzed at both reservoir elevations."--The Summit Environmental Report provides some suggestions of hard armoring (including cabled concrete mats) for erosion protection. Elders have requested use of only natural materials in other ONA bank erosion mitigation projects (i.e. Slocan Pool). Follow-up to BC HYDRO response: ONA recommends that any BC HYDRO projects that occur within our territory where erosion protection occur with natural materials. Duty to consult ONA and individual bands are still required to occur for every project.	We will share this comment with the BC HYDRO Environment and Indigenous Relations teams for future reference.	Recommendation noted and shared with IR and ENV team.
ONA	SHUMON-2 Sugar Lake Reservoir Shoreline Erosion	4.2.3 Interpretation of Data, 4.2.4 Conclusions	All erosion discussion and no flooding discussion.	Please see comment response in row 10.	Reflected in final ESR.

ONA	SHUMON-3 Flooding Risks in the Middle Shuswap River	Private land, fish and wildlife values, flooding	Initial comment: Project is related to flooding of private properties along the river. Future work should focus on identifying key fish and wildlife values that have been lost, and could be regained, if agriculturally properties were converted back to their original riparian habitat. Climate change effects will most likely make this system more extreme, resulting in the flooding of private land issues not being resolved. The Grand Forks flood recovery program is looking at by-back of some of the properties flooded on the Kettle system so they don't have to deal with same issues on the same properties year after year. Follow-up to BC HYDRO response: Agree, to be addressed in Step 2. ONA would support purchases of private land to benefit fish, wildlife and more naturalized processes to occur. In light of the uncertainty of Step 2 what are the short and long term management and protection steps that BC HYDRO will follow?	If there are outstanding questions, they will be brought to Step 2 of the WUPOR. We will track this question. Note that land use is the jurisdiction of the Province and local government, and is outside the scope of the WUPOR.	Response provided.
ONA	SHUMON-3 Flooding Risks in the Middle Shuswap River	4.3.1 Project Summary, p. 12	Initial comment: Is this the only objective/concern? What about Upper Shu flooding? Vegetation, wildlife, fish??? Follow-up to BC HYDRO response: Highlights the lack of broader scope of CC outcome objectives in relation to the project as a whole. If CC assumed that below flood mitigations would apply, would like to see the documentation for this assumption. The comment was specific to the area between Wilsey Dam and Sugar Lake. This as a data gap, not included in the original CC process.	Yes, this was the objective of this study, as discussed during the CC process and therefore included in the WUP. The CC report specified flooding as an issue along the flood plain of the river, specifically the area west of Cherry Creek, the Mabel Lake community north of Bessette to Mable Lake, and the community of Mara. It was assumed at the time that any improvements to flood control for properties upstream of Mabel Lake would also benefit properties below Mabel Lake to Mara Lake. F40	Response provided.
ONA	SHUMON-3 Flooding Risks in the Middle Shuswap River	4.3.1 Project Summary, Management Questions	Initial comment: Bessette Creek? Follow-up to BC HYDRO response: Take to Step 2. Summit determined and recommended that Bessette Creek needs a real-time station to better predict flooding potential below Wilsey, as Bessette is a major contributing stream to Middle Shuswap River. Need to follow up on the implication.	The management questions for the monitoring studies were established in the TORs for the studies and thus we are not able to add management questions within the ESR. If there are outstanding questions, they will be brought to Step 2 of the WUPOR. We will track this question.	Confirmed that Bessette Creek is now a real-time station

ONA	SHUMON-3 Flooding Risks in the Middle Shuswap River	4.3.1 Project Summary	3. outflows = Sugar, Wilsey and Bessette. Is there a station on Bessette?	Yes, we will clarify in the document. There is a gauge on Bessette.	Reflected in final ESR.
ONA	SHUMON-3 Flooding Risks in the Middle Shuswap River	4.3.3 Interpretation of Data Management Question 1: What are the key areas where flooding is a concern along the middle Shuswap River?	Were the key areas identified only from complaints? Should add bank stabilization map.	Yes, we will clarify in the document. The consultant reviewed all relevant hydrologic, geologic, and topographic information for the Middle Shuswap, including footage from a 2006 helicopter survey, and selected the 3 highest risk sites based on the data.	Reflected in final ESR.
ONA	SHUMON-3 Flooding Risks in the Middle Shuswap River	4.3.3 Interpretation of Data Management Question 1: What are the key areas where flooding is a concern along the middle Shuswap River?	Initial comment: Recommendation: Riparian and wetted areas, including seasonally wetted, provide key habitats to support the life stages of many species. Properties that continually flood should be purchased and reverted back to wildlife and fisheries habitats versus putting dollars into bank stabilization projects for re-containment of the river system. Follow-up to BC HYDRO response: OK. Will BC HYDRO forward this recommendation to the FWCP committee?	We understand the comment and have communicated that this issue is not within the scope of the WUPOR. A proposal to purchase properties with high ecological value could be developed and submitted to FWCP for consideration.	Additional information provided via email September 13, 2019.
ONA	SHUMON-3 Flooding Risks in the Middle Shuswap River	4.3.3 Interpretation of Data Management Question 2: At what discharge does flooding begin in the middle Shuswap River?	"The result for the 2011 observations is that flooding begins during a discharge of 229 m3/s." --229 from where/breakdown of flows?	Yes, we will clarify in the document. Discharge from Wilsey should be managed such that below Bessette Creek, the total discharge is at or below 229m3/s.	Reflected in final ESR.
ONA	SHUMON-3 Flooding Risks in the Middle Shuswap River	Figure 4-4	Need legend	Yes, we will have the figure updated	Reflected in final ESR.
ONA	SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring	4.4.3 Interpretation of Data	Initial comment: If not already in place, a Guardian Program similar to the one operating in the Arrow should be implemented; or, have the Arrow program expand to the Shuswap. Follow-up to BC HYDRO response: OK. Please provide future updates of when provided and the Working Group's response.	We understand this comment and will pass it along to the Sugar RAP Technical Working Group for consideration.	BC HYDRO will forward this request to ENV.
ONA	SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring	4.4.4 Conclusions	Initial comment: We should make recommendation as well. Follow-up to BC HYDRO response: OK. Confirm, this needs to be taken to Step 2 and allowance for ARC experts to provide recommendations.	Yes, recommendations will be included and considered in Stage 2 WUPOR.	Consider in Step 2 of WUPOR.

ONA	SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring	4.4.4 Conclusions	Initial comment: Look at elevations of sites, can other reservoir max levels alleviate some of the issues (both high and low levels)? Would any of these sites benefit from erosion protection works as mitigation? Follow-up to BC HYDRO response: OK. In light of the uncertainty of Step 2 what are the short and long term arc management and protection steps that BC HYDRO will follow at the lake?	Changes to operations would be a consideration under Step 2 of the WUPOR. However, to assess whether other reservoir max elevations would alleviate concerns, additional information would be required, including bathymetry. Erosion protection could be a consideration under both the RAP.	Consider in Step 2 of WUPOR.
ONA	SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring	4.4.4 Conclusions	For the RAP program, can you change the current operations to reduce the amount of area exposed?	Changes to operations will be considered via the WUPOR process.	Consider in Step 2 of WUPOR.
ONA	SHUWORKS-1 Wilsey Dam Flow Physical Works	5.1.1 Project Summary, Table 5-1	How many failures occurred where the bypass had to work?	We are seeking to obtain this information, and will share with OKIB and ONA when the information is available. On April 5, 2012 minimum flow was reduced to ~ 10.4 m3/s for ~ 20 minutes due to a forced outage on a transmission line which forced out the SHU plant. With a trip of generating unit 2, the bypass opened to 26% however should have opened to 32% to maintain minimum flow.	Provided additional information via meeting September 19, 2019.
ONA	Summary of Conclusions	Table 6-1	Initial comment: Include Data Gaps and Recommendations columns in table. Follow-up to BC HYDRO response: If not willing to include in Table Data Gaps and Recommendations columns, (although it is discussed in the specific objectives Page 1-2, bullets 3. and 4.), then you need to include a sentence or two stating that BC HYDRO feels there are no data gaps or recommendations from these studies. A note, SHUMON 3, Summit recommends that the Bessette Creek monitoring station gets upgraded to a Real-time monitoring station. There are other recommendations from the other studies as well that should be considered for inclusion.	The ESR doesn't contain recommendations. The ESR provides a summary of monitoring programs, physical works, and the conclusions drawn. If we felt there was a gap remaining after the study, we'd highlight it here, and recommendations would follow in the WUPOR report.	Reflected in final ESR. Additional edit made to clarify the purpose of the ESR and Monitoring programs.
ONA	Summary of Conclusions	Table 6-1, SHUMON-1, Implications	Only one year using Eagle River, confirm would still work during drought or wet year.	Agree, we will clarify in the document. BC HYDRO has been using the Eagle River gauge for over 10 years, since the beginning of the study, and it's still being used today.	Reflected in final ESR.
ONA	Summary of Conclusions	Table 6-1, SHUMON-2, Implications	Operating to a lower level exposes more for ARCH.	We understand this comments relates to the link between reservoir elevations and impacts to archaeological sites. The SHUMON-2 monitoring study did not assess impacts to archaeology due to lower reservoir levels. Outstanding or new questions would be included in Step 2 of the WUPOR.	Consider in Step 2 of WUPOR. See lines 50 and 62 for related considerations.
ONA	General Comment	Report Formatting	Make sure table titles on same page as table, put references on own page.	Typo - we will fix	Reflected in final ESR.

OKIB	General Comment	WUP General	Initial comment: What was the overall approved budget for the SHU WUP? Follow-up to BC HYDRO response: How does this compare with other dams of this capacity?	Financial information will be included in the WUPOR report. The total approved budget for SHU monitoring studies and physical works was $649,597.	Additional information provided via email September 13, 2019.
OKIB	General Comment	WUP General	Initial comment: Where did the majority of WUP money go for the of BC? And in this Order review should we be assessing or determine if the projects were well spent for theorized technical results? Follow-up to BC HYDRO response: Did not give break down province wide. Need to see this.	Allocation of funding for WUPs was done through approval of individual Terms of Reference for various studies and works. Allocations were not made as a set aside on a regional level. SHU WUP money went to study costs and management. There will be a section on finances in the WUPOR report	Additional information provided via email September 13, 2019.
OKIB	Executive Summary	Table E -1, SHUMON-1	Initial comment: There should have been more specific management questions for this study. How was the information valuable to BC Hydro for inflow forecasting? What operational adjustments are made with this information. Follow-up to BC HYDRO response: Is this a stage two discussion?	Agree that study is not very clear on how the information helps. The Management Questions cannot be change. Additional Management Questions would be considered in Step 2 of the WUPOR. We can clarify why the information is useful. Any outstanding mgmt questions will go forward to WUPOR.	Consider in Step 2 of WUPOR. Edit also made to the ESR to clarify the utility of the information.
OKIB	Executive Summary	Table E -1, SHUMON-2 Management Question 1: Does operating the reservoir at full pool (601.72 m) cause extensive shoreline erosion?	Initial comment: What percentage of shoreline for Sugar has high erosion risk level? Follow-up to BC HYDRO response: Is there a map to demonstrate this estimate?	This info is in the study section. It is estimated that at 601.72m, 6% of the shoreline is at high risk of erosion.	Reflected in the final ESR. Additional edit made.
OKIB	Executive Summary	Table E -1, SHUMON-3	Initial comment: With the recent high snow packs of 2017 and 2018 how much flooding occurred? Follow-up to BC HYDRO response: What considerations have been made and incorporated for flood control on lower SHU given the recent high snow packs? I guess stage 2 continued discussion	The study concluded in 2012, and assessments under the WUP were therefore not completed in 2017 or 2018. Internal operating procedures contain spill notification requirements when discharge from Sugar Dam exceeds 200 cms. River flows of 229m3/s are only reached in high inflow situations, for reasons outside of BC Hydro's control.	Additional information provided via meeting September 19, 2019.
OKIB	Executive Summary	Table E -1, SHUMON-4	Initial comment: With the out of control "pot hunting" occurring on Sugar maybe consider not drawing down as much. Follow-up to BC HYDRO response: This needs to be a recommendation! And not deferred to stage 2 which we may not even get too.	Changes to operations will be considered via Step 2 of the WUPOR process.	Consider in Step 2 of WUPOR.

OKIB	Executive Summary	Table E -1, SHUMON-4	How is the gap of the RAP program going to be melded with the SHUMON study results?	We sought clarification on this question during our June 28, 2019 meeting. We understand the concern to be with the time gap between this SHUMON4 study completing and the start of the Archeological Monitoring Program. Results from SHUMON-4 have been provided to the RAP team. Any recommendations regarding operations would be developed in Step 2 of the WUPOR, the Order Review.	Consider in Step 2 of WUPOR.
OKIB	Executive Summary	Table E - 2, SHUWORKS-1	What are the desired results of this project? Are DFO issues resolved?	The objective of this project was to minimize the impact on Shuswap River fishery values by eliminating downstream flow disruptions caused by unplanned outages on Unit 2 of Wilsey Dam. DFO issues refers to bolting shut the two LLOG which had previously been used to flush sediment from the headpond - DFO requested that the gates be sealed in 1991, and using the LLOGs to flush sediment was then replaced by dredging. The bypass valve is neither designed nor intended to pass sediment, it's only to maintain flows during a forced outage until all the river flow can go over the free crest. We wouldn't want it to pass sediment because that would gum up the workings of the valve.	Response provided.
OKIB	Shuswap River WUP Process	Consultative Committee	Initial comment: When did OKIB and ONA stop being a member of this group and when did OKIB and ONA join in the studies? Follow-up to BC HYDRO response: Could you provide the name of the lead BC HYDRO person for this project at the initial beginning phase?	We understand that no changes are requested to the ESR based on this comment, and that OKIB and ONA is seeking clarification. Section 3-2 of the Consultative Committee report states "Following the initial contact, the Okanagan Indian Band had planned to participate representing themselves and the Okanagan Nation Alliance. However, the Okanagan Indian Band decided to focus on other priorities and withdrew from the Shuswap River Water Use Plan process. The Shuswap Nation Tribal Council referred their participation to the Spallumcheen Band. A representative from the Spallumcheen Band attended Shuswap Consultative Committee (CC) meetings and the Band also attended some Fish Technical Committee (FTC) meetings." Additional information may be available in BC Hydro archives.	Additional information provided via email September 13, 2019.
OKIB	Shuswap River WUP Process	Assessing uncertainties	It says that the results were to be reviewed and assess further gaps. Who is doing the assessing for this? BC HYDRO or the consultative committee or individual interest groups?	Agree, we will clarify in the document. The tense should be changed - results from these studies are to inform this WUPOR review process. BC HYDRO is required to undertake the process and we are engaging with various groups for this review.	Reflected in final ESR.
	SHUMON-1 Sugar Lake Reservoir Inflow Monitoring	4.1.1 Project Summary - No specific management questions for this project were specified in the TOR.	How come there was no specific management questions in the TOR for this? With the information that came in from the Eagle River gauge was this immediately used in operations of the hydro facility?	Agree, we will clarify in the document. The Eagle River gauge provides hourly real-time data, which is used to predict inflow trends and is supplementary to the inflow calculations. This information has been used since the beginning of the SHUMON-1 study, and continues to be used today.	Reflected in final ESR.
OKIB	SHUMON-1 Sugar Lake Reservoir Inflow Monitoring	Figure 4-1 Location of the Eagle River gauge near Malakwa	This is not a very good map. Doesn't show the relevant distance to the Spallumcheen watershed and Sugar lake.	Yes, we will make this change	Reflected in final ESR.

OKIB	SHUMON-2 Sugar Lake Reservoir Shoreline Erosion	4.2.1 Project Summary, Management Questions	Its not very clear whether the management question was answered	Clarifications added to this section	Reflected in final ESR.
OKIB	SHUMON-2 Sugar Lake Reservoir Shoreline Erosion	4.2.2 Project Approach, editorial	# 3. planorm of shoreline What is this?	Agree, we will clarify in the document. It refers to the outline of the shore, as seen from above. Spelling error - "planform".	Reflected in final ESR.
OKIB	SHUMON-2 Sugar Lake Reservoir Shoreline Erosion	4.2.2 Project Approach	Initial comment: Was there consideration made when the study was designed should a very high snow pack occur and possible freshet (impacts) effects. Follow-up to BC HYDRO response: What happened at Wilsey Dam during abnormal high freshet years 2017 and 2018?? Did these years totally blow out all hypothesis on recommended flood scenarios?	At each monitoring site, a staff plate was installed, and permanent benchmarks and photopoints established, such that the water could be observed and measured during high flows (which could occur during freshet and as a result of high snowpack). The sites were all surveyed in 2008, 2009, 2010, and 2011. The 2011 site visit was when the required discharge from Wilsey Dam (232m3/s) was observed. This study was intended to determine when flooding starts, and if operations at Sugar could reduce flood risks - the cause of a flood could happen for any number of reasons. Internal operating procedures contain spill notification requirements when discharge from Sugar Dam exceeds 200 cms. River flows of 229m3/s are only reached in high inflow situations, for reasons outside of BC Hydro's control.	Additional information provided via meeting September 19, 2019.
OKIB	SHUMON-3 Flooding Risks in the Middle Shuswap River	4.3.2 Project Approach	Paragraph indicates that Splatsin worked with Summit Environmental Consultants. What did Splatsin actually do??	Agree, we will clarify in the document. The proposal for the work was submitted in conjunction with Splatsin, and stated that Splatsin would provide technical and administrative input, and a field technician to work with Summit in the field and to complete a number of office technical tasks. The final report indicates that this occurred.	Reflected in final ESR.
OKIB	SHUMON-3 Flooding Risks in the Middle Shuswap River	4.3.3 Interpretation of Data, wildlife	I do not see any reference or considerations for wildlife and impacts due to flooding.	Yes, the scope of this study was restricted to flooding thresholds. Please see comment response in row 6 for a discussion of the wildlife component assessed by the CC. Should OKIB feel that future wildlife work is warranted and a gap in the SHU WUP, we will note it in the WUPOR.	Consider in Step 2 of WUPOR.
OKIB	SHUMON-3 Flooding Risks in the Middle Shuswap River	4.3.4 Conclusions, Management Questions	Initial comment: Was the management question actually answered for this study. Was the terms of reference for this properly captured? Follow-up to BC HYDRO response: What was the baseline that was drawn from to make this determination? What information was this concluded from? Science or professional opinion?	Yes, we feel that the management questions were answered - a new flooding threshold was identified, and the discharge relationships are better understood. This study was intended to determine when flooding starts, and if operations at Sugar could reduce flood risks - the cause of a flood could happen for any number of reasons.	Reflected in final ESR. Additional edit made to refer to original study report.
OKIB	SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring	4.4.1 Project Summary	Why were there only two sites chosen by the CC for this SHU WUP? There were more sites discovered in various locations. There was no in the event clauses	This study was conducted based on the Terms of Reference. Sites were chosen for complexity and access for equipment.	Response provided.
OKIB	SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring	4.4.1 Project Summary, Table 4-4	Initial comment: An overall Arch guardian program with full resourcing needs to be developed Follow-up to BC HYDRO response: Then this needs to be a priority recommendation in STAGE TWO	Not within scope of WUPOR - but we understand the comment. This is being discussed at the Sugar RAP TWG.	Response provided. This is not within the scope of the WUPOR.

OKIB	SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring	4.4.2 Project Approach, Consultative Committee participation	Initial comment: Why was the WUP 2001 study done Diane French incorporated into the SHUWUP? Was there a consultative committee in place to help steer this work?? I don't believe this should have ever been considered to be incorporated into this WUP. Follow-up to BC HYDRO response: So you mean you talked to Splatsin. Change you response to say Splatsin and not generalizing all First Nations into this group.	Yes, the CC discussed archaeology with the First Nations Heritage and Archeology Resources sub-committee that guided the work. Splatsin Nation participated in this sub-committee. We understand that OKIB and ONA were not involved in the First Nations Heritage and Archeology Resources table for the original WUP and have some concerns with the Diane French study (2001).	Response edited to clarify FNs involved.
OKIB	SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring	4.4.3 Interpretation of Data, definition of terminology	What is diagnostic artifacts?	A diagnostic artifact displays particular characteristics that can be attributed to a time period and/or cultural group.	Reflected in final ESR.
OKIB	SHUWORKS-1 Wilsey Dam Flow Physical Works	5.1.3 Project Outcomes - Compliance, water licence question	Initial comment: Since Unit one is out of service what necessary adjustments to the water license that BC HYDRO needs to make since they are not compliant with the intended water usage? Follow-up to BC HYDRO response: And water comptroller	We understand that no change is required to the ESR. Changes to the water license are not within the WUPOR scope, but the comment is understood and will be referred to the Water License team.	Response provided. All comments received will be included in reports provided to the Comptroller of Water Rights.
OKIB	SHUMON-4 Sugar Lake Reservoir Archaeology Monitoring	Scope of WUP project and RAP	Initial comment: Disagree that this arch monitoring is off loaded onto the RAP!! BC HYDRO needs to discuss with OKIB/ONA Follow-up to BC HYDRO response: This needs to be made very clear with the intentions of any future program for Sugar Lake and downstream works	We discussed this concern with OKIB and ONA on June 28, 2019. If outstanding questions remain regarding archaeology and operations, these will be considered in the WUPOR. We have also added some more context regarding the RAP program to the ESR.	Reflected in final ESR.
Fisheries and Oceans Canada	SHUMON-1 Sugar Lake Reservoir Inflow Monitoring	Years of data; expected future correlation	Clarify how many years of data collected from the Eagle River gauging station were used to correlate with the Sugar Lake reservoir inflow data. As well, please comment on whether BC Hydro expects this correlation to continue in future years.	The Eagle River gauge has been in use since 1955 by the Water Survey of Canada. Data collected between 2005 and 2015 was used for this study to correlate with the Sugar Lake reservoir inflow data. It continues to be used today for this purpose today. So essentially it has been used from 2005 until today to support Sugar Lake Reservoir operations. The study recommendation was to continue operation of this gauge as there is no other gauge that provides an adequate level of correlation. The gauge has been valuable in supporting inflow forecasting and historical inflow data quality control for Sugar Lake Reservoir. We do not expect this practice to change in the future and BC Hydro will continue to fund the operation of this gauge.	Response provided

Fisheries and Oceans Canada	SHUMON-2 Sugar Lake Reservoir Shoreline Erosion	SHUMON-2 Management Question 2: Would operating the reservoir below full pool (at 601.52 m) significantly reduce shoreline erosion over the long-term?	Comment on the significance of shoreline erosion from operating the reservoir below the full pool elevation (i.e., 601.52 m). For context, the second management question sets out to identify if there is a significant difference to shoreline erosion when operating the reservoir below 601.52 m. BC Hydro has responded by stating that operating the reservoir below 601.52 m is "expected" to reduce shoreline erosion potential. DFO's concern is that the management question was not answered.	Maximum Normal Reservoir Level (MNRL) at Sugar Lake Reservoir is 601.72m. The management questions use the term "full pool" for this reservoir elevation. There was considerable uncertainty during the Consultative Committee process as to the extent of erosion from reservoir operations at this current MNRL relative to lower MNRL elevations. Therefore, the CC recommended that shoreline erosion be examined to reduce this uncertainty and help to determine the potential reduction in erosion that could be achieved by operating the reservoir at a MNRL of 601.52 m. The study was intended to determine whether operating the reservoir below the current MNRL (i.e. <601.72m) can reduce shoreline erosion over the long-term. The first management question asks about the erosion impact of operating at the current MNRL. The second management question asks whether operating **at** a new MNRL elevation of 601.52m would significantly reduce the erosion. BC Hydro considers the second question to be successfully answered with the results of this study that estimate the change in erosion impacts at a new MNRL of 601.52m. We will clarify this in the text.	Reflected in final ESR
Fisheries and Oceans Canada	SHUMON-3 Flooding Risks in the Middle Shuswap River	4.3.3 Interpretation of Data Management Question 2: At what discharge does flooding begin in the middle Shuswap River?	Clarify if the keys areas are flooded at the 229 m^3/s discharge rate or if they begin to flood at this discharge rate (see page 12, Table 6, "Response" column, question #2).	Based on the study results, overbank flooding begins at 229 m^3/s. We will clarify Table 6.	Reflected in final ESR
		Non-private sites	Clarify if there are non-private sites that begin to flood or are flooded at the 229 m^3/s discharge rate.	This study was included in the SHU WUP based on concerns brought forward during the Consultative Committee by individuals with property along the flood plain of the Shuswap River, and the impacts to farmland. SHUMON-3 assessed 3 private sites that were selected based on a review of hydrologic, geologic, and topographic information, which were deemed to have the highest risk of flooding. Additional sites were not assessed, although one could infer the characteristics of the sites selected could be a proxy for other locations along the river.	Response provided
Fisheries and Oceans Canada	SHUWORKS-1 Wilsey Dam Flow Physical Works	Unit trips	Clarify how many generation unit trips occurred in the monitoring period. DFO understands that the number of flow disruptions were reduced to zero following the modifications made to the Unit 2 bypass value hydraulic system. However, DFO is unclear of the number of unit trips this correlated to.	Prior to initial upgrades to the bypass valve, there were major flow disruptions four times per year. After completion of these initial upgrades (which were completed prior to the WORKS-1 project), major flow disruptions were reduced to two times per year. The consultant report then noted that the number of disruptions further dropped to zero, after completion of the WORKS-1 project.	Response provided

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October 10, 2019

Jim Scouras, Indigenous Relations Southeast Regional Manager
BC Hydro
Burnaby, BC, V3N 4X8
VIA EMAIL

Re: Shuswap Water Use Plan Order Review

Dear Mr. Jim Scouras:

Okanagan Indian Band (OKIB) in partnership with technical staff from the Okanagan Nation Alliance (ONA) are actively involved in the Shuswap Water Use Plan Order Review (SHU WUP-OR) project. We are writing to you to express our concerns with this Project, which include but are not limited to, the following:

1. **BCH pausing the SHU WUP-OR process in order to conduct Wilsey dam decommissioning review.**

The Okanagan Nation was not consulted on the decision to decommissioning or to pause the SHU WUP OR project. This does not follow current Provincial mandate for reconciliation. We did not relinquish our ability to recommend or acknowledge to the fact of the matter that there was any free and prior informed consent to a pausing phase of this process. Therefore, we require a more thorough discussion on the strategy and timeline for completion of the SHU WUP-OR (Step 2). When the Okanagan Nation (OKIB and ONA) became involved with this project, it was on the understanding that we would start and see this project to its scripted completion for this regulated process. Our concern is that with the lack of an agreed-to process and schedule the SHU WUP-OR will be stalled indefinitely. This stall or pause caused by the uncertainty surrounding the future of Wilsey dam, in our minds is not directly related to the requirements that need to continue with the SHU WUP-OR. Any recommendations that would come from Step 2 could be a benefit, it could provide additional information on the future of Wilsey dam and Sugar Lake reservoir options.

Step 2 of the SHU WUP-OR needs to proceed to completion. Information provided to date is that the decommissioning project will not look at Sugar Lake Reservoir, therefore the outstanding concerns regarding cultural heritage, archaeology, wildlife and wildlife habitat, and erosion will require further study in a timely manner.

2. **BCH internal reporting standards being lower than those expected of non-BCH report submissions.**

From our experience in other projects (West Kelowna Transmission/Columbia WUP), BCH holds the outside proponent to a very high reporting standard, ensuring no component of the reporting process is deficient or left out. The concern is that the background reports that comprise the Shuswap River WUP Environmental Synthesis Report (ESR) are missing some key environmental, cultural heritage and archaeology background information. For example, wildlife and wildlife habitat was not studied as part of the SHU WUP process. This shows a critical lack of due diligence on behalf of BCH, further studies and information on wildlife and wildlife habitat effects due to flow and reservoir changes needs to be conducted to ensure key environmental features within this project are not missed.

3. **The lack of a broader scope of project review recommendations from the Consultative Committee and within the project Terms of Reference.**

In hindsight, the WUP project Consultative Committee objectives are predominantly focused on private properties (flooding and erosion) and are not related to our Okanagan values. This narrowly focused set of objectives were then also reflected in the project TOR. This narrow focus reduced the usefulness of the SHU WUP Order Review's ability to fulsomely assess operational effects on key cultural heritage, archaeology and environmental issues such as wildlife and wildlife habitat. Okanagan Indian Band sees this as a major knowledge gap in this WUP process and needs to be immediately addressed.

We strongly recommend that BCH keep the momentum going onto Step 2 of the Shuswap Falls Water Use Plan Order Review Project. We do not see how this could hinder or interfere with the Decommissioning process. To not do so creates great uncertainty within our Community. We also recommend that BCH develop a clear and concise timeline for a decision on the decommissioning of Wilsey Dam. Finally, we would like to see a plan (with associated timelines) to address the data gaps identified in the Environmental Synthesis Report. Additional information and detail can be found in the enclosed document.

Sincerely,

OKANAGAN INDIAN BAND

Fabian Alexis

Fabian Alexis
Territorial Stewardship Division
Project Manager

Mr. Jim Scouras October 10, 2019
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Enclosure: Shuswap River Water Use Plan Environmental Synthesis Report OKIB ONA comments May 2019 BCH sent 18Sept2019

cc: Howie Wright, Program Manager, Okanagan Nation Alliance
Andrea Kennedy, Project Engagement Lead, Indigenous Relations, BC Hydro