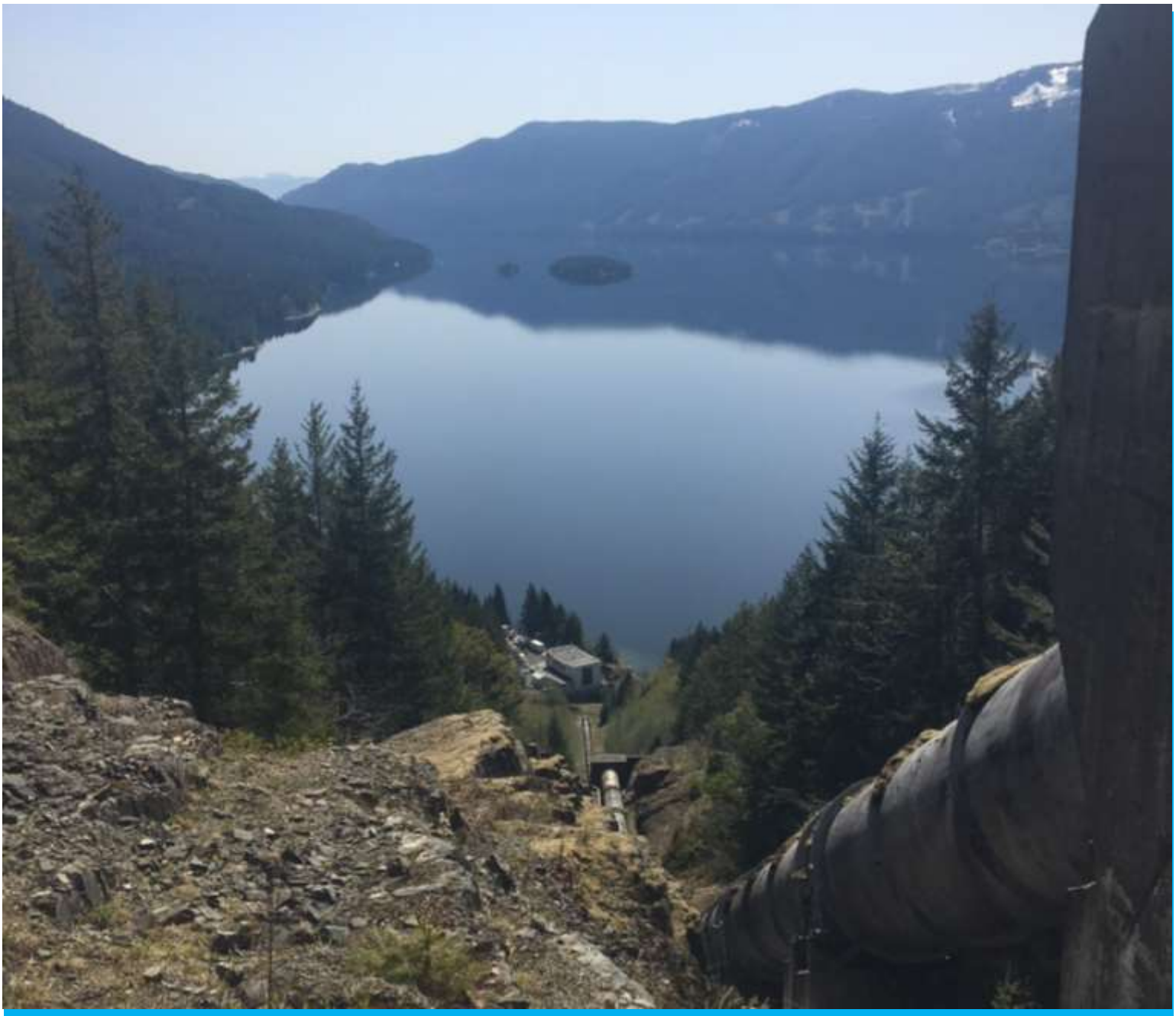

Ash River water use plan order review report

October 2018

BC Hydro
Power smart

Cover Photograph: Ash River Penstock and Generating Station.

The photograph depicts the penstock that carries water diverted from Elsie Reservoir to the Ash River powerhouse and into Great Central Lake.

Date: May 8, 2018

Photo Credit: Madeleine Fulton, BC Hydro

Report Citation:

BC Hydro. 2018. Ash River Water Use Plan Order Review Report. BC Hydro, Generation System Operations. Submitted to the Comptroller of Water Rights. 23 pp + appendices.

EXECUTIVE SUMMARY

On October 4, 2004, the B.C. Comptroller of Water Rights issued an Order requiring BC Hydro to implement the Ash River Water Use Plan (WUP). With the implementation phase complete, this report provides a comprehensive review of the Order implementation. BC Hydro initiated this review to fulfil its commitment to complete all 13 steps of the provincial water use planning process (cf. Figure 1 on page 1).

Implementation of the Ash River Order Has Been a Success

Since Order implementation began in 2004, there have been no significant variances from the new requirements for dam operations (operating conditions, Table 1). In addition, BC Hydro has completed all of the ordered monitoring studies. Overall, the facility operation changes resulted in the environmental improvements intended by the WUP Consultative Committee.

Table 1. WUP Order Key Operating Conditions.
Other Order conditions include monitoring and administrative requirements.

Cond.	Order Requirement Summary
1	Shall release minimum flows from Elsie Dam of 3.5 cms from 1 May to 31 October and of 5.0 cms from 1 November to 30 April.
2	Shall release such quantities of water from Elsie Dam as necessary to provide Steelhead passage in August and September.
3	Shall adhere to the specified ramping rates

New Operations Yielded Environmental Improvements

The ordered monitoring studies that assessed the changes to the Ash River Project operations yielded the following conclusions:

- Moderate pulse flow releases of 10 cms from Elsie Dam improve Steelhead fish passage and base flow conditions of 3.5 cms do not impede migration. A pulse flow of 20 cms yielded no detectable effect on fish passage.
- There is no one optimal water level at Elsie Lake Reservoir for protection of archaeological sites.

Should We Keep Operating Ash River the Same Way?

BC Hydro considers the implementation of the Ash River Water Use Plan a success and is committed to maintaining the ordered operations that benefit fish and fish habitat in the Ash River basin:

1. The minimum flow requirements are considered to have positive environmental outcomes, and therefore, the Order (Condition 1) should be maintained.

2. Given the significant positive environmental outcomes associated with the Elsie Dam pulse flows for Steelhead passage, Order Condition 2 should be maintained. The condition should be updated to reflect that the release of pulse flows is now consistent with the design approved by the Comptroller.

3. No changes are proposed to the ramping rates (Condition 3) at this time.

The Order recommendations to the Comptroller of Water Rights are presented below in Table 2.

Table 2. Order Update Recommendations to the Comptroller of Water Rights.

Cond.	Order Requirement Summary	Recommendation
1	**Release minimum flows from Elsie Dam of 3.5 cms from 1 May to 31 October and 5.0 cms from 1 November to 30 April**	**Continue**
2	**The licensee shall release such quantities of water from Elsie dam as necessary to provide pulse flows for steelhead passage during August and September, to be measured at the Moran Creek gauge, consistent with the design approved by the Comptroller. The total pulse flow approved for any year shall be up to a maximum of 40 cms-days, the instantaneous rate not to exceed 25 cms.**	**Update**
3	**Use specified ramping rates for changing flows**	**Continue**
4	The licensee shall submit a monitoring plan for assessing pulse flows for acceptance	Remove
5	The licensee shall implement monitoring in accordance with the plan as accepted	Remove
6	The licensee will undertake monitoring of erosion of archaeological sites	Remove
7	The licensee shall provide annual reports to the Comptroller which describe the effects of reservoir operations on archaeological resources	Remove
8	**The works may be operated in an alternate manner in the event of an emergency, a dam safety requirement, or an extreme hydrologic event**	**Continue**
9	**All emergency operations or other deviations from this ordered shall be reported to the Comptroller**	**Continue**

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1. OVERVIEW OF WATER USE PLANNING AND ORDER REVIEWS

1.1. Introduction

The operation of hydropower facilities and the relationship between fish, wildlife, archaeology, flood protection, recreation, power generation, and other water uses began to receive considerable attention in the 1990s. Environmental and other groups called for greater protection of natural and heritage resources. Consequently, the province began developing Water Use Plans for hydropower facilities and other water control structures (Province of British Columbia, 2017). BC Hydro has been engaged in this effort since it began in the 1990s when the province published their water use planning guidelines, depicted in Figure 1 (Province of British Columbia, 1998, p. 17).

Figure 1. The Provincial Water Use Planning Process.

Water use planning deals with the day-to-day operation of BC Hydro facilities and how the operations can be optimized to achieve a balance between competing uses of water that is environmentally, socially, and economically acceptable to British Columbians. While many of BC Hydro's 23 Water Use Plans are still in implementation, others have matured and are now ready to be reviewed. Therefore, BC Hydro has established the Water Use Plan Order Review Program which includes a review of the implementation of the Ash River WUP (Step 13 in Figure 1).

On October 4, 2004, the Comptroller of Water Rights (Comptroller) issued their order for BC Hydro to implement the Ash River Water Use Plan. The Order notes BC Hydro's recommended changes to the operations of the Ash River hydropower system are intended to provide benefits to fish habitat with minimal to no impacts on recreation. These operations have now been in place for over ten years and BC Hydro implemented studies to assess whether these operations have achieved the power generation, environmental, and social outcomes that were recommended to achieve the optimal balance of water use in the Ash River Basin. This document consolidates all the related information to conduct a review of the Ash River Order implementation and provides an update and recommendations to the Comptroller and other regulators, First Nations, and key stakeholders.

1.2. The Process of Water Use Planning

The process of determining WUP Order requirements generally followed the sequence of activities, in order of execution, depicted in Figure 2. The figure represents the multi-year process from initiation of water use planning to the review which occurs after implementation is complete.

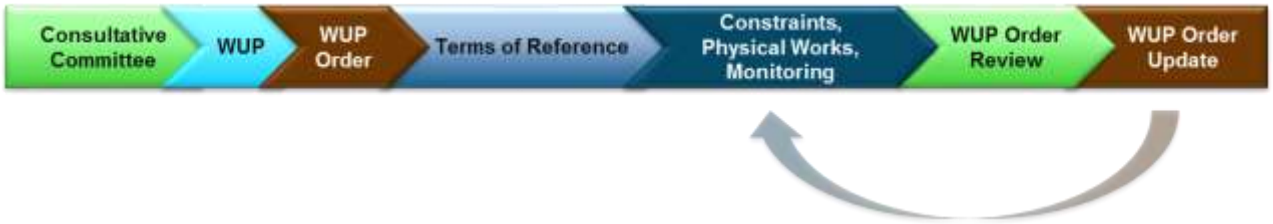

Figure 2. Water Use Planning at BC Hydro.
Water Use Plan Orders do not expire. In addition to periodic reviews such as this one, depending on circumstance, the Comptroller of Water Rights may review an order at any time during the WUP's implementation.

1.2.1. Why Water Use Planning?

In 1998 the B.C. provincial government issued their *Water Use Plan Guidelines* with an overall goal of finding a better balance between the often competing uses of water, such as domestic water supply, fish and wildlife, recreation, heritage protection, flood control, and electrical power generation. Implementation of water use plans refines a BC Hydro facility's licensed operations by making incremental adjustments to levels on reservoirs and flows downstream. (These parameters and boundaries are termed "operation conditions" or "operation constraints".) Thus, the WUP process is designed to provide benefits to British Columbians across a variety of cultural, economic, environmental, and social objectives.

> *Water use plans (WUPs) are intended to provide greater clarity with respect to the use of water resources, for the licensee… as well as for other water users, by specifying operating parameters and boundaries.*
>
> *BC Hydro et al., 1998, p. 1.*

1.2.2. How Were BC Hydro's WUPs Developed?

Water Use Planning is a 13 step process developed by the Province of British Columbia and described in their *Water Use Plan Guidelines* (Province of British Columbia, 1998). In general, BC Hydro's 23 WUPs were developed through a consultative, multi-stakeholder engagement process that identified and evaluated BC Hydro operations against multiple other uses of water resources using a structured decision making approach (BC Hydro, 2009). The water use planning process included input from First Nations, local communities, stakeholders, other interested parties, and municipal, provincial, and federal government agencies.

The outcomes of the consultative process for each facility are captured in a Consultative Committee Report. From the Consultative Committee Report recommendations, a Water Use Plan was drafted by BC Hydro and submitted to the Comptroller for acceptance.

1.2.3. How Are WUPs Implemented?

Once accepted by the Comptroller, the plan is ready for implementation. The Comptroller then issues BC Hydro a *Water Act*[1] Order. Generally, the Comptroller has required BC Hydro to implement most, if not all, elements of the Water Use Plan and also includes a reporting component. Thus, this report, and all other related WUP implementation reports, are submitted to the Comptroller.

The implementation of Water Use Plans is directed by the B.C. Comptroller of Water Rights. The Comptroller's direction is in the form of a Water Act Order issued to BC Hydro.

The 23 WUP Orders specify various combinations of: (i) facility operation changes optimized for power generation, recreation, heritage protection, and habitat enhancement, (ii) monitoring studies, (iii) physical works, and (iv) effectiveness and compliance monitoring and reporting.

Actual examples of operation changes to BC Hydro facilities include:

- Absolute limits on water releases discharged from facilities. E.g., a minimum flow of 142 cms.
- Ramping rates: the rate at which flows may change. E.g., a maximum change of 142 cms per hour or 425 cms per day.
- Reservoir drawdown rates: the rate at which a reservoir may be lowered. E.g., 15 cm/h.
- Reservoir or tailrace elevation limits. E.g., a minimum elevation of 372 m.
- Downstream compliance points. E.g., provide a minimum flow of 73 cms as measured below the confluence of two rivers (and downstream of a BC Hydro facility).

Physical works may be prescribed in lieu of operation constraints. For example, boat ramps may be extended to lower elevations to provide recreational access to reservoirs that otherwise would have to be held at higher elevations at the expense of power generation. Monitoring programs are implemented to confirm the effectiveness or define the effects of the operation constraints (including the physical works). For example, a monitoring program may be implemented to assess whether a minimum flow yields benefits to fish and fish habitat.

Once ordered, operation changes are amongst the first WUP recommendations to be implemented. Monitoring programs and physical works are implemented over a period of a year to a decade or longer. Once implemented, the changes to operations and physical works typically continue indefinitely; monitoring

[1] Superseded by the *Water Sustainability Act*.

programs typically end after a specified implementation period or when the related operation uncertainties or management questions have been answered[2].

Across the province, BC Hydro is implementing or has completed approximately 750 ordered changes to operations and 360 ordered monitoring studies and physical works.

1.2.4. What Happens after Order Implementation?

Once all the ordered requirements have been implemented and are complete in fulfilling the requirements of the Order and the intent of the WUP, then the WUP's implementation phase is complete and a review of the ordered requirements may occur. The review is Step 13, the final step, of the provincial water use planning process and is the focus of this report. The deliverable of the Water Use Plan Order Review (WUPOR) Program is a recommendation to the Comptroller to update the Order to reflect what has been learned to date from the Order implementation. If new in-scope issues have come to light then a new Order requirement may have to be implemented; as depicted by the arrow in Figure 2.

1.3. The WUP Order Review Program

BC Hydro created the WUPOR Program to assess the activities undertaken in response to the WUP Order once all the ordered conditions of the WUP have been implemented. Ordered conditions generally relate to changes to facility operations, new physical works (usually in lieu of an operation change), and monitoring programs to assess the operation change. The Consultative Committee Report and Water Use Plan will serve as important foundational guides, as these were the primary inputs to developing the Order.

BC Hydro initiated the WUPOR Program to review the outcomes from implementing 23 Water Use Plans. These results will be communicated to agencies, First Nations, and key stakeholders. Recommendations coming from the reviews will be submitted to the B.C. Comptroller of Water Rights.

1.3.1. Goals of the Order Review

The goals of the WUP Order Review Program are to:

- Synthesize and document the outcomes of the water management operation constraints, physical works, monitoring, and other activities with respect to the Order objectives.
- Identify any areas where it was not possible to fully comply with the Order and why.

[2] It must be noted that typical WUP monitoring programs differ from those implemented by regulatory agencies. For example, a stock assessment monitoring program informs regulatory agencies about the health of the ecosystem in general, and more specific, the status of specific commercial and/or recreational fish stocks from one fishing season to the next, and define or recommend what are sustainable harvests. Thus, regulatory monitoring programs may go on indefinitely to facilitate ongoing sustainable resource management including harvesting.

WUP monitoring programs are typically designed to answer management questions to assess the impacts of a change in facility operations; therefore, they run only until the management questions have been answered.

- Describe what actions, if any, are required to fulfil BC Hydro's ordered obligations.
- Identify any new facility operations-related issues that may have arisen or been discovered since the initial WUP planning process.
- Document the recommended WUP costs compared to actual implementation costs.
- Seek input from regulators, First Nations, and key stakeholders on priority aspects of Order implementation and what an updated Order should contain.
- Use all the above to develop a report containing recommendations to the Comptroller of Water Rights to update the Order such that it reflects the current status and outcomes of the Order implementation and any new issues that may need addressing.
- The recommendations must be mindful of the work already accomplished and the need to contain costs to keep electricity rates affordable for British Columbians.

As noted in the provincial guidelines, a WUP can be reviewed by the Comptroller of Water Rights at any time for compliance or in response to new water use issues (Step 13). The Comptroller will determine the appropriate extent of the review. The guidelines also note that WUPs should provide the opportunity for a scheduled periodic review oriented to specific priority issues that may arise during the plan's implementation.

With the implementation of the Ash River WUP complete, BC Hydro has initiated this review of the Order.

1.3.2. Process to Assess and Evaluate Order Implementation

The WUP activities that BC Hydro was ordered to implement will be reviewed by the WUPOR Program.

The reviews will be based on data and documents from the studies and projects implemented under the Order. (Much of this information is published on bchydro.com, see Appendix E). It is expected the Order will be maintained, revised, or replaced to reflect the status of activities associated with the original WUP Order.

The BC Hydro WUPOR Program's six core principles are:

1. Focus on specific priority issues
2. Apply an issue evaluation approach
3. Use foundational documents and processes
4. Engage First Nations
5. Engage regulators
6. Seek input from key stakeholders

1.3.2.1. Order Review Issue Scope

The scope of the WUP Order review is framed by the activities or constraints that were ordered by the Comptroller of Water Rights. Therefore, the WUPOR Program will focus on BC Hydro's facility operations, monitoring, and physical works implemented in lieu of operation changes.

If a new operation issue is raised or discovered, it will be assessed during the review (the same for issues that may arise in the future). BC Hydro may consider new physical work projects, monitoring studies, or facility operations in response to new issues; new activities or conditions may be recommended if:

- the information necessary for decision making related to the Order is not available or incomplete and gathering new information is expected to inform the operation decision(s).

- a significant new issue has arisen or been discovered during the implementation period.

Therefore, issues already reviewed during the development of the WUP, such as those not recommended by the Consultative Committee, or not ordered by the Comptroller of Water Rights are out of scope for the Program.

In addition to Order implementation, BC Hydro implements a number of other environment and heritage mitigation programs to address existing effects related to a facility's footprint and operation. These other programs range from dealing with facility environmental footprint, fish impact mitigation directly at the facility (e.g., fish passage), projections of climate change for the region, through to reservoir archaeology. If such issues arise during the WUPOR, they will be documented and the other programs are engaged as appropriate. These programs are described in detail in Appendix C.

1.3.2.2. Spatial and Temporal Boundaries of the Review

The Order Review will be limited to the water use planning boundaries; i.e., those areas of a drainage basin impacted by BC Hydro facility operations. As the Order does not expire, the Review will encompass the entire period after the WUP Order was issued/implemented (e.g., facility water conveyance will be assessed through to present day).

1.3.3. External Engagement on the Results and Recommendations

Performance reports on environment, heritage, and operations will be prepared and provided to federal and provincial government agencies, First Nations, regional and municipal governments, and key stakeholders. The reports will also be posted on bchydro.com. Input from these groups will be considered by BC Hydro and provided to the Comptroller of Water Rights. It is expected this input, along with the technical and financial information, will inform any additional action that may be needed and what operation constraints and commitments should continue to be maintained by BC Hydro. There may be a need for more extensive engagement, depending on the nature of the issues raised during the review process.

1.3.4. Final Deliverable to the Comptroller of Water Rights

The core deliverable of the Ash River WUPOR Review is this report including recommendations to the Comptroller of Water Rights to update the Order such that it reflects the current status and outcomes of the Order implementation and any new or residual issues that may need addressing.

BC Hydro has initiated this review to fulfil BC Hydro's commitment to complete the 13 Steps of the provincial Water Use Planning Guidelines. Step 13 states the: "licensee and Comptroller (will) review the plan on a periodic and ongoing basis".

1.4. Future Order Reviews

The WUPOR Program has scheduled 23 facility/system WUP Order reviews over ~15 years. At this time there is no plan to routinely repeat the reviews (e.g., on rotating 15 year cycles). However, as noted in the provincial guidelines, a WUP can be reviewed by the B.C. Comptroller of Water Rights at any time (Step 13). It is anticipated that the scope and timing of future Ash Order implementation reviews will depend on the context of the issue (e.g., new water use conflicts or non-compliance issues).

2. THE ASH RIVER PROJECT AND THE COMPTROLLER'S ORDERED OPERATION

2.1. Location of the Ash River Project

The Ash River is located within the Regional District of Alberni-Clayoquot on central Vancouver Island. The Ash River flows south, between Strathcona Park to the west and the Beaufort mountain range to the east, into the Stamp and Somass Rivers, and eventually into the Alberni Inlet.

A map of the Ash River facility is provided in Figure 3.

2.2. History of Ash River Hydropower Development

The original Ash River power development by the B.C. Power Commission was initiated in 1957 with the construction of dams on Elsie Lake. The project was completed in July 1958 and the generating station was put into service in 1959.

2.3. Ash River Facility Components

Ash River facility components consist of physical infrastructure such as dams, a powerhouse, and flow control infrastructure. These elements are described in the following subsections. The subsections are divided into a discussion of the facility physical components (structures), their role in the hydropower system, and their role in BC Hydro generation system operations. The schematic of the basin, hydrology, and facility components is presented in Figure 4.

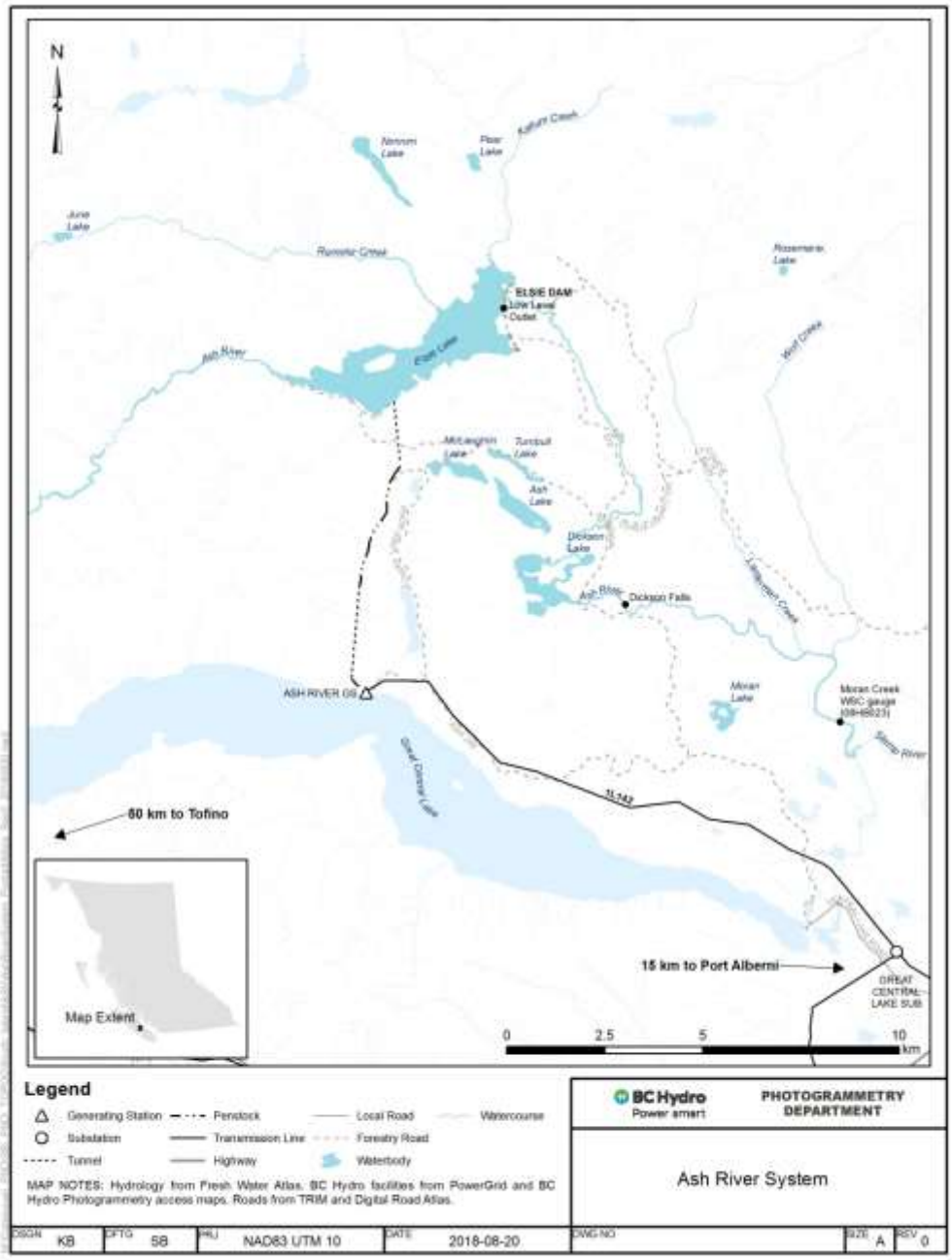

Figure 3. Ash River Map and BC Hydro Infrastructure.

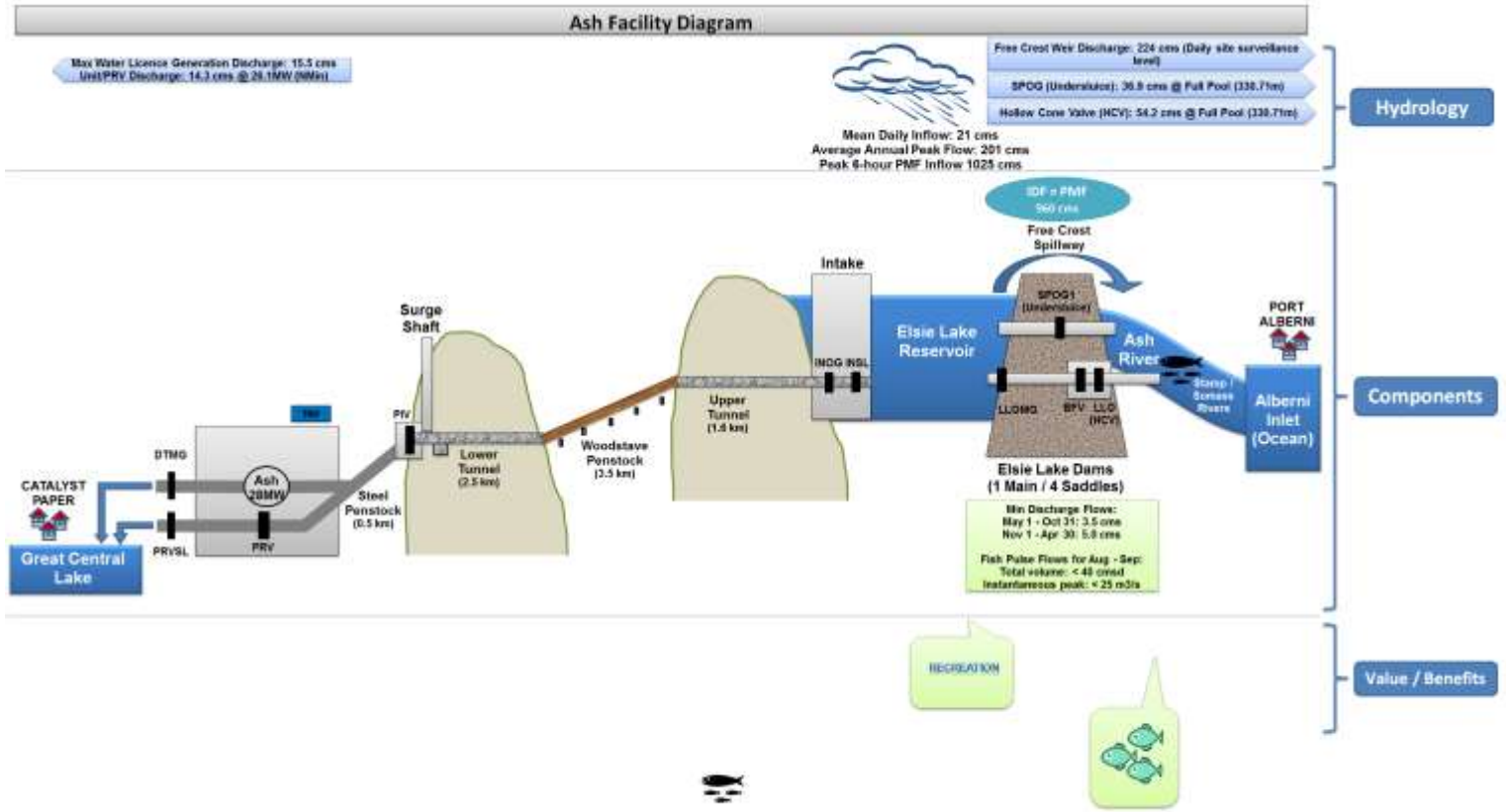

Figure 4. Ash River Facility and Basin Schematic.

2.3.1. Dams

The current physical structures comprising the Ash River project include the following:

Main Dam: This primary dam is located at the eastern end of Elsie Lake Reservoir. The earthfill dam is 189.2 m long and 30.5 m high with a crest elevation of 334.37 m above sea level.

Saddle Dams: Four earthfill saddle dams numbered 1 to 4.

Low Level Outlet: The low level outlet located at the base of Saddle Dam 1 is a 2.44 m diameter steel conduit 60 m long encased in concrete. The sill of the low level outlet (invert elevation) is at 313.33 m. At the downstream end of the conduit is a hollow cone valve to control supply of water to the Ash River. When the reservoir is at full pool (330.71 m) the low level outlet has a maximum discharge capacity of approximately 55 cms.

Photograph 1. Ash River Low Level Outlet. This outlet delivers pulse flows to the Ash River.

Freecrest Overflow Spillway: The freecrest overflow spillway is located between Saddle Dams 1 and 4. The left, centre and right spillway crest elevations are 330.71 m, 331.45 m and 331.14 m respectively. At elevations above 330.71 m, water flows over the freecrest overflow spillway and into the Ash River. The freecrest overflow spillway has a discharge capacity of approximately 1280 cms when the reservoir elevation is at 334.37 m (dam crest).

Spillway Sluicegate: In 2001, as part of the ongoing Dam Safety Upgrade Program, BC Hydro constructed a new spillway sluicegate between Saddle Dams 1 and 4. The spillway sluicegate has a discharge capacity of approximately 35 cms when the reservoir is at full pool and is intended to supply water for fish in the Ash River in the event the low level outlet is out of service for maintenance.

Power Intake: The power intake is located on the south shore of Elsie Lake Reservoir, 5 km southwest of the Main Dam, with a sill (invert) elevation of 309.88 m. The power intake is a 3.35 m x 3.35 m concrete lined tunnel opening and is comprised of 2 trashracks, a steel operating gate, and a bulkhead gate.

2.3.2. Powerhouse

The Ash River powerhouse is located on the north shore of Great Central Lake and contains a single 27 MW capacity vertical shaft Francis turbine generator unit. Water is delivered through a 1.6 km upper tunnel, 2.46 km lower tunnel, 3.37 km woodstave penstock, and 0.5 km steel penstock. Once through the turbine, the water is discharged from the Ash River Generating Station into Great Central Lake.

Photograph 2. Ash River Powerhouse. The penstock is visible behind the powerhouse.

2.3.3. Project Operations

Relevant current operation aspects of the Ash River project are as follows:

Elsie Lake Reservoir: Elsie Dam impounds Elsie Lake Reservoir. The reservoir covers approximately 658 ha (6.58 km^2) at full pool. The normal operating range of the reservoir is between 315.47 m and 330.71 m. At elevations above 330.71 m, water flows over the freecrest overflow spillway. The maximum quantity of water that may be diverted from Elsie Lake Reservoir, used at the Ash River Generation Station, and discharged into Great Central Lake ranges between 13.6 cms and 15.01 cms, depending on reservoir elevation.

Photograph 3. Panorama of the Saddle Dam and Freecrest Overflow Spillway on Elsie Lake Reservoir.

2.4. Project Role in BC Hydro System Operations

The Ash River generating facilities are part of BC Hydro's integrated generation system. In addition to generating electricity, the Ash River powerhouse provides ancillary support to electricity supply on Vancouver Island. The generating station is equipped with a back-up diesel generator and batteries. Following an outage, the Ash River hydroelectric facility can be started without any external supply of electricity ("black start" capability). Once restarted, electricity from the Ash River generation plant can provide electricity to restart other plants on Vancouver Island and provide voltage support for the electricity transmission system.

To have this ancillary support in reserve, generation at the Ash River powerhouse is limited to 10 MW when the reservoir drops below 320.04 m and the weather forecast does not anticipate inflows. The curtailment conserves sufficient water in storage to allow the Ash River hydroelectric facility to generate for several days in the event that other generating stations on Vancouver Island or the transmission line to Vancouver Island from the mainland are out of service. The Ash River hydroelectric facility can supply power to Port Alberni, Tofino and Ucluelet in the event that transmission lines between Port Alberni and the Vancouver Island Transmission Grid are out of service.

The Ash River hydroelectric facility contributes approximately 6% of BC Hydro's Vancouver Island hydroelectric generation, or about 0.27% of BC Hydro's total hydroelectric generation.

2.5. Ash River Basin Hydrology

The Ash River basin is situated in the southern portion of Vancouver Island along the southwest coast. The Ash River basin is in the transition zone between the wet west coast and drier east coast climates of Vancouver Island. The basin is affected by frontal storms arriving from the southwest off the Pacific Ocean with strong,

moist winds that bring heavy precipitation for durations of a few hours to four days. Very often a series of cyclonic storms are carried in the flow of air separated by hours or days.

The west-facing mountain slopes of Vancouver Island are usually cloud-covered and wet during the winter because of the orographic (mountain) lifting of warm, moist air flowing inland. Prolonged and heavy rains can fall on these slopes when a Pacific cyclone approaches. The east faces of these mountains experience the spillover effect of these winds. Precipitation formed by the lifting of the moisture-laden winds is carried over the mountain barrier. The climate tends to be less rainy on the east coast of the island because the descending air now has less moisture which lessens the cyclonic rainfall.

During these large winter storms, the air temperature may be above freezing at all altitudes in the basin. Consequently, the accumulated snowpack may vary appreciably at low elevations. Typically, a period of cooler weather in which the snowpack increases may be followed by a large Pacific disturbance that raises temperatures and melts a portion of the snowpack. A detailed summary of the Ash River basin hydrology is provided in Appendix 1 of the WUP (BC Hydro, 2004).

2.6. Ash River WUP Order

On October 4, 2004, the Comptroller of Water Rights issued its Order for BC Hydro to implement the Ash River Water Use Plan. The Order notes BC Hydro's recommended changes to operations of the Ash River hydropower system are intended to provide benefits to fish and fish habitat. All nine requirements of the Order are presented in Appendix J (page 53); the key conditions are in Table 3, below[3]. Other Order conditions include monitoring, administrative tasks such as reporting, and allowance for emergency operations.

[3] Note that in this and subsequent tables "Cond." is a cross-reference to the relevant numbered condition in the Order.

Table 3. WUP Order Key Operation Changes and Related Priority Issues.
Please see the full Order in Appendix J (page 53) for the detailed ramping requirements.

WUP Order Requirements for ASH (Key Elements)			
Cond.	**Order Requirements**	**Operations**	**Fish**
1	The licensee shall release .minimum flows from Elsie Dam (POD 30269) into Ash River as follows: a) 3.5 cubic metres per second from May 1 to October 31 measured at the dam, and b) 5.0 cubic metres per second from November 1 to April 30 measured at the dam.	✓	✓
2	The licensee shall release such quantities of water from Elsie dam as necessary to provide pulse flows for steelhead passage during August and September, to be measured at the Moran Creek gauge, consistent with a design to be approved by the Comptroller. The total pulse flow approved for any year shall be up to a maximum of 40 cms-days, the instantaneous rate not to exceed 25 cms	✓	✓
3	When changing flow rates from Elsie Dam into Ash River, the licensee shall ramp the rates up or down according to the following schedule:	✓	✓

As part of the changes to facility operations, the Consultative Committee recommended a monitoring program designed to address key uncertainties and answer specific questions that may change future decisions regarding the WUP-ordered operation for delivering pulse flows (Ash River Water Use Plan Consultative Committee, 2003, p. 8-1)[4]. Accordingly, BC Hydro recommended in the WUP that the change in operations should be contingent on the implementation of a monitoring program that would:

- evaluate the effectiveness of the new operating conditions on steelhead migration, and
- provide additional steelhead information on which to base decisions about future operating conditions (BC Hydro, 2004. p. 6-7).

Therefore, the Comptroller ordered the changes to operations and the complementary monitoring programs to assess whether the expected benefits are realized.

[4] The "future changes" are the outcome of this review.

2.7. Order Implementation Details

In response to the Order, BC Hydro developed Terms of Reference to define the budget, timeline, and scope of the monitoring studies to comply with the Order. The Terms of Reference describe the scope of work that is needed to be undertaken. Appendix D (ASH Water Use Plan Order Implementation Summary) includes a summary of the Terms of Reference development and related approval timeline. The Terms of Reference are published on bchydro.com (Appendix E).

BC Hydro has completed the ordered monitoring programs required to assess the environmental and social benefits as a result of the implemented changes to facility operations.

Order conditions 1 through 3 (Appendix J) specified the operational requirements. Conditions 4 through 6 (Appendix J) included two monitoring programs: one related to fish and one related to heritage resources. To assess whether the expected benefits are provided by the change in facility operations, each study has specific objectives, hypotheses, and management questions.

These and an overview of the studies are summarized in Chapter 3 and Appendix D.

3. INPUT RECEIVED: EXTERNAL ENGAGEMENT AND REVIEW

3.1. Introduction

The water use planning process included consultation and engagement with First Nations, regulators, and stakeholders in the development of the *Ash River Water Use Plan*. As part of the WUP Order Review Program, BC Hydro is re-engaging with these parties to report on the outcomes of implementing the WUP Order. In general, engagement includes:

- First Nations with asserted rights and title in the project area, as defined by the B.C. Consultative Area Database or who participated in the Ash Water Use Plan
- B.C. Ministry of Environment and Climate Change Strategy
- B.C. Ministry of Forests, Lands, Natural Resource Operations & Rural Development
- Canada Department of Fisheries and Oceans
- Potentially affected stakeholders

An engagement round was completed for the *Environmental Synthesis Report* with responses included in this *Report*. A second engagement round on this *Report* occurred in the summer of 2018. Feedback on this report is also incorporated into this section and was considered in the context of finalizing the draft recommendations to the Comptroller of Water Rights (Chapter 5).

The full engagement process is presented in the appendices: Appendix F is a list of participants, Appendix G describes the First Nation engagement process, Appendix H regulatory agencies, and Appendix I stakeholders. A summary of feedback and applicable BC Hydro responses is presented below.

3.2. Feedback Received and BC Hydro's Responses

No comments were received on the *Environmental Synthesis Report* from First Nations or stakeholders. One comment (Table 4) was received from the Ministry of Environment (MoE) and Climate Change Strategy. One comment was received from the Barkley Salmon Group (BSG) on this *WUPOR Report* (Table 4).

Table 4. Regulatory Interests, Concerns, and BC Hydro Response.

Comment Received	BC Hydro Response
MoE-Further study related to ASHMON-1 (pulse flows) is ill-advised.	Concur.
BSG-BC Hydro document our practice of providing regular communication on changes to the ASH/Elsie Lake generation discharge in to Great Central Lake as a standard procedure.	This communications protocol is documented in the BC Hydro Ash River system operating orders and will continue to be followed. Since the communications, including the methods and parties involved, may change and they are not about how the water should be used, they are better managed outside the WUP Order.

4. WHAT HAPPENED WHEN WE IMPLEMENTED THE NEW OPERATIONS?

This section summarizes outcomes of the Ash River Order implementation and performance. Priority conditions of the Order requirements are emphasized: system operation water conveyance, environment, and heritage and archaeology monitoring studies.[5] The outcomes are assessed using a critical review of the data and documents from the studies and conveyance reports. In addition, the outcomes were presented to regulators, First Nations, and key stakeholders. The outcomes and feedback were then assessed and recommendations subsequently formulated using an iterative engagement and review approach.

Appendix E summarizes the extensive inputs to the water use planning process; Appendix D summarizes implementation of the Order; Appendix F lists participants engaged in the Order review.

4.1. Changes to Project Operations and Works

At the core of the Ash River Order are the changes to operations at Elsie Dam (Table 3). These changes to facility discharges were implemented with the objective to improve the environmental values identified by BC Hydro, regulators, First Nations, and key stakeholders during the consultative WUP planning process. Therefore, a critical performance measure is to implement and sustain the changes ordered to facility operations.

BC Hydro's Water Licences and WUP Orders, issued by the Comptroller of Water Rights, identify the regulated rights and constraints under which BC Hydro may operate its hydropower facilities. It is a regulatory requirement under the *Water Sustainability Act* that BC Hydro monitor and report on its compliance with these constraints. Therefore, BC Hydro submits to the Comptroller of Water Rights an annual *Water Conveyance Report*. The annual summary for each hydropower development includes constraints and operation data associated with water licence obligations and the ordered constraints. Exceptions to the operation requirements are noted in the *Report* and below in Table 5. All charts submitted to the Comptroller since the implementation of the Ash River Order are contained in Appendix K.

For Ash River operation, the following operations are summarized in the charts (Appendix K); the relevant Ash River Order requirement (Appendix J) is in *parentheses*:

- Elsie Dam
  (minimum flow requirement)
- Elsie Dam
  (delivery of pulse flows Aug-Sep)
- Elsie Dam
  (*ramping rate restrictions*)

Since WUP Order implementation began in 2005, Ash River operations have had no significant or systematic exceptions to the ordered operation constraints.

[5] Other Order elements, such as administrative conditions, are presented in Appendix D (d).

Since 2005 the entire record of operation observations contains only one reportable exception to the Licence and Order requirements:

Table 5. Order Operation Exception 2005-2017.

Date	Constraint	Exception
2009 Aug 29	Ramping rate – maximum ramp up rate	Ramping from 3.5 cms to 10 cms faster than maximum

On 29 August 2009, August pulse flows in the Ash River were ramped up from approx. 3.5 cms to 10 cms over 1 hour and 15 minutes which is faster than the planned 2 hours. Commissioning and calibration of the newly installed counter on the Hollow Cone Valve (HCV) had not yet been completed as the requisite reservoir conditions had not yet been achieved. Calibration was, therefore, estimated on site, but resulted in a faster delivery of the flow. BC Hydro notified DFO and the responsible Provincial Ministry (MWLAP at the time) and no environmental impacts were anticipated. The new counter device on the HCV was re-calibrated with data from the August pulse flows.

Conclusion 1: Implementation of the Elsie Dam operation changes is complete and meets the Order intentions.

4.2. Monitoring Program Results

Physical works are the one-time modification or addition of infrastructure to facilitate an equivalent operations outcome. Monitoring programs are implemented to confirm the effectiveness or define the impacts of an operation constraint (or the physical work). Once the operation's effectiveness is confirmed (or refuted), then the monitoring program has met the intent of the WUP and the Order and the ordered condition may be considered complete in the context of the water use planning process. The main outcomes are summarized in Table **6** (which is derived from the more detailed tables in Appendix D).

The ordered WUP changes in operations resulted in the environmental improvements intended by the Consultative Committee.

Table 6. Summary of Ordered Monitoring Program Objectives and Results.

ASH Ordered Study Objectives and Response		
Study	**Study Objective**	**Operation Implications**
ASHMON-01 Assessment of Adult Fish Passage During Pulse Flow Releases	**The primary objective was to assess the benefits of pulse flow releases to steelhead in terms of migration rate.** **The second objective was to collect data to determine the characteristics of the pulse flow that would be most beneficial while staying within the water budget of 26 cms days.**	Moderate pulse flow releases of 10 cms from Elsie Dam do improve steelhead fish passage and that base flow conditions of 3.5 cms do not impede migration. Flows released in early August may be more effective when seasonal migration rate is highest. Data also support a 10 cms pulse instead of 20 cms with some evidence suggesting 7 to 9 cms could be the preferred range. Migration events typically occurred in afternoon/evening so potential to focus pulse flows at a fine scale.

ASH Ordered Study Objectives and Response		
Study	**Study Objective**	**Operation Implications**
ASHMON-02 Elsie Reservoir Archaeological Investigations	**1. Determine the rate of erosion at site DiSh-17 and the magnitude of impact that erosion may be having on the archaeological resources at the site via annual monitoring.** **2. Prepare a list of alternatives for the protection of archaeological resources at DiSh-17.** **3. Complete opportunistic monitoring to monitor the rate of artifact exposure at known sites in the reservoir.**	From the annual erosion monitoring, the study concluded that there is evidence that archaeological deposits continue to erode at all monitoring stations, of the two sites with high scientific significance that have been identified to date (DiSh 17 and DiSG-31), DiSh-17 is the most vulnerable to disturbance by erosion. The impact of erosion at DiSh-17 is significant as there may be as much as 10 cm of sediment depth eroding every 6 years. The study recommends there is no optimal reservoir elevation that will protect all sites. High reservoir elevations (>330 masl) would protect the majority of sites in the shoreline fluctuation zone, but may have an impact on undiscovered sites above the fluctuation zone. Maintaining elevations below 318 masl would protect most sites from wave erosion, but all sites will be exposed to erosion from precipitation, changing temperatures-freeze/thaw cycles and recreational activities. If reservoirs cannot be maintained at high or low elevations it is preferred they fluctuate as little as possible. A number of erosion protection options were outlined. Geotextile fabric appears to be effective at mitigating erosion at the site areas where this treatment was applied. Any additional recommendations for erosion protection options would require further discussion and evaluation of the costs and benefits with BC Hydro, the Hupacasath First Nation, and the BC Archaeology Branch under BC Hydro's RAP. Sites DiSh-17, DiSg-27 and DiSg-31 were identified initially to be the most appropriate candidates for protection using geotextile installations. Additional work at site DiSg-27 undertaken for the RAP determined that the site did not have the complexity or depth as originally reported and therefore no geotextile installations were recommended. Extensive opportunistic monitoring was completed in every year other than 2007 which is a greater frequency than outlined in the TOR (2 occasions in 5 years).

There is a residual uncertainty in the pulse flow study (ASHMON-1) in that an "optimal" pulse flow was not identified; however, the significant costs for further refinement of this operation may not result in measurable improvements to fish passage.

While no monitoring study was ordered with respect to ramping rates and no changes to the Order are proposed at this time, BC Hydro may pursue alternative compliance points and ramping restrictions at certain times of year. A temporary variance to the Order may be required, which may include a program to assess the effects of a different ramping regime.

Responsibility for implementation of archaeology site protection measures was transitioned to the BC Hydro Reservoir Archeology Program (RAP). The RAP was established in Elsie Reservoir in 2008 and continued some works conducted under the ASHMON-2 study. The Reservoir Archaeology Program, including the archaeology related WUP order requirements, was largely complete in 2016; however, future management works will include maintenance visits to DiSh-17 and DiSg-31 to check geotextile installations. Any recommendations for archaeological site management work will be managed by the Reservoir Archaeology Program.

Conclusion 2: Implementation of the monitoring programs is complete and meets the Order intentions.

Conclusion 3: There were significant positive outcomes for Steelhead passage associated with Elsie Dam pulse flows of 10 cms.

Conclusion 4: There is no one optimal operation for protecting heritage sites on Elsie Reservoir.

4.3. Assessment of the Results

- **Conclusion 1: Elsie Dam minimum flow implementation**
  The minimum flow requirements are considered to have positive environmental outcomes, and therefore, the Order (Condition 1) should be maintained.
- **Conclusion 2: Implementation of the monitoring programs**
  As the monitoring programs were successfully implemented these Order conditions (Conditions 4 and 5) may be removed.
- **Conclusion 3: Elsie Dam pulse flow implementation**
  Given the significant positive environmental outcomes associated with the Elsie Dam pulse flows for Steelhead passage, the Order (Condition 2) should be maintained. The condition should be updated to reflect that the release of pulse flows is now consistent with the design approved by the Comptroller.
- **Conclusion 4: Elsie Lake Reservoir levels and protection of heritage sites**
  Given that monitoring demonstrated there is no one optimal operation for protecting heritage sites on Elsie Lake Reservoir the Order conditions (Condition 6 and 7) may be removed. Any subsequent archaeological work is to be implemented under BC Hydro's RAP.

4.4. Summary

The Ordered operation constraints and monitoring studies were implemented. Since initiation of the Order implementation in 2005, Ash River operations have had no significant or systematic exceptions to the ordered

operation constraints on water discharges. The overall outcome of BC Hydro's implementation of the Ash River System Order was positive and resulted in benefits to fish populations and habitat. The monitoring study successfully addressed the uncertainty of discharge required for successful fish passage, with the exception of determining a precise pulse flow to maximize migration.

5. CONCLUSIONS AND RECOMMENDATIONS TO THE COMPTROLLER OF WATER RIGHTS

To comply with the Ash River Order implementation, BC Hydro completed the required actions related to operation constraints and environmental and other monitoring over a six-year period to address fish habitat and heritage resource objectives. Implementation of the Ash River Order was conducted within the Comptroller of Water Rights-approved budgets (Appendix D (b)). The overall outcome of Order was positive, and resulted in benefits to fish resources; therefore, the objectives of the Order have been satisfied.

The following conclusions are made based on monitoring conducted to answer management questions and assess water conveyance:

- There were no significant or systematic exceptions to the water conveyance requirements.
- Pulse flow releases of 10 cms increased steelhead passage and the number of steelhead above Dickson Falls. No effect was detected with a 20 cms pulse flow.
- There is no one optimal operation for protecting heritage sites on Elsie Reservoir.

Based on the Order implication conclusions and feedback received, BC Hydro recommends to the Comptroller that the Ash River Order be updated, as presented below. An update is an opportunity to have the Order reflect the outcomes and current status of the Order implementation and to confirm future operation constraints to benefit and balance power generation, environment, and heritage values.

BC Hydro considers the ordered implementation of the Ash River Water Use Plan a success and is committed to maintaining the ordered operations that have been shown to benefit fish and fish habitat in the Ash River basin.

Table 7 contains BC Hydro's proposal regarding amendments to the Ash River Order. Conditions recommended for remaining unchanged or improved are in bold. All others are recommended for removal as they are complete. There is no recommendation for new conditions although BC Hydro may pursue alternative compliance points and ramping restrictions at certain times of year. Variances to the Order would be sought where required. (Note that the annual water conveyance and other reports will continue to be submitted to the Comptroller of Water Rights as per regulatory requirements and the specifics of what must be reported under the facility water Licence and/or the WUP Order.).

Table 7. Order Update Recommendations to the Comptroller.

Cond.	Order Requirement Summary	Recommendation
1	**Release minimum flows from Elsie Dam of 3.5 cms from 1 May to 31 October and 5.0 cms from 1 November to 30 April**	**Continue**
2	**The licensee shall release such quantities of water from Elsie dam as necessary to provide pulse flows for steelhead passage during August and September, to be measured at the Moran Creek gauge, consistent with the design approved by the Comptroller. The total pulse flow approved for any year shall be up to a maximum of 40 cms-days, the instantaneous rate not to exceed 25 cms.**	**Update**
3	**Use specified ramping rates for changing flows**	**Continue**
4	The licensee shall submit a monitoring plan for assessing pulse flows for acceptance	Remove
5	The licensee shall implement monitoring in accordance with the plan as accepted	Remove
6	The licensee will undertake monitoring of erosion of archaeological sites	Remove
7	The licensee shall provide annual reports to the Comptroller which describe the effects of reservoir operations on archaeological resources	Remove
8	**The works may be operated in an alternate manner in the event of an emergency; a dam safety requirement, or an extreme hydrologic event**	**Continue**
9	**All emergency operations or other deviations from this ordered shall be reported to the Comptroller**	**Continue**

BC Hydro considers the ordered implementation of the Ash River Water Use Plan a success and is committed to maintaining the facility ordered operations that benefit fish and fish habitat in the Ash River basin.

APPENDIX A. GLOSSARY

Ash River System - Ash River hydropower facility. Part of the Bridge River/Coastal Generation Area and includes the Elsie Reservoir, dams, intakes and spillways on Elsie Reservoir, and Ash Generating Station.

ASHMON-1 – Assessment of Adult Fish Passage during Pulse Flow Releases

ASHMON-2 – Elsie Reservoir Archaeological Investigations

cms – cubic metres per second.

Completion Report – A report submitted to the Comptroller of Water Rights at the conclusion of each monitoring study and physical works. The report indicates the ordered requirements are complete and concludes with a request that BC Hydro be relieved of its implementation obligation under the Order.

Consultative Committee (CC) Report – Facility-specific *Consultative Committee Report* published by BC Hydro. The reports were prepared in accordance with the provincial government's *Water Use Plan Guidelines*. The reports document the interests, values, and recommendations of the Committee and is a supporting document to BC Hydro's *Water Use Plans.*

CWR, Comptroller – Comptroller of Water Rights for British Columbia. The Comptroller approves BC Hydro's WUPs, monitoring and physical works Terms of Reference, and issues WUP implementation Orders.

***Environmental Synthesis Report* –** A Report which integrates all the monitoring programs for a facility across fields of study (e.g., fish) and time (e.g., a series of annual studies). Also used as generic term that can be applied to social issue studies (e.g., archaeology) and/or environmental issue studies (e.g., vegetation or wildlife). This will be an input to, and part of, the *WUPOR Report*.

Energy Constrained System – Electrical generating stations with insufficient reservoir storage or inflows to support around-the-clock generation**.**

Facility – BC Hydro generating station or water control structure. In the context of BC Hydro Water Use Plans and related *Water Act* Orders, facility may refer to a systematic grouping of facilities. E.g., The Columbia Water Use Plan Order refers to the collective of Mica and Revelstoke Generating Stations and H.L. Keenleyside Dam.

Generation Operating Order - summarises the generation, reservoir management, and water conveyance parameters for a facility.

Guidelines – Water Use Plan Guidelines.

Hollow Cone Valve (HCV) – Also known as the Low Level Outlet (LLO) at the base of the main saddle dam at Elsie Dam. The valve used to control discharge from Elsie Lake Reservoir to the Ash River. This valve must be operated manually.

masl – metres above sea level

Monitoring Studies (or Monitors) – Programs implemented to monitor the efficacy of BC Hydro operations for environmental, social (including recreational), or economic (including power generation) benefit. May be referred to "environmental" in the text but should be considered to include all monitoring programs related to the Order. Monitoring programs are implemented to confirm the effectiveness or define the impacts of the operation constraints (including the physical works). For example, a monitoring program may be implemented to assess whether a minimum flow yields benefits to fish and fish habitat.

MW – Megawatt (1000 watts). Unit of power. Power is energy transfer per unit of time. 1 W = 1 J/s.

Natural Inflow – Total water supply to a point or area from all natural inputs from the hydrologic cycle such as precipitation, streamflow, and groundwater. (vs. Regulated Inflow).

Order – A *Water Act* (or *Water Sustainability Act*) Order. Made by the Comptroller of Water Rights to require BC Hydro to implement the priority elements of a *Water Use Plan*.

Physical Works – Construction programs undertaken generally in lieu of operation constrains. For example: instead of holding a reservoir at a high elevation, (i) a control structure may be constructed to hold water in a wetland, thereby maintaining its ecological integrity during low reservoir elevations, or (ii) a boat ramp may be constructed or extended to allow reservoir recreational access during low elevation periods.

Regulated Inflow –Water supply to a point or area from all regulated or controlled inputs such as water discharged from a dam or generating station. (vs. Natural Inflow).

***Social Issue* –** The subset of social issues related to environmental quality. For example, a flow discharge or reservoir wave action that erodes a shoreline containing a valued asset such as artifacts, architecture, biofacts or ecofacts, and cultural landscapes

Total Inflow –Water supply to a point or area from all regulated and natural sources; Total Inflow = Regulated Inflow + Natural Inflow.

***Water Act/Water Sustainability Act* –** Legislation that enables the CWR to require BC Hydro to implement priority operations, monitoring, and physical works recommended in Water Use Plans. The *Water Sustainability Act* superseded the *Water Act* in 2016.

Water Use Plan (WUP) – *Water Use Plan* published by BC Hydro. A WUP is a technical document that defines the detailed operation parameters to be used by facility managers in their day-to-day water conveyance decisions. Plans are intended to clarify how BC Hydro's rights to provincial water resources should be exercised and to take account of the multiple uses for those water resources. WUPs recognise existing legal and constitutional rights and responsibilities, as set out in legislation and court decisions.

WUPOR – Water Use Plan Order Review Program.

WUPOR Report – The final report of the Water Use Plan Order Review Program. A report will be submitted to the Comptroller of Water Rights for each of the WUP implementation Orders. The report will contain an environmental synthesis and an operational compliance summary. It will be complete with recommendations to update the Order such that it reflects the new status of activities and outcomes associated with the implementation of the Order.

APPENDIX B. REFERENCES

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APPENDIX C. ABOUT BC HYDRO AND OUR ENVIRONMENTAL AND HERITAGE MITIGATION PROGRAMS

A variety of mitigation programs are implemented at BC Hydro hydropower generation facilities to address existing effects related to the facility's footprint and operation. These programs include:

- Water Use Plan implementation
- Fish and Wildlife Compensation Programs
- Fish Passage Decision Framework
- Fish Entrainment Strategy
- Total Dissolved Gas Strategy
- Generation Wildlife Program
- Environmental Management System
- Reservoir Archaeology Program
- Climate Change Strategy

a. BC Hydro

BC Hydro is a provincial Crown Corporation, owned by the people of British Columbia. We operate an integrated system of generation, transmission, and distribution infrastructure to deliver reliable, affordable, and clean electricity to our four million customers, safely. As an organization, we have a huge impact on the lives of the people of British Columbia and we are working together to uphold this responsibility and become the most trusted, innovative utility company in North America - smart about power in all we do.

BC Hydro is one of the largest energy suppliers in Canada, generating and delivering electricity to 95 per cent of the population of British Columbia. We operate an integrated system backed by 30 hydropower plants and two thermal generating stations as well as over 79,000 kilometres of transmission and distribution lines.

Generating, transmitting, and distributing electricity in an affordable and environmentally- and socially-conscientious manner is tremendous responsibly for BC Hydro. Energy, environment, and economy directly impact all British Columbians and there are high expectations to manage all three responsibly.

BC Hydro has become a leading sustainable energy company by producing and delivering electricity in environmentally and socially responsible ways. The first and best way to meet our future electricity and environmental needs is through "demand side management" such as conservation and energy efficiency efforts. Through the Power Smart Program, BC Hydro is a global leader in conservation, providing programs and incentives to encourage customers to use less energy.

Reducing the demand for energy can eliminate or at least delay the need for new generation and thereby eliminate or delay any environmental, economic, or social impacts associated with the construction, footprint, and operation of new facilities.

When hydropower generation facilities are established and operated, sustainability and impact mitigation programs are factored into operations. These programs are described below and include:

- Water Use Plan implementation
- Fish and Wildlife Compensation Programs
- Fish Passage Decision Framework
- Fish Entrainment Strategy
- Total Dissolved Gas Strategy
- Generation Wildlife Program
- Environmental Management System
- Reservoir Archaeology Program
- Climate Change Strategy

b. Water Use Plans

Water use planning is an example of sustainable work in practice at BC Hydro. The overall goal is to find a better balance between competing uses of water, such as domestic water supply, fish and wildlife, recreation, heritage, flood control and electrical power needs.

Water use plans were developed for most of BC Hydro's hydropower facilities through a consultative planning process involving participants, such as government agencies, First Nations, local citizens, and other interest groups.

The provincial Comptroller of Water Rights reviewed the water use plans under the provisions of B.C.'s *Water Sustainability Act*, and involved Fisheries and Oceans Canada, other provincial agencies, First Nations, and holders of water licences who might be affected by the plans. Once accepted by the Comptroller, operation changes, monitoring studies and physical works outlined in the plans were implemented by BC Hydro through Orders from the Comptroller under B.C.'s *Water Sustainability Act*.

Starting in 2015, and occurring over the next 15 or more years, reviews will be undertaken of the activities that BC Hydro has performed to meet the intent of the Orders from the Comptroller.

c. Fish and Wildlife Compensation Program

The Fish and Wildlife Compensation Program (FWCP) is a partnership between BC Hydro, the Province of BC, DFO, First Nations, and Public Stakeholders conserve and enhance fish, wildlife and their supporting habitats impacted by existing BC Hydro owned and operated generation facilities. Since 1988[6], through funding from BC Hydro, the FWCP has invested more than $160 million in fish and wildlife projects that support the FWCP's vision of thriving fish and wildlife populations in watersheds that are functioning and sustainable. The FWCP operates in three regions in BC: Peace, Columbia, and Coastal.

[6] The Peace-Williston Fish and Wildlife Compensation Program (now known as the FWCP Peace Region) was established in 1988. The Columbia Basin Fish and Wildlife Compensation Program (now known as the FWCP Columbia Region) was established in 1995. The Bridge-Coastal Restoration Program (now known as the FWCP Coastal Region) was established in 1999.

For more information about the FWCP, see www.fwcp.ca.

d. Fish Passage Decision Framework

The development of some BC Hydro dams in certain drainage basins resulted in a blockage to migratory fish. Dams can create two categories of impacts on fish passage: those resulting from dam operations and those resulting from the dam footprint. Dam operations can create conditions where river hydraulics (low or high flows) impede migration or create homing issues. Operations can also result in mortality to fish upstream of the dam through entrainment. Operations-related fish passage issues and solutions are evaluated as part of the WUP process and the Fish Entrainment Strategy. In most cases these programs do not consider fish passage solutions that would mitigate footprint impacts.

BC Hydro's Fish Passage Decision Framework (the Framework) was developed in 2008[7] to establish a process for determining how BC Hydro addresses fish passage issues at its facilities. The Framework was based on recommendations made by Bocking and Gaboury (2002)[8] in their peer-review of a preliminary evaluation of restoring historical passage at BC Hydro facilities (Bengeyfield 2001). The current focus of the Framework is the restoration of passage for anadromous populations of salmon and steelhead. The Framework is a collaborative process involving regulatory agencies, First Nations, stakeholders, and other interest groups whose mandate is to determine the feasibility of restoring fish passage at each facility.

The Framework is implemented as a partnership between BC Hydro and FWCP. The focus of FWCP's involvement in the analysis and decision making around restoring fish passage is the determination of environmental and technical feasibility and likelihood of success. BC Hydro then evaluates feasibility with respect to operations and dam safety requirements as well as social and financial objectives.

The Framework is a seven step process that outlines the role of both FWCP and BC Hydro in the advancement, evaluation, implementation and funding of fish passage restoration projects. The Framework also shows the flow of work and decisions needed to advance proposals and where proposals may be terminated in the decision process (Figure 5). The Framework is divided into two parts:

1. The FWCP Role

   The process is initiated when a proponent (typically a fish passage committee) seeks funding from FWCP to evaluate the feasibility of restoring target species above a BC Hydro facility through the installation of some form of fish passage infrastructure. This part of the Framework is completed when a proposal is either found to be infeasible or is endorsed by the regional FWCP Board.

2. The BC Hydro Role

   Following regional FWCP Board endorsement ("Step 5" of the Framework), the proponent submits a supported project proposal to BC Hydro for business case and financial approvals.

[7] The Framework was updated in 2017. The most recent version can be accessed at: http://fwcp.ca/app/uploads/2017/03/Fish-Passage-Decision-Framework-Revision-1-Final-17Jan2017.pdf

[8] Recommendations included an expanded decision making process beginning with the establishment of stock and habitat profiles, followed by operational and structural profiles, and finally an assessment of cost-effectiveness.

Further information on the Framework, including the Fish Passage Decision Framework for BC Hydro Facilities process guide (BC Hydro 2016), can be found at http://fwcp.ca/fish-passage-decision-framework/ .

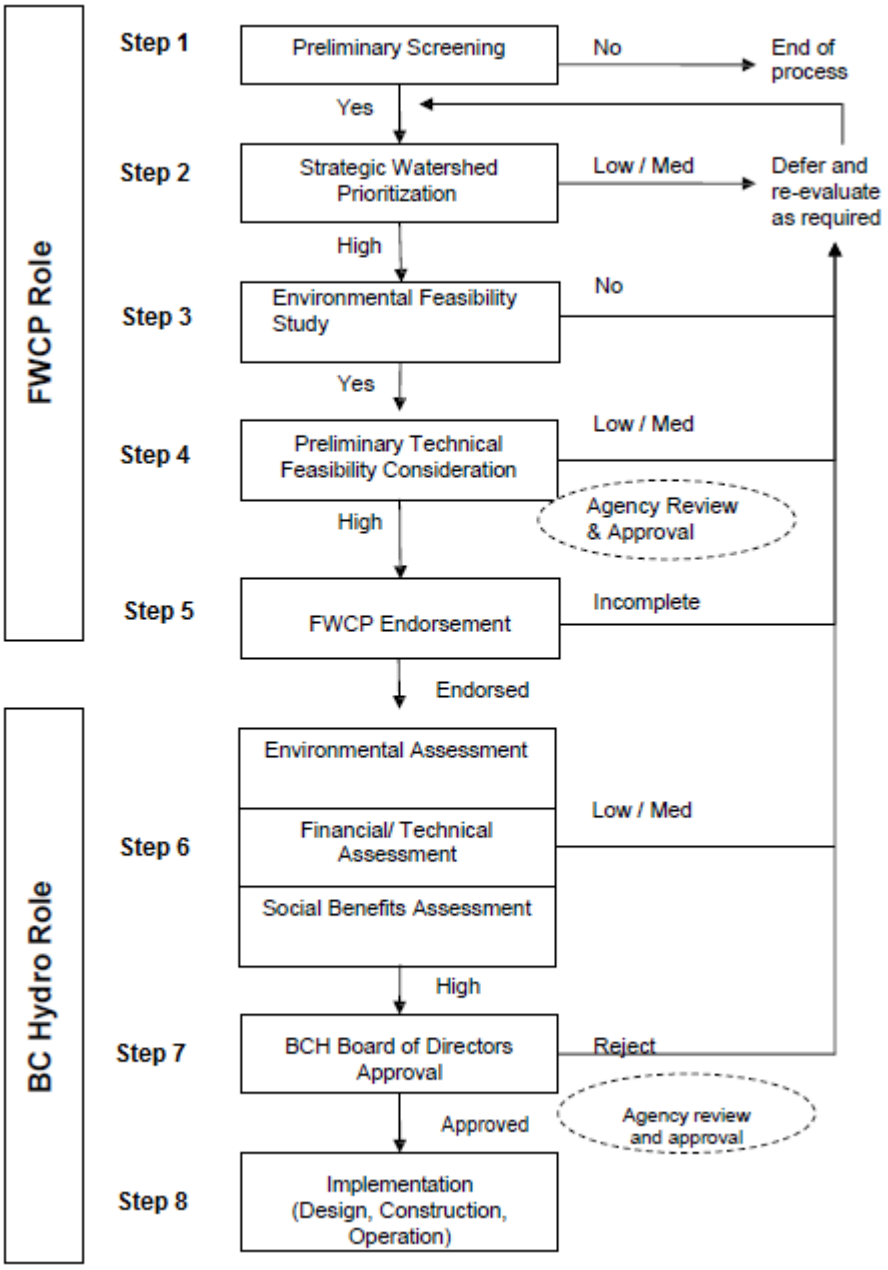


Figure 5. BC Hydro's Fish Passage Decision Framework.

e. Fish Entrainment Strategy

To achieve regulatory certainty regarding *Fisheries Act* requirements to mitigate fish mortality through entrainment at existing facilities, BC Hydro developed a Fish Entrainment Strategy. The Entrainment Strategy defines a process for assessing and resolving entrainment risks, a methodology for evaluating risks, and a schedule for application to existing facilities throughout the BC Hydro system. The Entrainment Strategy was supported by BC Hydro, DFO, and the BC Ministry of Environment (BCMOE) and had input from various regional First Nations representatives. Water use planning and capital projects have relied on the Entrainment Strategy to resolve fish entrainment issues that were beyond the capacity and scope of the respective WUP and BC Hydro facilities to fully address.

The Entrainment Strategy process is divided into four steps:

1. Prioritization: Based on fisheries and regulatory issues, operation risks and commitments, should this facility be included in the Entrainment Strategy process?
2. Risk Screening: For high priority facilities, what is the focus for assessment in the Entrainment Strategy?
3. Action Planning: What are the entrainment impacts and what options exist to mitigate impacts?
4. Mitigation-Compensation: What is the final recommendation for mitigation?

f. Total Dissolved Gas Strategy

Total dissolved gas (TDG) levels downstream of some BC Hydro facilities can exceed the Province's Approved Water Quality Guidelines, particularly where high magnitude spill flows or air injection methods are used during operations. High TDG levels can be harmful to fish, causing gas bubble disease and mortality. To address these challenges BC Hydro developed a Total Dissolved Gas Strategy (the TDG Strategy).

The TDG Strategy is being implemented at generating stations, as needed, to reduce environmental and regulatory risk. The TDG Strategy evaluates the TDG risk associated with facility operations to determine where more monitoring is needed to develop the relationship between operations and TDG production. It also determines where mitigation involving operation changes or cost-effective physical works can be undertaken. The TDG Strategy's implementation is regularly reviewed by provincial and federal regulators to determine its overall success.

g. Generation Wildlife Program

BC Hydro's Generation Wildlife Program has been developed to manage wildlife issues associated with the operation of its generation facilities, including habitat loss, migration route disruption, and mortality. Wildlife issues are addressed by a number of programs and projects, including the FWCP, the water use planning process, capital projects, and operations, maintenance and administration projects. The foundation of the Wildlife Management Program consists of the Wildlife Issues Management Guide and Facility Reports.

The BC Hydro Wildlife Issues Management Guide (BC Hydro 2011) provides the legal and policy background for the Generation Wildlife Program, along with recommendations on how to safely manage wildlife issues. Wildlife issues captured in the Guide include birds, species and ecosystems at risk, pest management, problem wildlife, hazardous wildlife, wildlife-borne diseases, wildlife mortality (reporting and disposal), vegetation management, hydrocarbon spills, and human health and safety.

h. Environmental Management System

In 2016, BC Hydro drafted a new Environmental Management System (EMS) Framework and preliminary strategy. These documents are being integrated into a comprehensive system emphasizing delivery of environmental standards, tools, and procedures. The EMS encompasses the four elements of "plan, do, check, act"; components of each are outlined briefly below.

Plan

The planning element of the EMS includes BC Hydro's Corporate Environmental Responsibility Policy and two Statements of Strategic Intent that provide elaboration on the management of fisheries and species at risk. This element also defines standards for document definitions and approval processes.

Do

The implementation of the EMS includes, hazard and risk assessment, training, Incident Management System, and resources and tools (e.g., environmental best management practices).

Check

Monitoring the application and effectiveness of the EMS includes components of reporting, auditing, and compliance reviews.

Act

Periodic management reviews of the EMS ensure objectives are being met and there is continual improvement within the system.

i. Reservoir Archaeology Program

BC Hydro established the Reservoir Archaeology Program (RAP) in 2008 to ensure that reservoir operations comply with the B.C. *Heritage Conservation Act*. Through RAP, BC Hydro works with the Archaeology Branch of FLNRO and affected First Nations to assess and manage impacts to protected archaeological sites in the active erosion zones of 26 reservoirs across the Province. The RAP is a two phase program:

- Phase 1: Inventory and the development of archaeological management plans
    - An inventory of archaeological sites in active erosion zones of reservoirs;
    - Archaeological site significance assessments
    - Identification of potential impacts to sites
    - Development of reservoir-specific Archaeological Management Plans
- Phase 2: Implementation of Archaeological Management Plans

j. Climate Action Strategy

Global climate change is upon us. The provincial government's responsibility to current and future generations as natural resource stewards requires

If significant impacts result from climate change to a basin's hydrology or ecology, the provincial water use planning guidelines allow for another Order review to assess and accommodate adaptation strategies.

coordinated, province-wide action on climate change (Province of British Columbia 2018).

BC Hydro is doing its part. Both natural cycles and human-related greenhouse gas emissions influence climate in British Columbia and the river flows that supply the majority of power that BC Hydro generates. BC Hydro's climate action strategy addresses both the mitigation of climate change through reducing our greenhouse gas emissions and adaptation to climate change by understanding the risks and magnitude of potential climatic changes to our business today and in the future. BC Hydro has published reports on bchydro.com regarding the potential impacts of climate change on BC Hydro-managed water resources, the most recent being Jost and Weber (2013).

As part of its climate change adaptation strategy, BC Hydro has undertaken internal studies and worked with some of the world's leading scientists in climatology, glaciology, and hydrology. BC Hydro collaborated with scientists from the Pacific Climate Impacts Consortium (PCIC) at the University of Victoria; the Western Canadian Cryospheric Network (WC2N), which consists of six Western Canadian and two Washington state universities; and the Climate Impacts Group (UW-CIG) at the University of Washington.

If significant impacts result from climate change to a basin's hydrology or ecology, the provincial water use planning guidelines allow for another Order review to assess and accommodate adaptation strategies.

APPENDIX D. ASH WATER USE PLAN ORDER IMPLEMENTATION SUMMARY

a. Chronological History

The Ash River Water Use Plan (JOR WUP) was initiated in 2000 and finalized in 2004. The outputs during the WUP process included:

- **Ash River Consultative Committee Report (BC Hydro 2003)** – documentation of the structured decision making process which evaluated operating alternatives against objectives represented by the Consultative Committee, and documented uncertainties that would define the study program for implementation following WUP approval;
- **ASH Water Use Plan (BC Hydro 2004)** – submitted by BC Hydro to the Comptroller of Water Rights (CWR) as the summary of operating constraints and implementation commitments (studies and physical works) to be appended to its Water Licences;
- **Ash River Facility Order (Comptroller of Water Rights 2004)** – the Water Act Order issued by the CWR to implement the Water Use Plan as a condition of the 5 licences associated with the Ash River projects; and
- **Study progress reports and annual watershed reports** – reports summarizing annual data collection results for ordered studies were prepared, and watershed activities were summarized each year in an annual watershed report and submitted to the CWR. All reports were published online.

As noted above, in 2004, the Comptroller of Water Rights (CWR) issued an Order in response to the ASH WUP under the Water Act that included implementation of two pulse flow releases from Elsie Lake Dam. Two monitoring projects were conducted to assess for anticipated benefits to fish passage during pulse flows, and on archaeological sites in the Elsie Reservoir. As a result, the following outputs were prepared:

- **Water Licence Requirements (WLR) Monitoring Terms of References (BC Hydro 2005a,b; 2007)** - for the two monitoring studies ordered by the CWR, management questions and methodologies were prepared to address uncertainties defined in the WUP consultative process and submitted to the CWR for Leave to Commence.

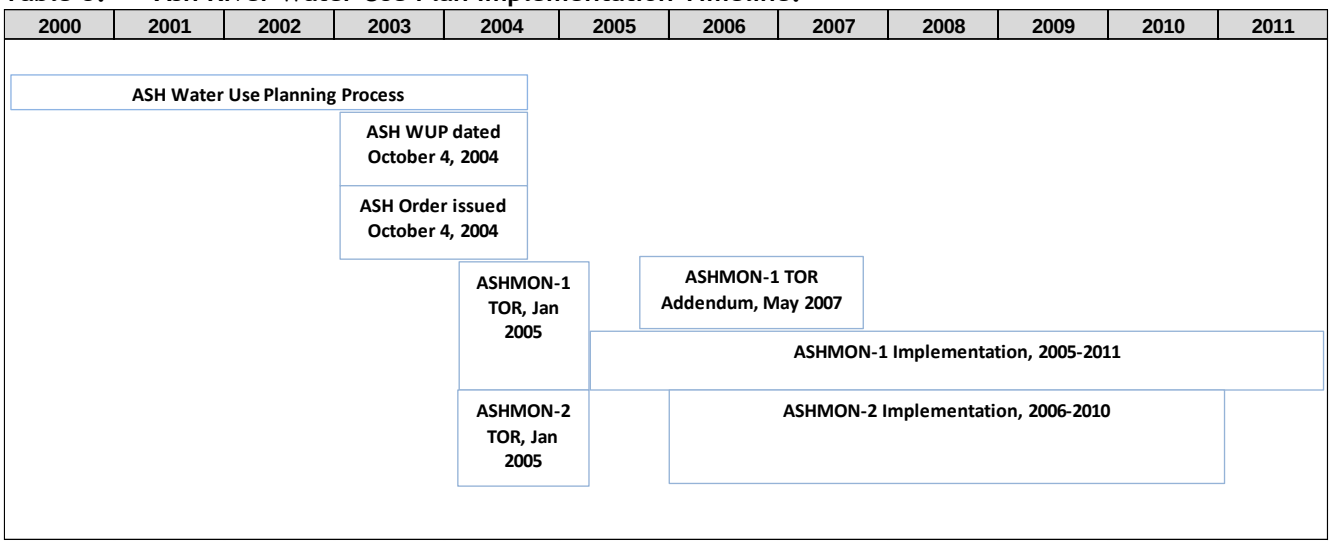
The two monitoring studies were as follows:

- **ASHMON-1** – Assessment of Adult Fish Passage during Pulse Flow Releases: assess whether pulse flow releases during August and September improve steelhead passage at Dickson Falls and thus increase the number of steelhead present upstream of the falls. The program was also intended to determine the appropriate magnitude and hourly flow release to maximize steelhead passage; and
- **ASHMON-2** – Elsie Reservoir Archaeological Investigations: undertake monitoring of erosion on archaeological resources in the drawdown zone of Elsie Lake Reservoir, and assess the effects of the operating regime on those resources.

Pulse flow releases commenced in summer 2005. ASHMON-1 was a seven-year program, which commenced in 2005 and concluded in 2011. ASHMON-2 was a five-year program, which commenced in 2006 and concluded in 2010.

The table below outlines the implementation timeline of the Ash Water Use Plan.

Table 8. Ash River Water Use Plan Implementation Timeline.



b. Financial Summary

This section describes the costs associated with implementation of the ASHMON-1 and ASHMON-2 monitoring programs. During the WUP process, detailed cost estimates were prepared that reflected the data collection and analysis costs, which were submitted to the CWR with the Terms of References. Upon CWR approval, these costs became the budgets for the physical works and monitoring studies. The table below provides the CWR approved costs, actual costs, and the variance between CWR approved and actual costs. As shown in the table, all work was completed within budget.

Table 9. Ash River WUP Order Implementation Budget and Cost.

Physical Works Project or Monitoring Study	CWR Approved Cost	Actual Cost	Variance Between CWR Approved and Actual Costs	
			Dollars Under Budget	Percent Under Budget
ASHMON-1	$ 364,530	$ 362,565	$ 1,965	0.54%
ASHMON-2	$ 133,219	$ 131,615	$ 1,604	1.20%
Total	**$ 497,749.00**	**$ 494,180.00**	**$ 3,569.00**	**0.72%**

The change to the annual value of energy was estimated at $600,000/yr (BC Hydro 2003).

c. *Environmental Synthesis Report* Summary

Pellett (2017) considers the fish passage results from the monitoring programs ordered in response to the ASH WUP, and outlines whether benefits anticipated by the WUP Consultative Committee (CC) are being realized under the current operation constraints. The Report is summarized in this section; the full report is published on bchydro.com.

The two WUP monitoring programs were generally successful in addressing the management questions posed by the WUP CC.

The following conclusions were made based on monitoring conducted to answer management questions around the effectiveness of the ordered changes to Ash River facility operations:

- ASHMON-1 was intended to determine whether pulse flow releases during August and September improved Steelhead passage at Dickson Falls and assess what the appropriate magnitude and hourly flow release to maximize Steelhead passage. Pulse flows of 10 cms and 20 cms were tested. The base flow condition was set at 3.5 cms.
- Snorkel survey data provided a contrast of migration rates for 10 cms and 20 cms. Pulse flows of 10 cms were found to have a significant positive effect on migration rate, while no effect was detected for the 20 cms pulse, when compared to non-pulse periods.
- The magnitude and hourly release schedule which maximized passage were investigated with radio telemetry; however, few tagged fish ascended the falls during pulse flow periods. Steelhead were found to ascend the falls at a range of 3.7-11.2 cms which supports snorkel survey data.
- Frequency of Steelhead passage attempts increased (leaps) for the 10 cms pulse only, but the number of successful leaps was highest at 20 cms. The confidence in accurately determining migration success was low, so the frequency of leap attempts was highlighted.
- Results of the study indicate that moderate pulse flow releases (<11 cms) significantly improved the rate of passage at Dickson Falls, but the majority of passage likely occurred during non-pulse periods.
- Base flow conditions of 3.5 cms did not prevent migration.
- ASHMON-2 results indicated that reservoir operation was affecting two significant archaeological sites. The two sites were at high and moderate risk of damage from erosion. The findings revealed that there was no optimal reservoir level that would protect all sites (Gray and McLaren, 2011). However, several options for protecting archaeological sites were identified.
- The Reservoir Archaeology Program was established in Elsie Reservoir in 2008 continued and completed a selection of protection works started under the ASHMON-2 study. Future management works will include maintenance visits to DiSh-17 and DiSg-31 to check geotextile installations. Any recommendations for archaeological site management work received through the WUPOR process will be managed through the Reservoir Archaeology Program.

Implementation of the WUP operation changes has benefited fish and fish habitat in the Ash River. Pulse flows of 10 cms had a significant positive effect on Steelhead migration rate.

Table 10 (fish) and Table 11 (archaeology) summarize the *Environmental Synthesis Report* results.

Table 10. Summary of *Environmental Synthesis Report* - Fish

Study	Objectives	Management Questions	Response	Operation Implications
ASHMON-1: Assessment of Adult Fish Passage during Pulse Flow Releases	1. To assess the benefits of pulse flow releases to Steelhead in terms of migration rate. 2. To collect data to determine the characteristics of the pulse flow that would be most beneficial while staying within the water budget of 26 cms^2 days.	1. Do the pulse flow releases during August and September improve Steelhead passage at Dickson Falls, and thus increase the number of Steelhead present upstream of the falls? 2. What is the appropriate magnitude and hourly flow release to maximize Steelhead passage?	1. Pulse flow releases during August and September were found to improve the rate of Steelhead passage at Dickson Falls. 2. The 10 cms pulse flow significantly improved the rate of passage while the 20 cms pulse was found to have no effect (positive or negative) relative to the 3.5 cms base flow. Although 10 cms improved passage, it is not known if passage could be further improved at other flows. Therefore, this management question is only partly answered.	Moderate pulse flow releases of 10 cms from Elsie Dam do improve Steelhead fish passage and that base flow conditions of 3.5 cms do not impede migration. Pulse flows released in early August may be more effective when seasonal migration rate is highest. While the optimal pulse flow for aiding Steelhead passage over Dickson Falls may differ from those assessed, the potential benefits of further refinements should be reviewed prior to considering the significant resources required to detect a change.

Table 11. Summary of *Environmental Synthesis Report* - Archaeology

Study	Objectives	Management Questions	Response	Operation Implications
ASHMON-2: Elsie Reservoir Archaeological Investigations	1. Determine the rate of erosion at site DiSh-17 and the magnitude of impact that erosion may be having on the archaeological resources at the site via annual monitoring.	No specific management questions were outlined	1. Average erosion rates were calculated for each station; however, rates are based on only 2 years of data. The highest average erosion rate was 16.77 mm/year and the highest average deposition rate was	Rates of erosion are having significant impacts on archaeological deposits. Changing reservoir levels, wind-generated waves, precipitation and changing temperatures are all contributing to erosion.

Study	Objectives	Management Questions	Response	Operation Implications
	2. Prepare a list of alternatives for the protection of archaeological resources at DiSh-17. 3. Complete opportunistic monitoring to monitor the rate of artifact exposure at known sites in the reservoir.		18.29 mm/year. The impact of erosion on DiSh-17 presents a considerable risk to remaining archaeological deposits at the site. 2. Options for protection of DiSh-17 were developed. Placement of geotextile fabric over vulnerable and discrete sites appears to limit the erosion at those sites. 3. Four years of site revisits revealed continued artifact exposure from previously recorded sites.	The presence of artifacts on the surface of the inundation zone and an increase in the collection of artifacts in the final two years of study provide evidence that intact archaeological deposits at the site continue to be affected by erosion. There is no optimal reservoir elevation that will protect all archaeological sites. However, recommendations to keep reservoir levels higher than 330 metres above sea level (masl), or lower than 318 masl or that they fluctuate as little as possible to protect some archaeological sites from effects of erosion are provided for consideration. Sites DiSh-17 and DiSg-31 are the sites with the most complexity in the reservoir. These sites are currently protected in part by geotextile fabric and cobble anchors. If reservoir elevations are to be maintained at a high elevation, then the upper terraced portion of DiSh-17 could be entirely protected with geotextile.

d. Order Completion by Aspect and Condition

(i) Changes to Operations

Current key operation conditions are depicted in Table 12. Key conditions represent those implemented at the facility that are associated with a significant change from the pre-WUP operation regime.

Table 12. Core Order Conditions - Changes to Operations.

WUP Order Requirements for ASH (Key Elements)		
Cond.	**Order Requirement Summary**	**Complete?**
1	**Release minimum flows from Elsie Dam of 3.5 cms from 1 May to 31 October and 5.0 cms from 1 November to 30 April**	✓
2	**Release pulse flows in August and September for fish passage as determined by monitoring study (Clause 5)**	✓
3	**Shall adhere to the specified ramping rates**	✓

Table 13 depicts other operational or related administrative requirements in the Order.

Table 13. Static and Administrative Facility Operation Requirements.

WUP Order Requirements for ASH (Static Ops Elements)		
Cond.	**Order Requirement Summary**	**Complete?**
8	**The works may be operated in an alternate manner in the event of an emergency; a dam safety requirement, or an extreme hydrologic event**	✓

(ii) Monitoring Studies and Physical Works

Physical works are the one-time modification or addition of infrastructure to facilitate an equivalent operations outcome. Monitoring programs are implemented to confirm the effectiveness or define the impacts of an operation constraint (or the physical work). Once the operation's effectiveness is confirmed (or refuted), then the monitoring program has met the intent of the WUP and the Order and the ordered condition may be considered complete in the context of the water use planning process. No physical works were required under the Ash River Water Use Plan.

Table 14 and Table 15 show the monitoring and administrative sections of the Order. No physical works were required under the Ash River Water Use Plan.

Table 14. Monitoring Conditions.

WUP Order Requirements for ASH (Monitoring Elements)		
Cond.	**Order Requirement Summary**	**Complete?**
5	**The licensee shall implement monitoring in accordance with the plan as accepted**	✓
6	**The licensee will undertake monitoring of erosion of archaeological sites**	✓

(iii) Reporting

Table 15. Order Administrative Conditions.

WUP Order Requirements for ASH (Administrative Elements)		
Cond.	**Order Requirement Summary**	**Complete?**
4	**The licensee shall submit a monitoring plan for assessing pulse flows for acceptance**	✓
7	**The licensee shall provide annual reports to the Comptroller which describe the effects of reservoir operations on archaeological resources**	✓
9	**All emergency operations or other deviations from this ordered shall be reported to the Comptroller**	✓

APPENDIX E. LIST OF WUP IMPLEMENTATION DOCUMENTATION AND RECORDS

Appendix B References refers to discrete documents such as the Water Use Plan and Consultative Committee Report used extensively in the preparation of this report. Appendix K contains the Annual Water Conveyance Charts submitted to the Comptroller of Water Rights.

Below is a complete list of Ash River WUP implementation documents found on bchydro.com related to the monitoring programs and physical work. The full URL is:

https://www.bchydro.com/about/sustainability/conservation/water_use_planning/vancouver_island/ash_river.html

a. Implementation Annual Reports

- October 2012 [PDF, 125 KB]
- October 2011 [PDF, 227 KB]
- October 2010 [PDF, 30 KB]
- October 2009 [PDF, 71 KB]
- October 2008 [PDF, 103 KB]
- October 2007 [PDF, 161 KB]
- October 2006 [PDF, 99 KB]

b. Study Annual Reports and Terms of Reference

Table 16. Ash River WUP Study Annual Reports and Terms of Reference.

PROJECTS	STUDIES	TERMS OF REFERENCE
ASHMON-1 Assessment of Adult Fish Passage during Pulse Flow Releases	• October 2012 [PDF, 710 KB] • February 2011 [PDF, 369 KB] • August 2010 [PDF, 2.3 MB] • June 2010 [PDF, 9.3 MB] • March 2009 [PDF, 3.5 MB] • April 2008 [PDF, 3.1 MB] • February 2007 [PDF, 3.2 MB] • October 2006 [PDF, 1.7 MB]	• May 2007 [PDF, 36 KB] • January 2005 [PDF, 103 KB]

ASHMON-2 Elsie Reservoir Archaeological Investigations	• March 2011 [PDF, 12 KB] • June 2010 [PDF, 13 KB] • March 2009 [PDF, 22 KB] • June 2007 [PDF, 18 KB]	• January 2005 [PDF, 45 KB]

APPENDIX F. WUP ORDER REVIEW ENGAGEMENT PROCESS PARTICIPANTS

The following were engaged for the Ash River Water Use Plan Order Review:

- Hupacasath First Nation
- Tseshaht First Nation
- Dan Sneep, Department of Fisheries and Oceans
- Ron Ptolemy, Ministry of Environment and Climate Change Strategy
- Mike McCullough, Ministry of Forests, Lands, and Natural Resources
- Steve McAdam, Ministry of Environment and Climate Change Strategy
- Larry Cross, Norske Canada
- Mike Irg, Alberni – Clayoquot Regional District
- Penny Coate, Regional Director ACRD
- Sheena Falconer, Westcoast Aquatic
- Barkley Salmon Group

APPENDIX G. FIRST NATIONS ENGAGEMENT

a. Introduction

BC Hydro recognizes that our system has impacts on the lives and interests of First Nations communities. We are committed to working together and to building relationships that respect these interests.

- We will inform First Nations of projects and works as early as possible for discussion;
- We will strive to provide the clearest, accessible, and transparent information possible;
- We will seek advice on the First Nations' perspectives on how to best reduce or avoid impacts on the environment, cultural heritage, and social needs;
- We will be accessible and open to understanding the unique interests of the First Nations in relation to our operations;
- We will deliver on our commitments and we will be open and transparent if something is standing in the way of our mutual success.

b. First Nations

The following First Nations were engaged based on their involvement in the Water Use Plan and also based on the Project area (which is determined by the Order issued for the Ash River System) and the B.C. Provincial Consultative Area Database (CAD):

- Hupacasath First Nation
- Tseshaht First Nation

c. Engagement

(i) Engagement Plan

The engagement objectives are to:

- Inform identified First Nations of the WUPOR Process
- Ensure the First Nations are proactively informed of the reviews and receive clear, concise information in a timely manner to facilitate their appropriate engagement in the WUPOR of the Ash River System;
- Communicate WUP Order review scope (see Section 1.3 The WUP Order Review Program on page 4):
    - The scope of the WUP Order review is framed by the province's Water Use Plan Guidelines.
    - Only those activities or constraints that were ordered by the Comptroller of Water Rights will be included.
    - WUPOR will focus on BC Hydro's facility operations, monitoring, and physical works implemented in lieu of operation changes.

- New issues that may have arisen directly related to facility operations.

- Solicit input from the identified First Nations and consider incorporating that input into the Ash River WUPOR Findings Report, *Environmental Synthesis Report*, draft WUPOR Report, and associated work;
- Ensure transparency and accountability in communicating with the identified First Nations; and
- Maintain and build relationships with First Nations in the Ash River System area.

(ii) Engagement Activities Summary

Table 17. First Nation Engagement Summary.

Activities	Activity Duration
Send Project Information and updates to First Nations through email and mail. (First Information Sheet went out on August 25, 2014)	First Information Sheet went out on August 25, 2014
Respond to First Nations general questions and concerns - phone calls, email	Through-out project
Capacity Funding Agreements	Funding was offered in 2015. Revised funding agreements were sent out in October 2017 with draft reports
Meet with First Nations to provide information on WUPOR ASH River	Met with Hupacasath Nation – September 2015 Met with Tsehaht First Nation – September 2015 and April 2016
Document consultation activities	Through-out project
Issue Draft Findings Report and Draft *Environmental Synthesis Report* for comment to First Nations	Version 3 sent April 2016 Final Draft October 2017
Meet with First Nations to present the report and discuss its contents (if required)	Meet with First Nations if requested
Receive Issues/Comments from First Nations	October to January 2018
Analyze Issues/Comments from First Nations - issues raised will be evaluated individually to determine if additional engagement is needed.	January/February/March 2018
Provide Draft Water Use Plan Order Review Report to First Nations for comment	August 23, 2018

Activities	Activity Duration
Meet with First Nations to present the report and discuss its contents (if required)	Summer 2018 – no meetings requested
Receive Comments from First Nations	September, 2018 – no comments received

d. First Nation Interests, Concerns, and Responses

BC Hydro has not received comments from Hupacasath or Tseshaht First Nations on any of the reports that were sent.

Table 18. First Nation Interests, Concerns, and BC Hydro Responses.

Comments Received	BC Hydro Responses
No comments received from Hupacasath First Nation	
No comments received from Tseshaht First Nation	

APPENDIX H. AGENCY ENGAGEMENT

a. Introduction

(i) Objectives

Receive feedback from identified agency representatives regarding the Ash River *Environmental Synthesis Report* (ESR), and *Findings Report*.

(ii) Agency Identification

In an October 2017 meeting of the Fish Hydro Management Committee, a subcommittee was formed with the purpose of identifying the appropriate regional and provincial agency representatives to review the Ash *Environmental Synthesis Report* and *Findings Report*. The following agency representatives were engaged:

- Dan Sneep, Department of Fisheries and Oceans
- Ron Ptolemy, Ministry of Environment and Climate Change Strategy
- Mike McCullough, Ministry of Forests, Lands, and Natural Resources
- Steve McAdam, Ministry of Environment and Climate Change Strategy

(iii) Engagement Plan and Activities

Table 19. Agency Engagement Plan and Activities.

Activity	Lead	Timing
Contact agency representatives	Teri Neighbour	Before 2017-Nov-14
Make *Environmental Synthesis Report* (ESR) and *Findings Report* available for review and comment on BC Hydro website	Teri Neighbour	2017-Nov-14
Follow up and respond to any comments on the reports	Teri Neighbour	2018-Jan

b. Engagement

(iv) Communication and Engagement Activities and Record

The table below outlines the communication and engagement activities related to request for review and comment by agencies on the Ash *Environmental Synthesis* and *Findings* reports.

Table 20. Regulatory Agency Communication Activities and Record

Date	Communication Type	Notes	Sent To
14-Nov-2017	email	Initial notification that draft ERS and findings report are posted; request review and comment by Jan 13, 2018	Dan Sneep Ron Ptolemy Mike McCullough Steve McAdam
29-Nov-2017	Phone call	Reminder that ESRs are posted and that comment period ends January 13	Dan Sneep Ron Ptolemy (voice mail) Mike McCullough (voice mail)
05-Dec-2017	Email from Ron Ptolemy	Indicated that he had reviewed and provided his comments to Mike McCullough. Commented that further studies related to ASHMON-1 (pulse flows) were ill-advised, and questioned a reference to spawning habitat performance.	Teri Neighbour
09-Jan-2018	email	Notification that this is final week for comments	Dan Sneep

(v) Summary of Feedback and Responses

No requests for changes were received from agencies regarding the Ash *Environmental Synthesis* or *Findings Report*s. A response regarding the December 5, 2017 email which questioned a reference to spawning habitat performance was sent back to Ron Ptolemy. The complete synthesis of outcomes can be found in Appendix D and the complete *Environmental Synthesis Report* is posted on bchydro.com

APPENDIX I. STAKEHOLDER ENGAGEMENT

1. Project Purpose

Receive feedback from interested stakeholders regarding Ash River WUPOR.

2. Project background

The Ash River Water Use Plan was formally initiated in September 2000. There were a total of 23 Consultative Committee and subcommittee meetings with the final WUP CC meeting held June 25, 2002. The Consultative Committee Report and the Draft WUP were submitted to the Comptroller of Water Rights in 2003.

3. Engagement Process

Activity	Lead	Timing
Contact consultative committee member organizations	Ted Olynyk	Before 2017-Nov-14
Make WUPOR report available for review and comment on BC Hydro website	Ted Olynyk	2017-Nov-14

4. Key Stakeholders

- Larry Cross, Norske Canada
- Mike Irg, Alberni – Clayoquot Regional District
- Penny Coate, Regional Director ACRD
- Sheena Falconer, Westcoast Aquatic

5. Key messages

The WUPOR Program is the final step of implementing the provincial WUP guidelines. THE WUPOR program will determine whether the ordered water management constraints on BC Hydro's operations are achieving the specific environmental and social objectives identified in each WUP.

BC Hydro made significant water flow regime changes to the Ash River system in 2005 that came from the collaboration of the 15-member committee comprised of First Nations, agencies and stakeholders. The primary benefits were:

- **Fish and wildlife benefits:** Increase in the Ash River minimum flow released below the Elsie Dam. Prior to the water use planning process, the minimum Ash River flow was less than 1 cms. Since 2005, it now varies seasonally between 3.5 cms and 5 cms; and

- **Fish migration flows:** BC Hydro increases the river flow over a few days, three times per year in August and September, to assist steelhead in migrating past Lanterman and Dickson falls. Pulse flow releases of 10 cms increased steelhead passage and the number of steelhead above Dickson Falls. No effect was detected with a 20 cms pulse flow.

BC Hydro, with community consultation, was able to make significant flow management changes to the Ash River hydroelectric system. That process likely covered about 95% of the potential changes that may benefit social and environmental considerations given the limited water storage. In addition, over and above the original water use planning process, from 2006 through 2011, there were five years of study and study review through a community Monitoring Advisory Committee.

(vi) Summary of Feedback and Responses

Comments Received	BC Hydro Responses
When the WUP was originally prepared, local stakeholders wanted a condition or at least a note/comment included in the Plan regarding the value of BC Hydro providing regular communication on changes to the ASH/Elsie Lake generation discharge in to Great Central Lake. BC Hydro did not include it in the formal WUP, however they did agree to improve communication outside the WUP. This occurs now but relies on the key person(s) at BC Hydro knowing that this is something they need to do. Typically local stakeholders get an update email every month or two from Wuben Luo at BC Hydro. And, BC Hydro provides some flow information on their public website, although updating of forecast discharge flow is sometimes sporadic. The Barkley Salmon Working Group is requesting that this practice be documented in BC Hydro standard procedures. This will greatly reduce the chance that the information flow is interrupted should there be a change in personnel. Thank you for the consideration, Tawney Barkley Salmon Working Group Facilitator	Currently BC Hydro provides communications on ASH operations to stakeholders in different ways including monthly operations update, e-mails, webpage, and conference calls, such as the Somass Fish Flow Meeting. These communications are documented in the Ash River system operating orders and will continue to be followed. Since the communications including the methods and parties involved may change and they are not about how the water should be used, they are better managed outside the WUP Order.

APPENDIX J. ASH RIVER WATER ACT ORDER

Order source: http://www.env.gov.bc.ca/wsd/water_rights/scanned_lic_dir/117500-119999/119975/licence_plat_order.pdf

Province of British Columbia
Water Act

Order
Water Act
Section 39

File No. 0212196

WHEREAS British Columbia Hydro and Power Authority (BC Hydro) is the operator of the Ash River hydroelectric system, in respect of which it holds licences FL119975 and FL119976; and

WHEREAS the licensee has submitted the Ash River Project Draft Water Use Plan, which recommends changes to the operations of Ash River hydroelectric system which are intended to provide benefits to fisheries and wildlife habitat with no or minimal effects on recreation and other values; and

WHEREAS I have accepted the Ash River Project Water Use Plan dated October 4, 2004; and

WHEREAS BC Hydro has proposed a monitoring programme to determine whether operating the facility in accordance with the operating parameters and procedures in the Ash Water Use Plan will provide the expected benefits;

I HEREBY ORDER THAT:

1. The licensee shall release minimum flows from Elsie Dam (POD 30269) into Ash River as follows:
   a) 3.5 cubic metres per second from May 1 to October 31 measured at the dam, and
   b) 5.0 cubic metres per second from November 1 to April 30 measured at the dam.
2. The licensee shall release such quantities of water from Elsie dam as necessary to provide pulse flows for steelhead passage during August and September, to be measured at the Moran Creek gauge, consistent with a design to be approved by the Comptroller. The total pulse flow

approved for any year shall be up to a maximum of 40 cms-days, the instantaneous rate not to exceed 25 cms.

3. When changing flow rates from Elsie Dam into Ash River, the licensee shall ramp the rates up or down according to the following schedule:

Maximum Ramp Up Rate		**Maximum Ramp Down Rate**	
Discharge (cms)	Rate of Change (cms/h)	Discharge (cms)	Rate of Change (cms/h)
0-2.8	1.1	>30	n/a
2.8-5.7	2.3	30-27	2.5
5.7-8.5	2.8	27-19.8	2.3
8.5-14.2	3.4	19.8-17.0	2.0
14.2-19.8	4.0	17.0-14.2	1.8
19.8-26.9	4.5	14.2-8.5	1.0
27-30	5.1	8.5-5.7	0.9
>30	n/a	5.7-3.5	0.3
		3.5-0	0.2

4. The licensee shall submit a monitoring plan for acceptance by the Comptroller, within four months of the date of this order, outlining details of monitoring steelhead migration before and after the flows described in clause 2.

5. The licensee shall implement monitoring in accordance with the monitoring plan accepted by the Comptroller of Water Rights and shall report monitoring results to the Comptroller annually;

6. The licensee shall undertake monitoring, in accordance with the *Heritage Conservation Act,* of erosion on archaeological resources, including exposure of _artefacts, within the drawdown zone of Elsie Lake Reservoir at the large lithic site DiSh-17 and scattered sites as identified under Permit 2001-266, issued under the *Heritage Conservation Act.*

7. The licensee shall prepare reports annually, based on the results of monitoring as required in clause 6 above, which describe the effects, if any, of reservoir operations on archaeological resources within Elsie Lake Reservoir and shall submit copies of those reports to the Comptroller of Water Rights and to the Archaeology and Registry Services Branch.

8. The licensee may operate the works in an alternate manner in the event of an emergency, a dam safety requirement, or an extreme hydrologic event.

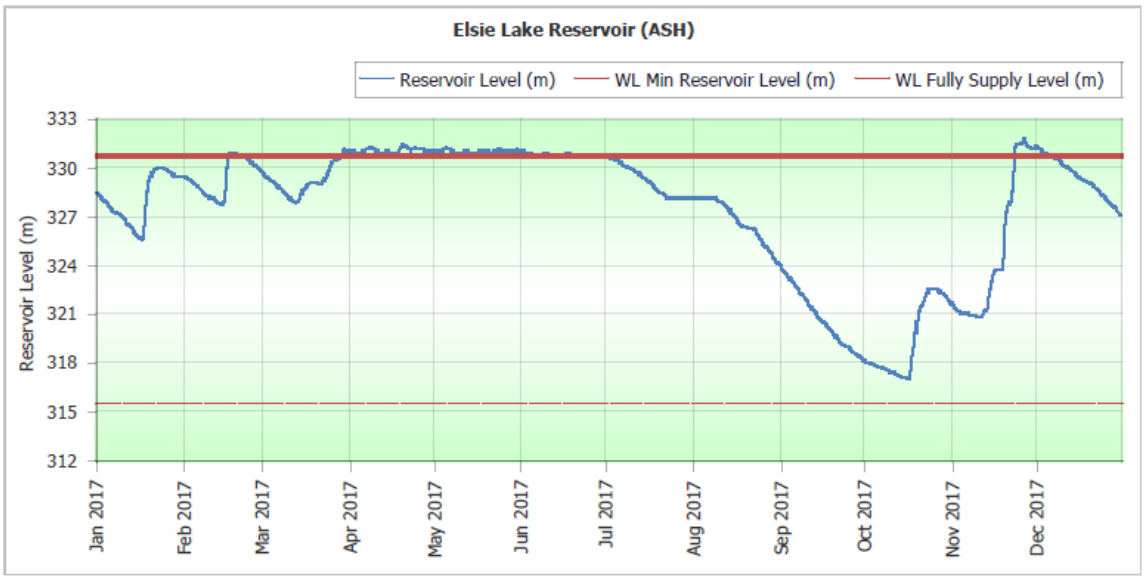
9. All emergency operations or other deviations from those ordered above shall be reported to the Comptroller of Water Rights in a timely manner.

Dated at Victoria, B.C., this 9th day of October, 2004.

Pieter J. Bekker
Deputy Comptroller of Water Rights

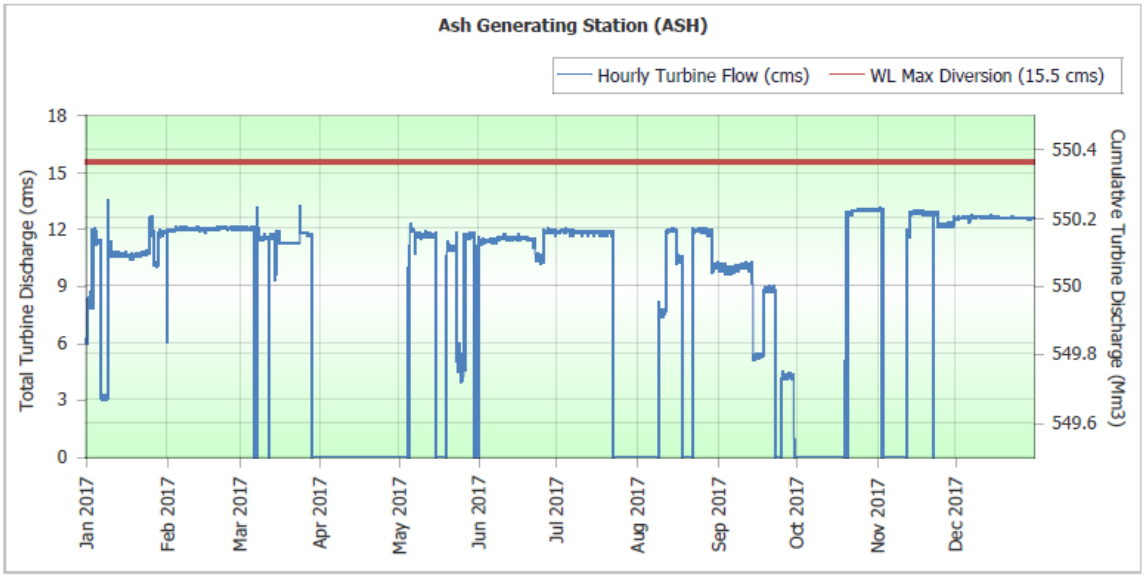
APPENDIX K. ANNUAL WATER CONVEYANCE CHARTS

ASH

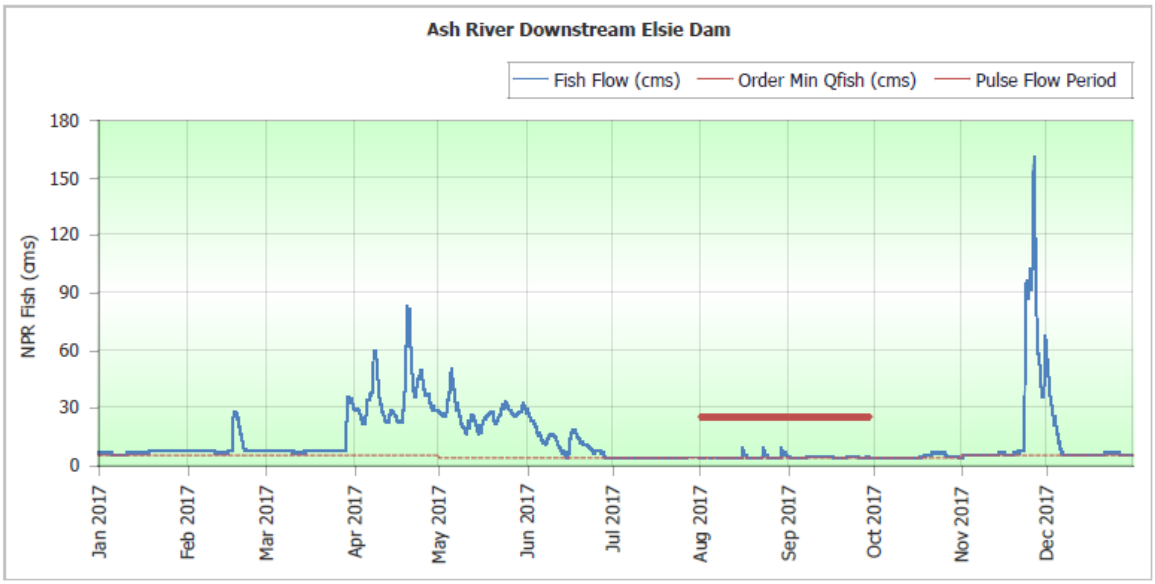


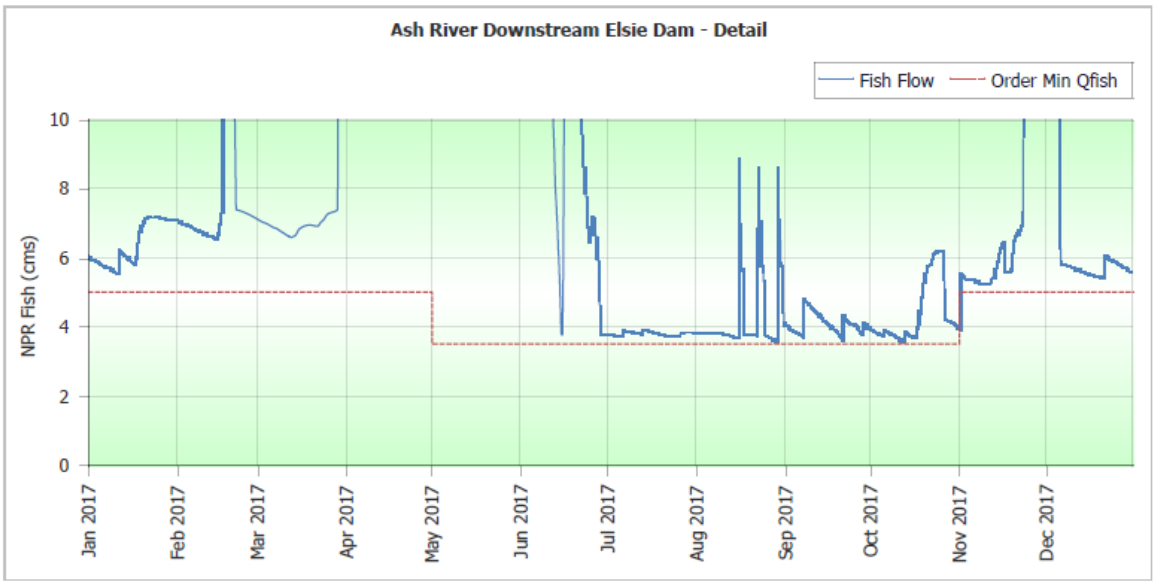
Start Date	End Date	Type	Description
2017-01-01	2017-12-31	Miscellaneous	Maximum reservoir level controlled by freespill weir at 330.71 m.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2017



There are no reportable exceptions for the period Jan 1 to Dec 31, 2017





There are no reportable exceptions for the period Jan 1 to Dec 31, 2017

Start Date	End Date	Type	Description
2017-01-01	2017-12-31	Miscellaneous	Min flow 3.5 cms May 1 to Oct 31 and 5.0 cms Nov 1 to Apr 30 provided by the HCV or the sluice gate.
2017-08-01	2017-09-30	Miscellaneous	CWR notified of the plan for pulse flows on 10 Jul 2017.
2017-08-01	2017-09-30	Miscellaneous	Order (Oct 4, 2004) requires pulse flow between Aug and Sep. Pulse flows delivered in Aug and Sep.

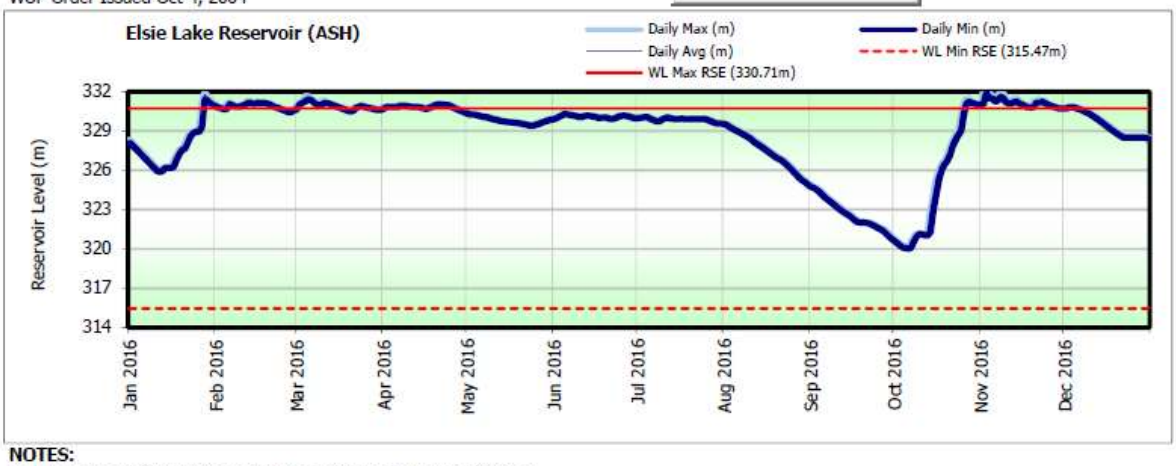
There are no reportable exceptions for the period Jan 1 to Dec 31, 2017

ASH PROJECT

WUP Order Issued Oct 4, 2004

ASH Charts

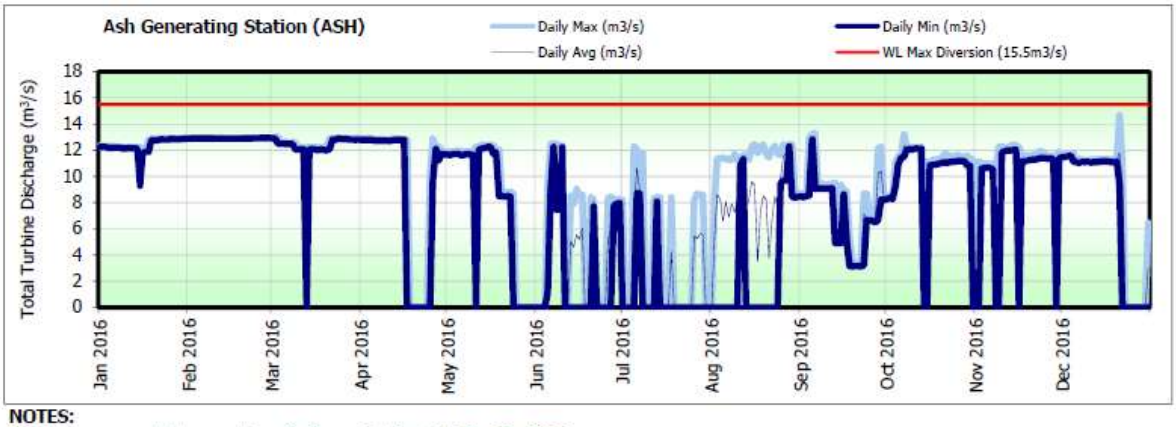
Goto ASH Data



NOTES:

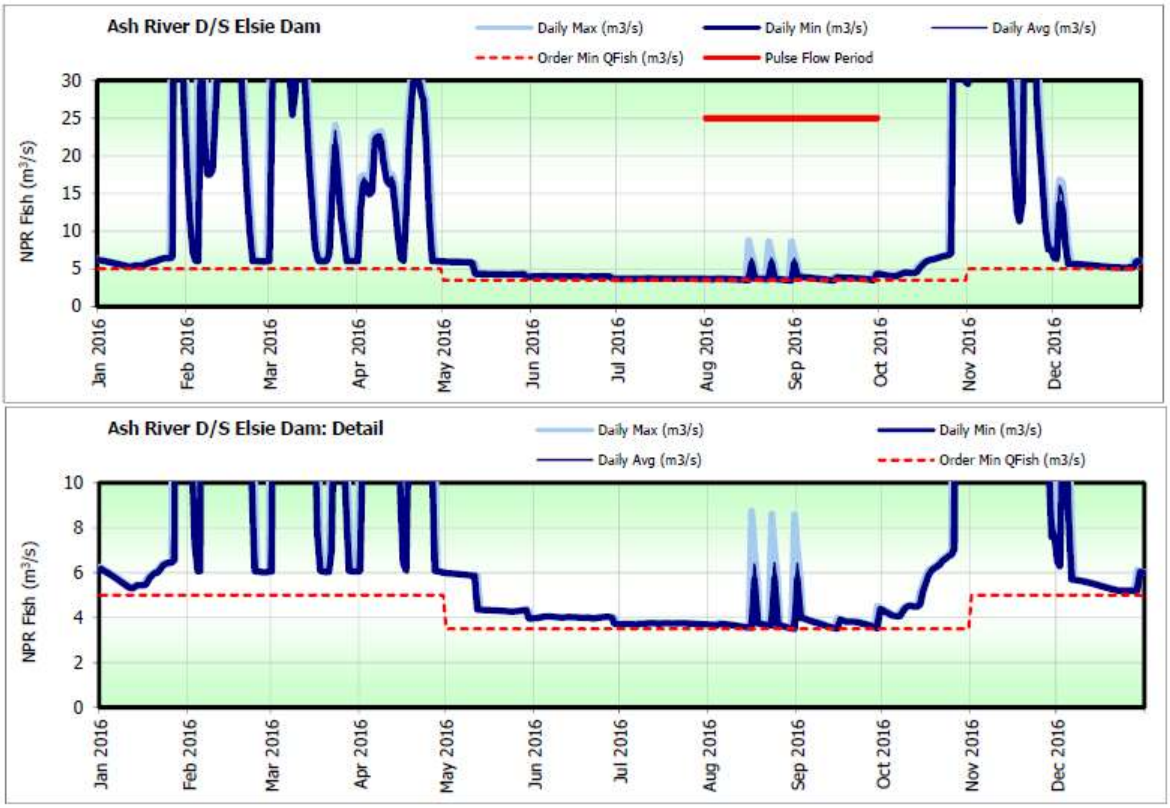
Maximum reservoir elevation controlled by freespill weir at 330.71 m.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2016.



NOTES:

There are no reportable exceptions for the period Jan 1 to Dec 31, 2016.



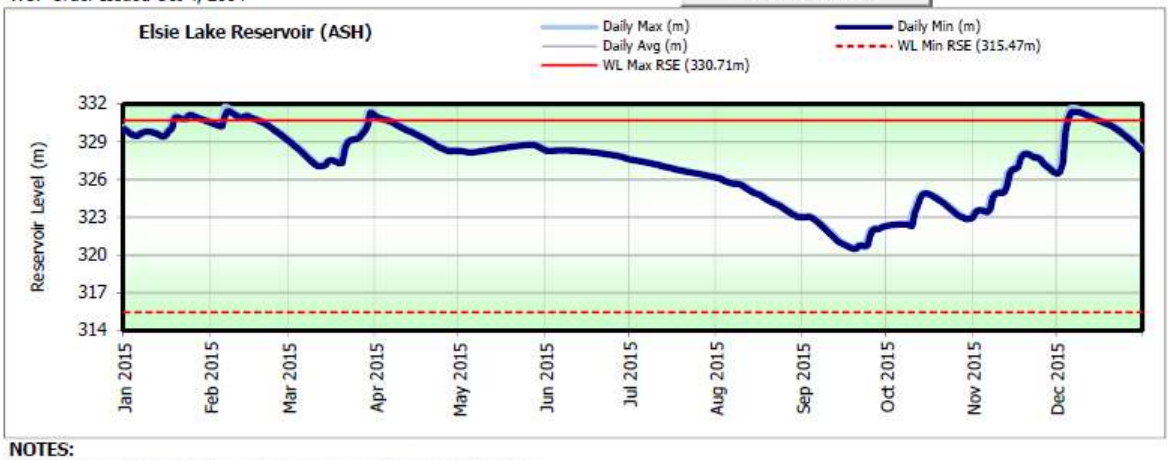
NOTES:
Min flow 3.5 m^3/s May 1 to Oct 31 and 5.0 m^3/s November 1 to April 30 provided by the HCV or the sluice gate.
Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September.
CWR notified of the plan for the pulse flows on 14 Jul 2016.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2016.

ASH PROJECT

WUP Order Issued Oct 4, 2004

ASH Charts

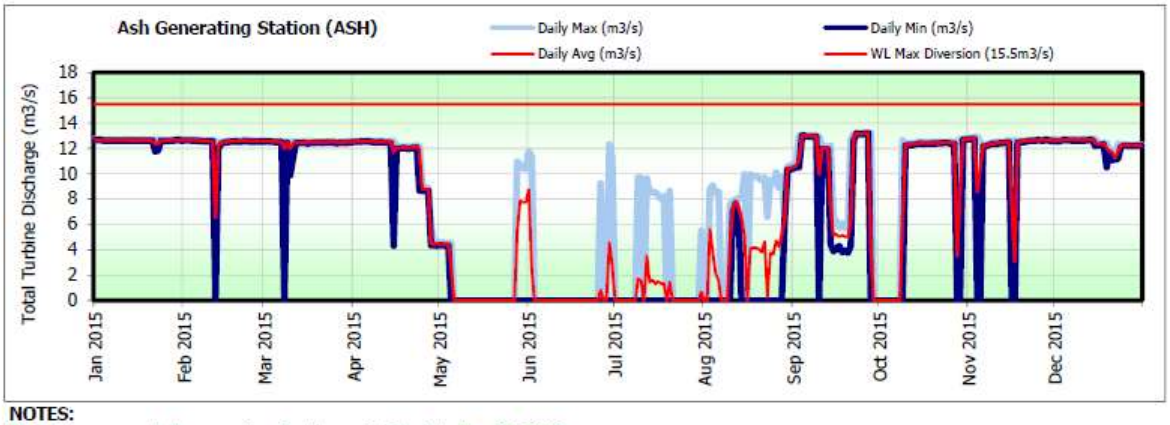
Goto ASH Data



NOTES:

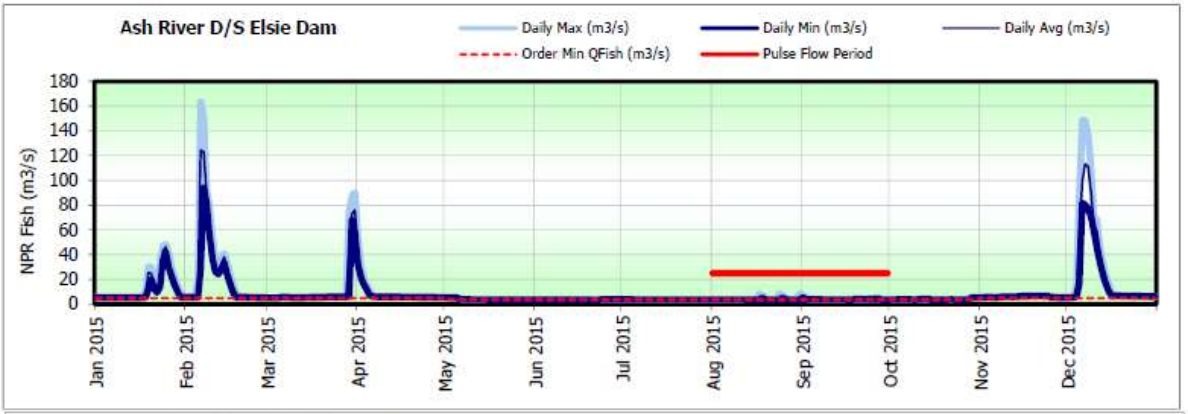
Maximum reservoir elevation controlled by freespill weir at 330.71 m.

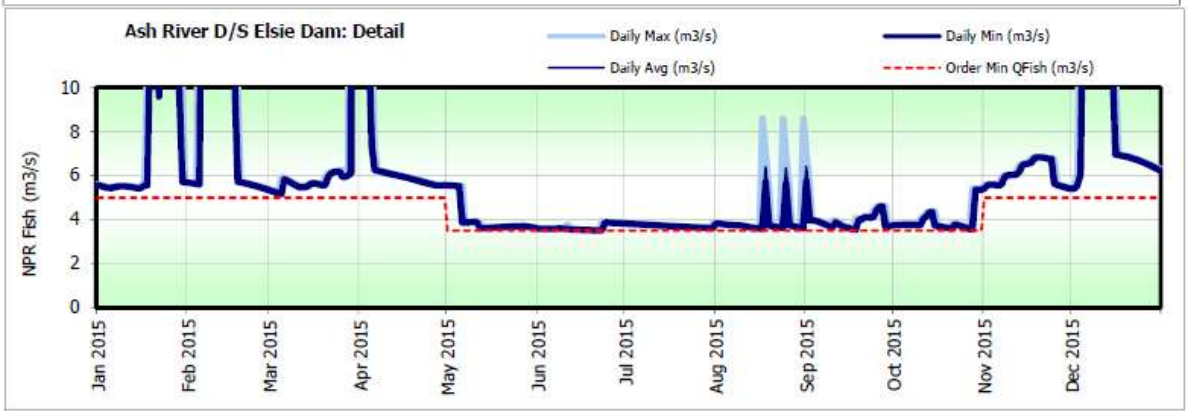
There are no reportable exceptions for the period Jan 1 to Dec 31, 2015.



NOTES:

There are no reportable exceptions for the period Jan 1 to Dec 31, 2015





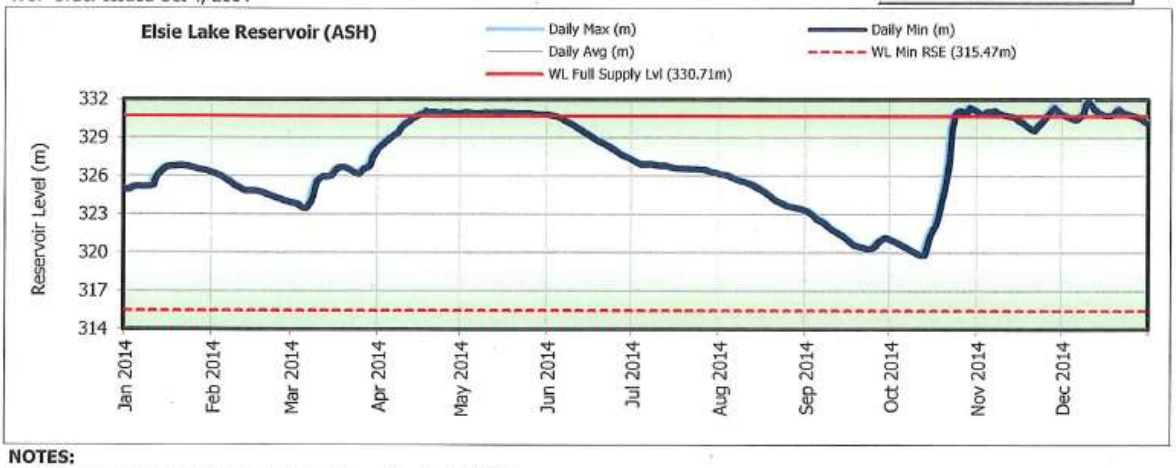
NOTES:
Min flow 3.5 m3/s May 1 to Oct 31 and 5.0 m3/s November 1 to April 30 provided by the HCV or the sluice gate.
Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September. CWR notified of the plan for the pulse flows on 27 Jul, 2015.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2015.

ASH PROJECT

WUP Order Issued Oct 4, 2004

ASH Charts

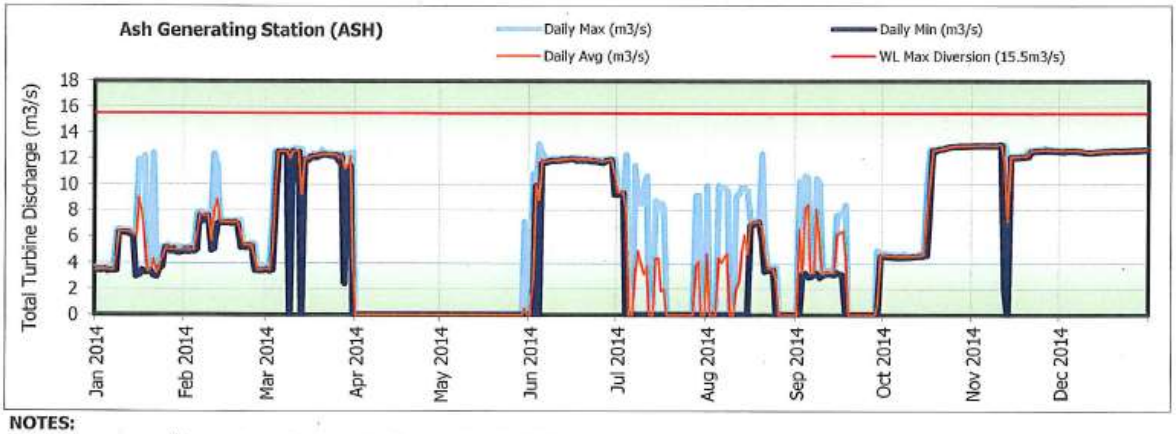
Goto ASH Data



NOTES:

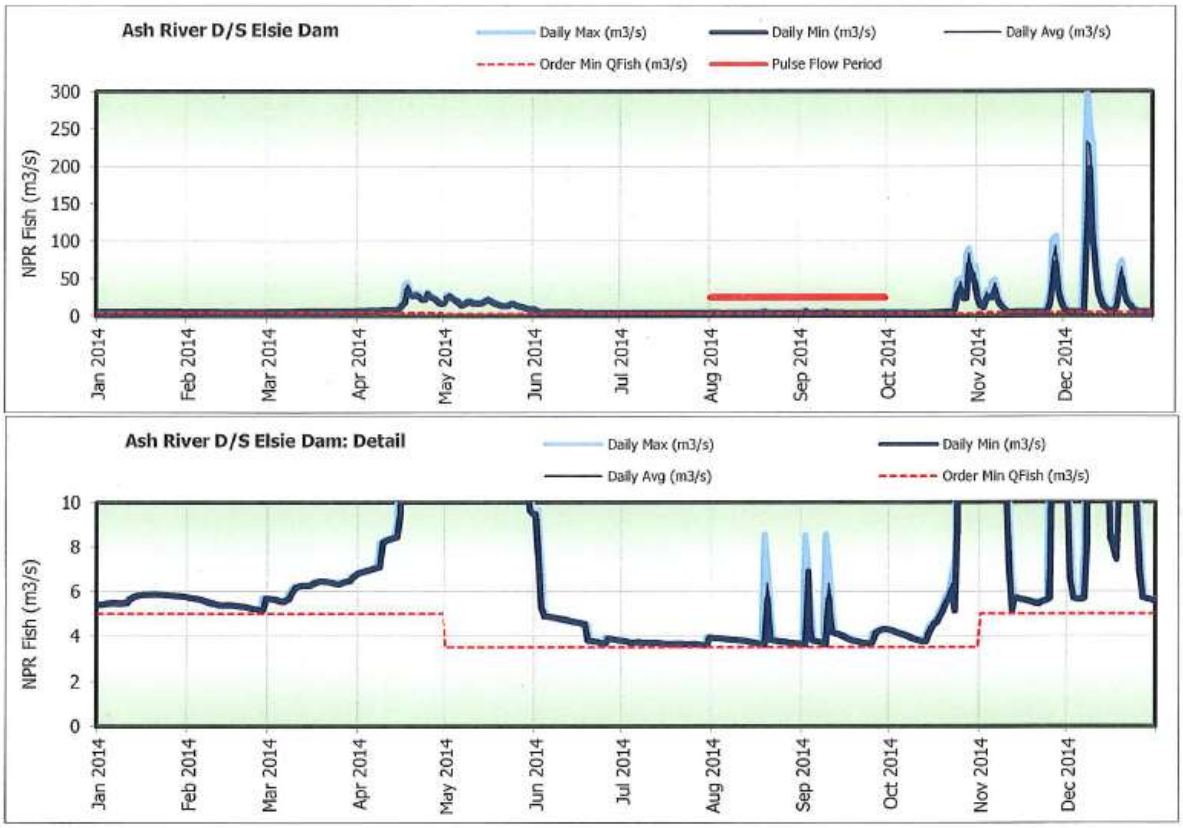
Maximum reservoir elevation controlled by freespill weir at 330.71 m.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2014



NOTES:

There are no reportable exceptions for the period Jan 1 to Dec 31, 2014



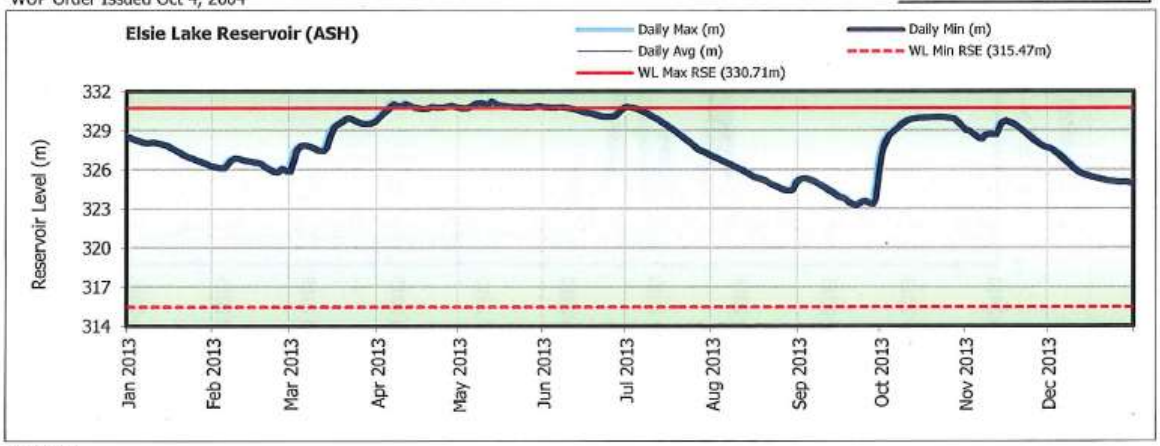
NOTES:
Min flow 3.5 m3/s May 1 to Oct 31 and 5.0 m3/s November 1 to April 30 provided by the HCV or the sluice gate.
Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September. CWR notified of the plan for the pulse flows on July 24, 2014. Revision to pulse flows, CWR notified August 5, 2014.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2014

ASH PROJECT

WUP Order Issued Oct 4, 2004

ASH Charts

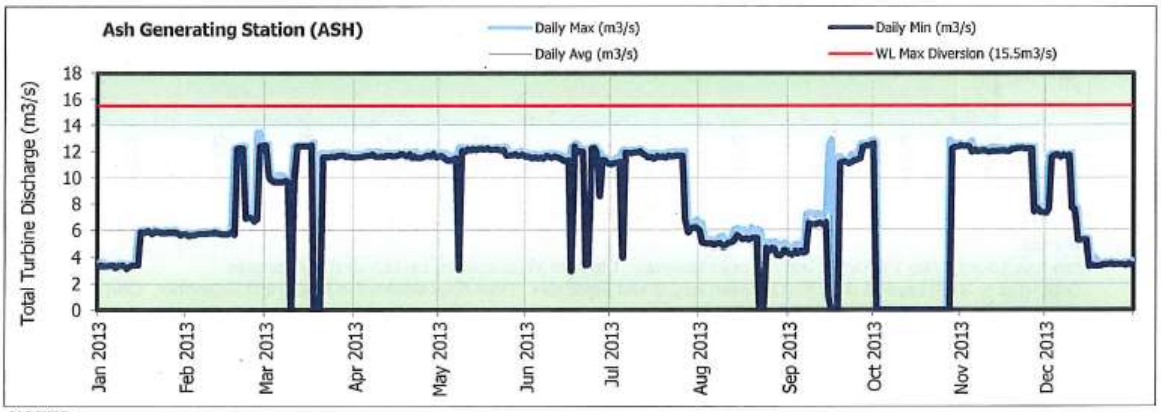
Goto ASH Data



NOTES:

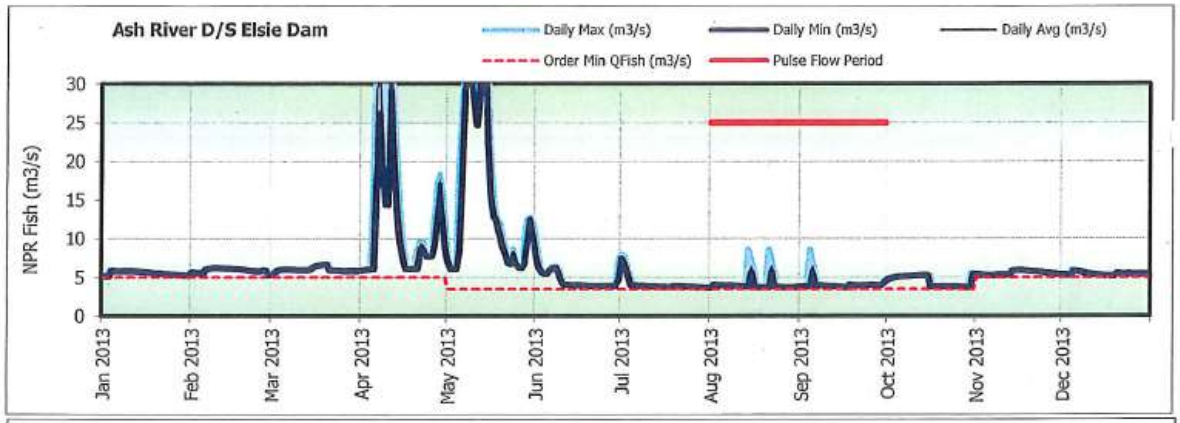
Maximum reservoir elevation controlled by freespill weir at 330.71 m.

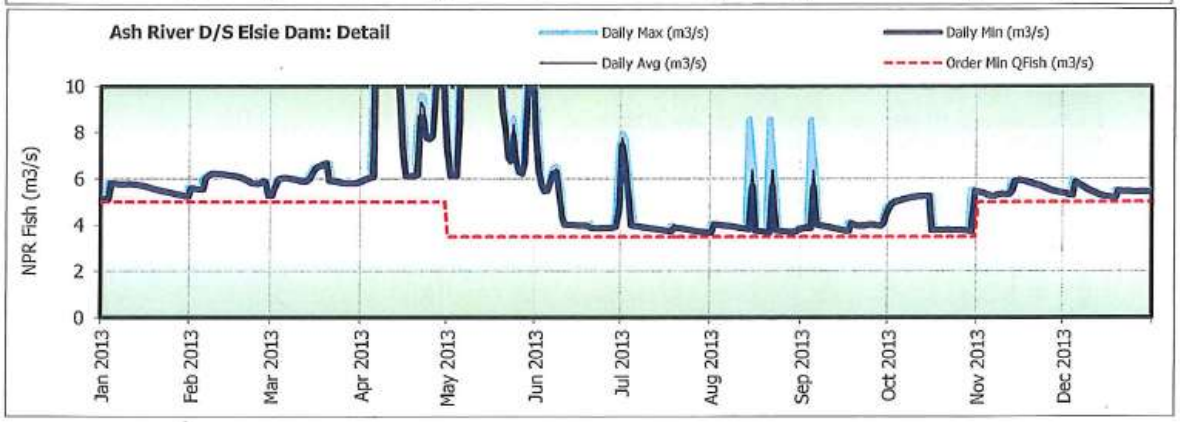
There are no reportable exceptions for the period Jan 1 to Dec 31, 2013



NOTES:

There are no reportable exceptions for the period Jan 1 to Dec 31, 2013





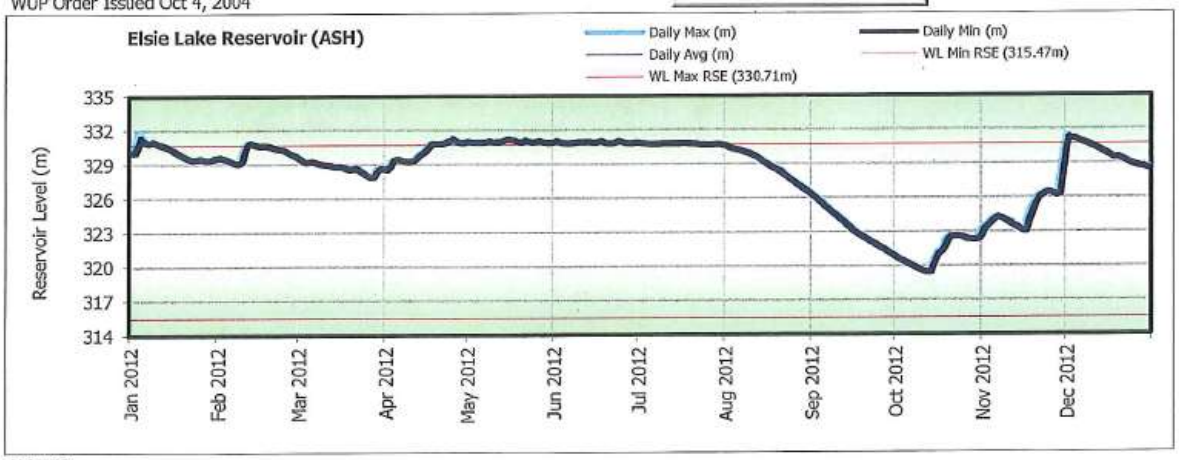
NOTES:
Min flow 3.5 m3/s May 1 to Oct 31 and 5.0 m3/s November 1 to April 30 provided by the HCV or the sluice gate.
Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September. CWR notified of the plan for the pulse flows on 31 Jul 2013.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2013

ASH PROJECT

WUP Order Issued Oct 4, 2004

ASH Charts

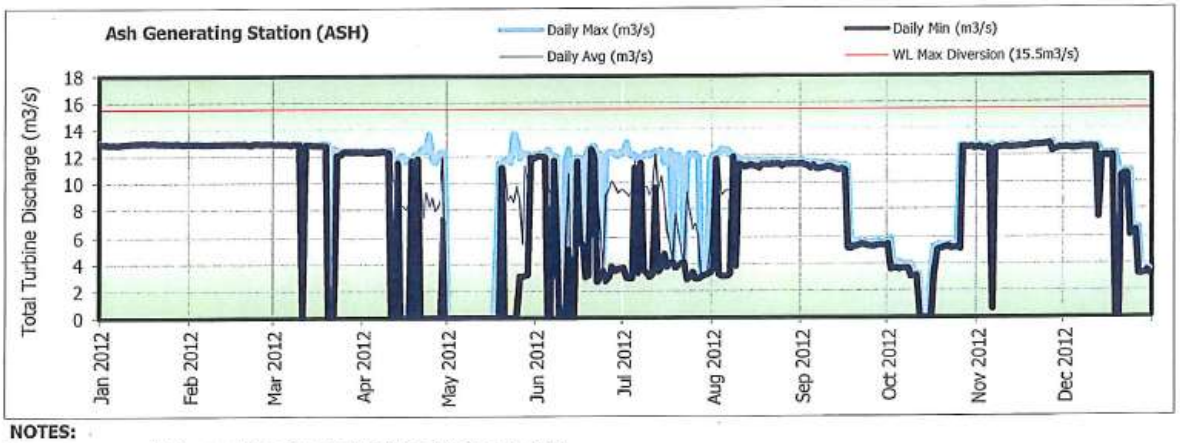
Goto ASH Data



NOTES:

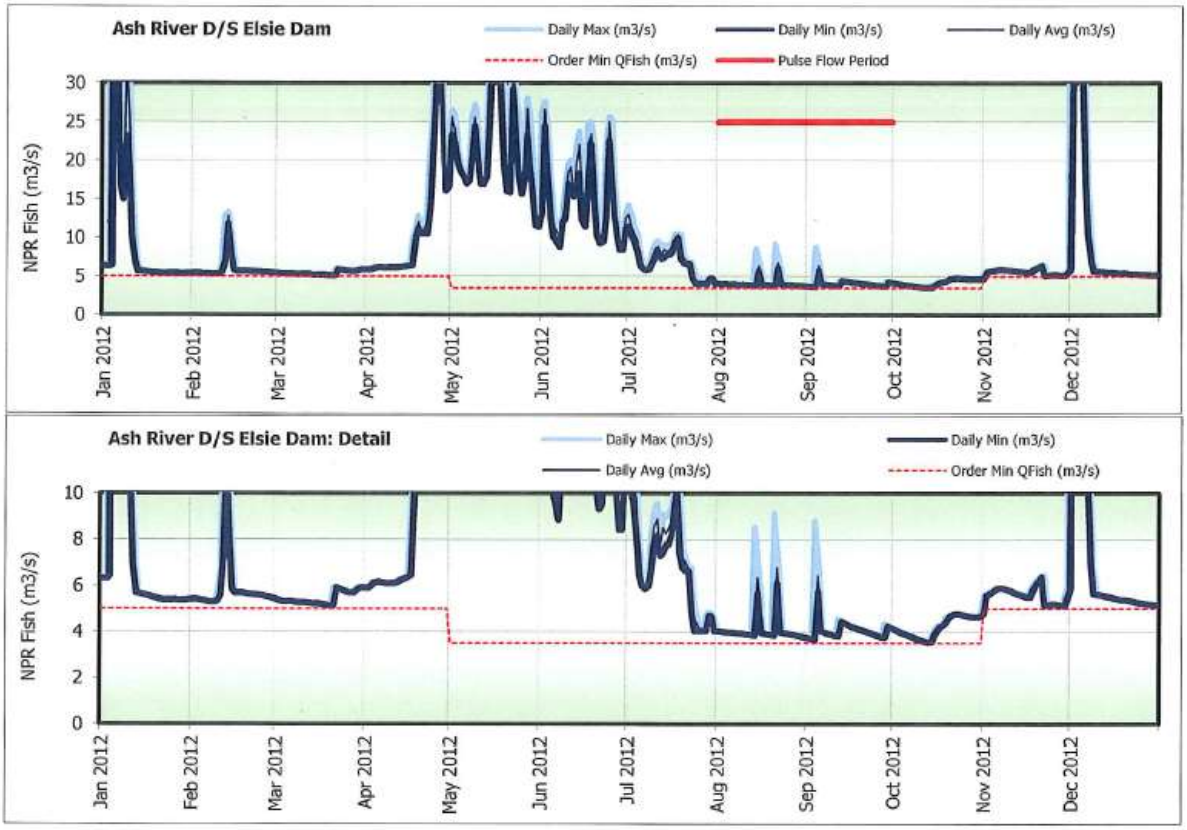
Maximum reservoir elevation controlled by freespill weir at 330.71 m.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2012



NOTES:

There are no reportable exceptions for the period Jan 1 to Dec 31, 2012



NOTES:
Min flow 3.5 m3/s May 1 to Oct 31 and 5.0 m3/s November 1 to April 30 provided by the HCV or the sluice gate.
Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2012

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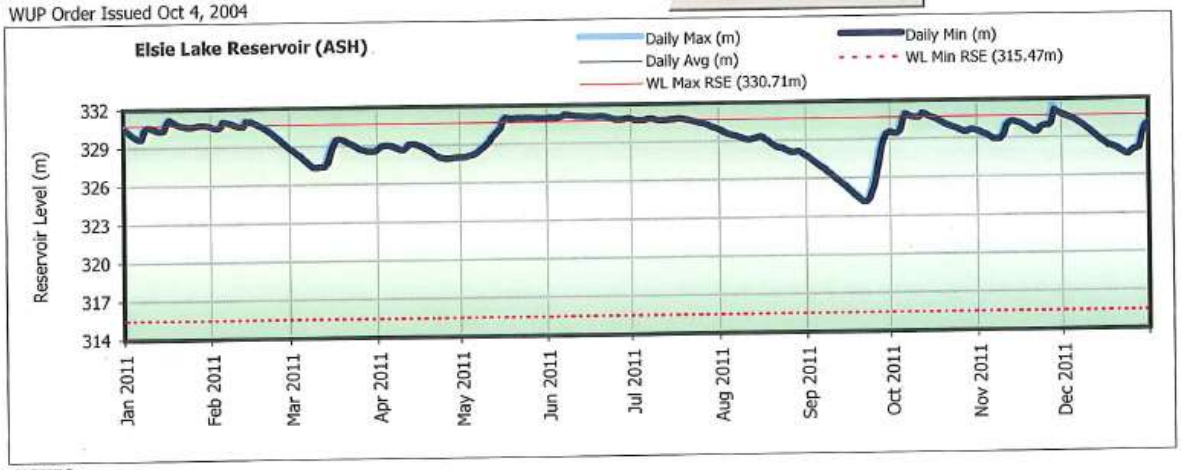
ASH Charts

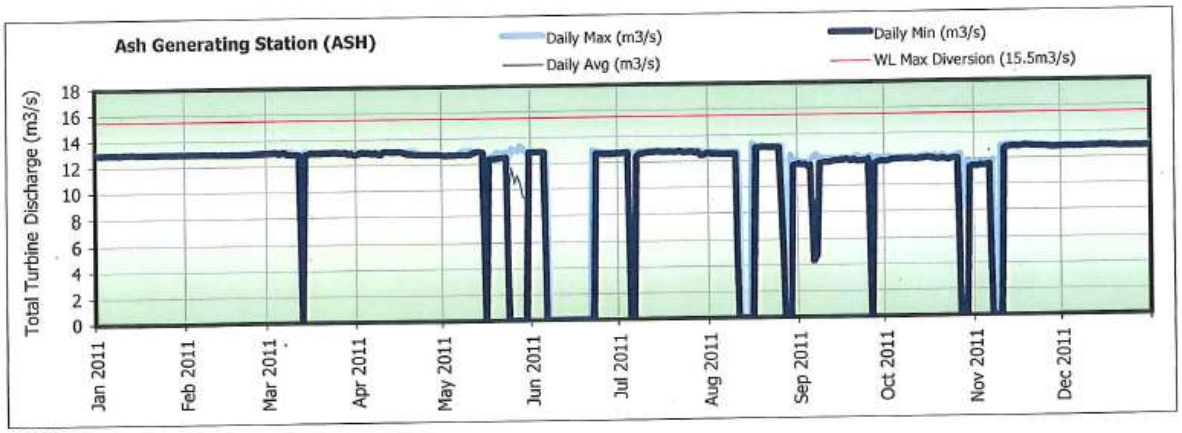
Goto ASH Data



NOTES:

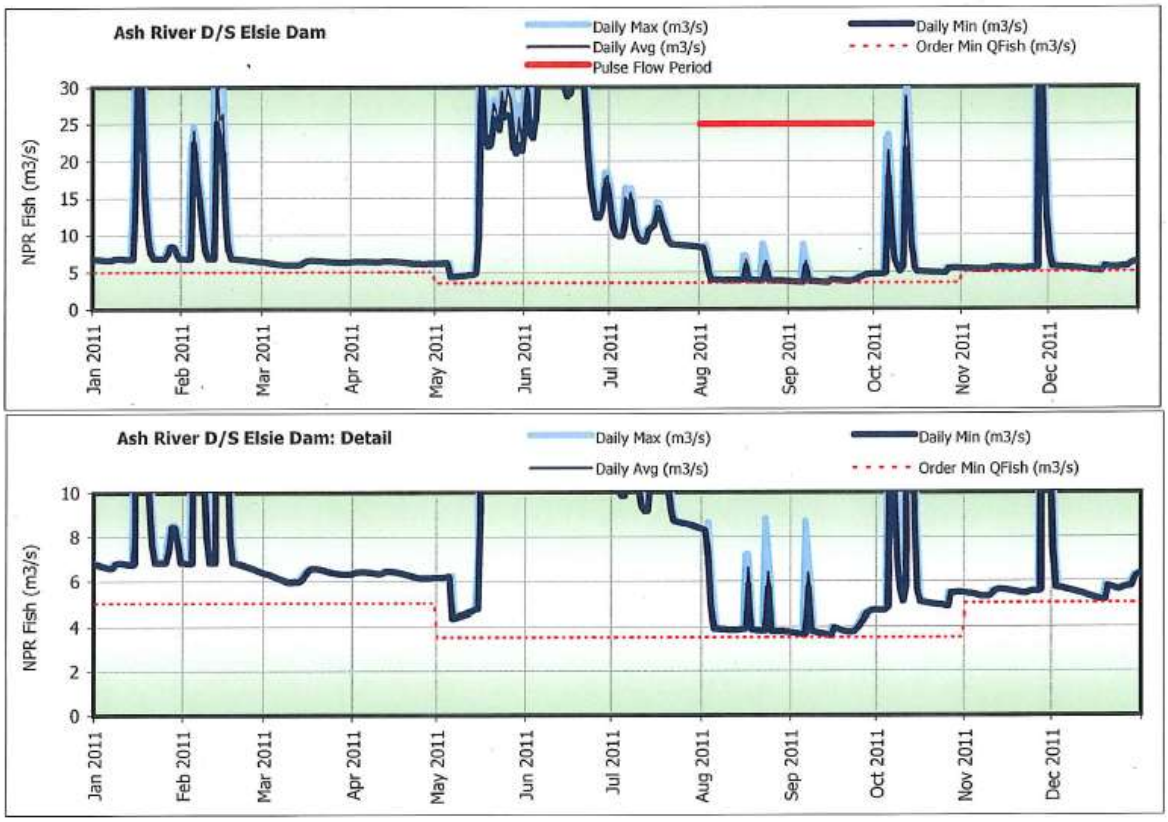
Maximum reservoir elevation controlled by freespill weir at 330.71 m.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2011



NOTES:

There are no reportable exceptions for the period Jan 1 to Dec 31, 2011



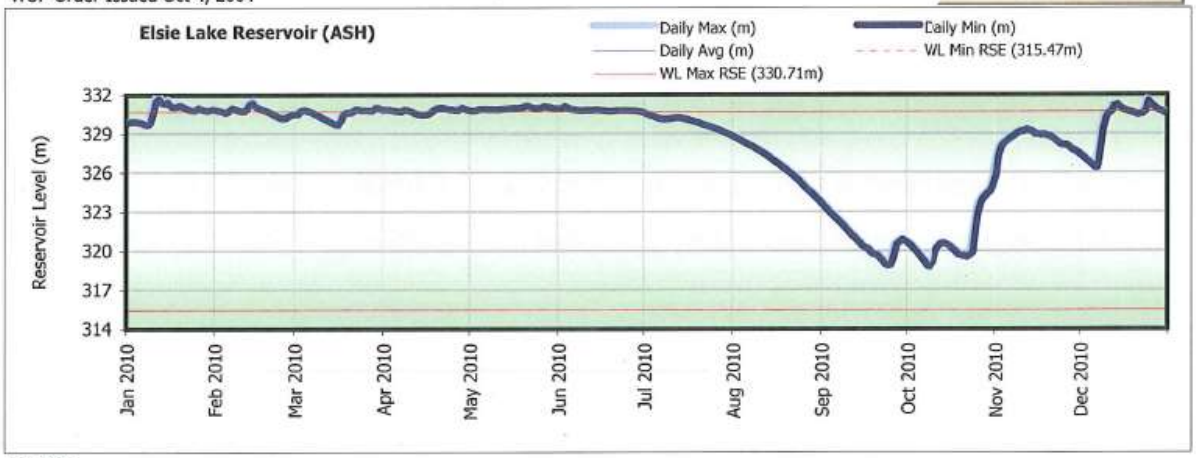
NOTES:
Min flow 3.5 m3/s May 1 to Oct 31 and 5.0 m3/s November 1 to April 30 provided by the HCV or the sluice gate.
Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2011

ASH PROJECT

WUP Order Issued Oct 4, 2004

ASH Charts

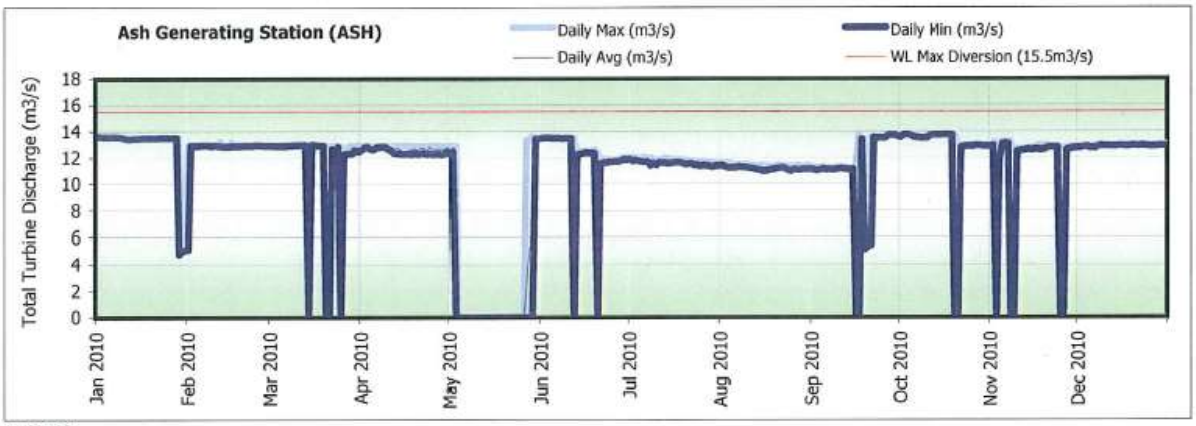
Goto ASH Data



NOTES:

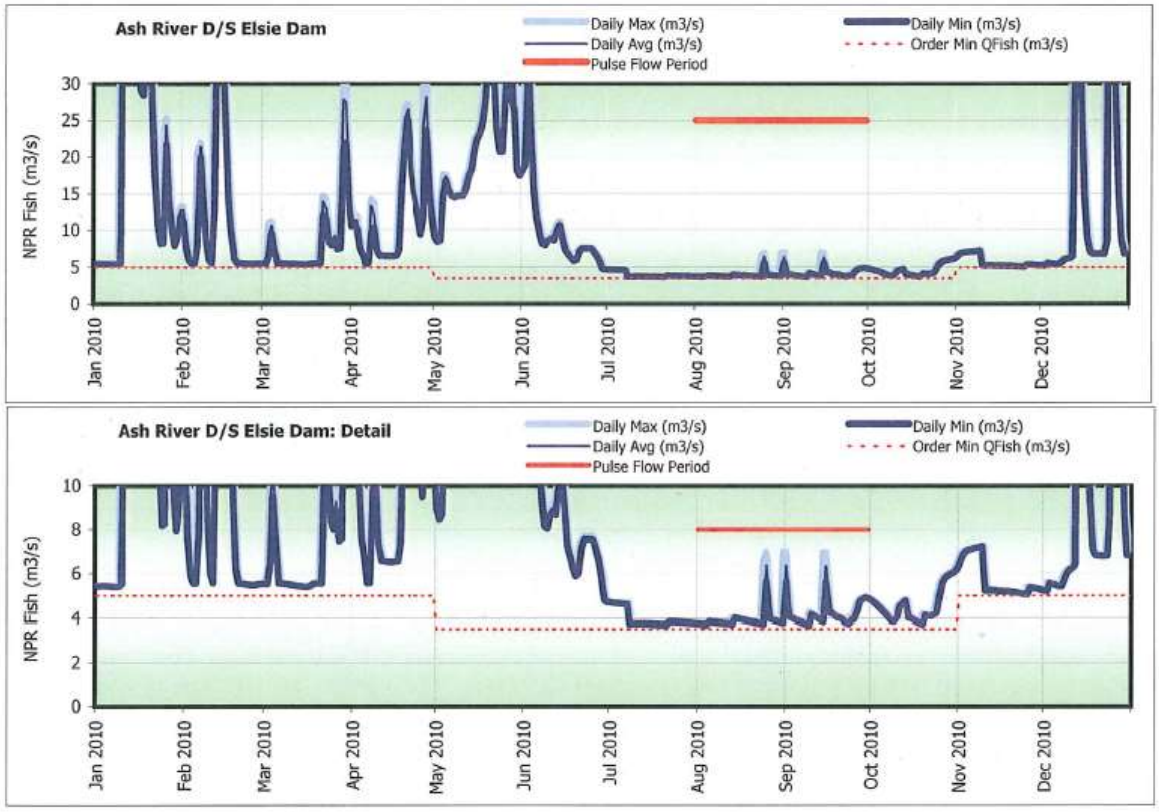
Maximum reservoir elevation controlled by freespill weir at 330.71 m.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2010



NOTES:

There are no reportable exceptions for the period Jan 1 to Dec 31, 2010



NOTES:
Min flow 3.5 m3/s May 1 to Oct 31 and 5.0 m3/s November 1 to April 30 provided by the HCV or the sluice gate.
Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September.

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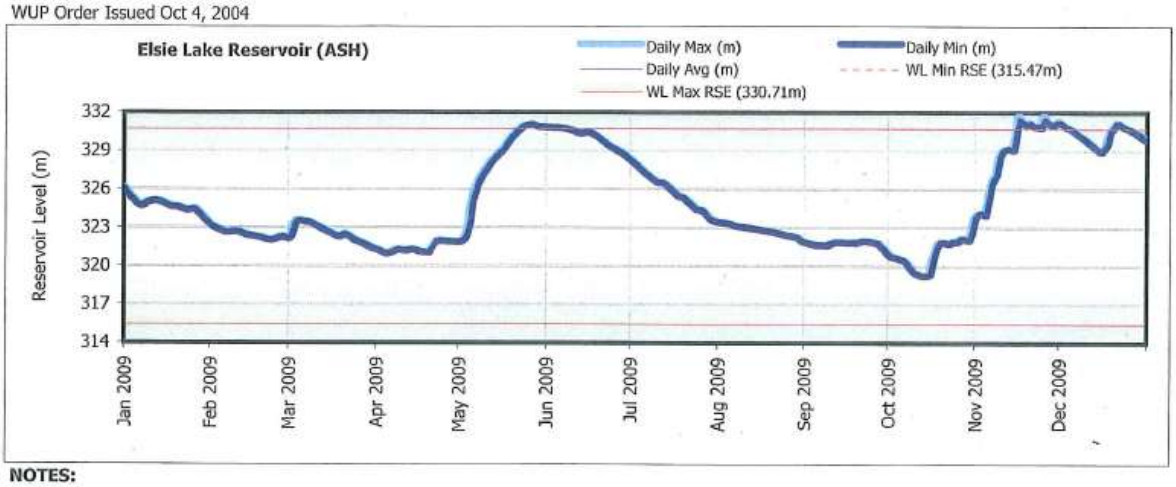
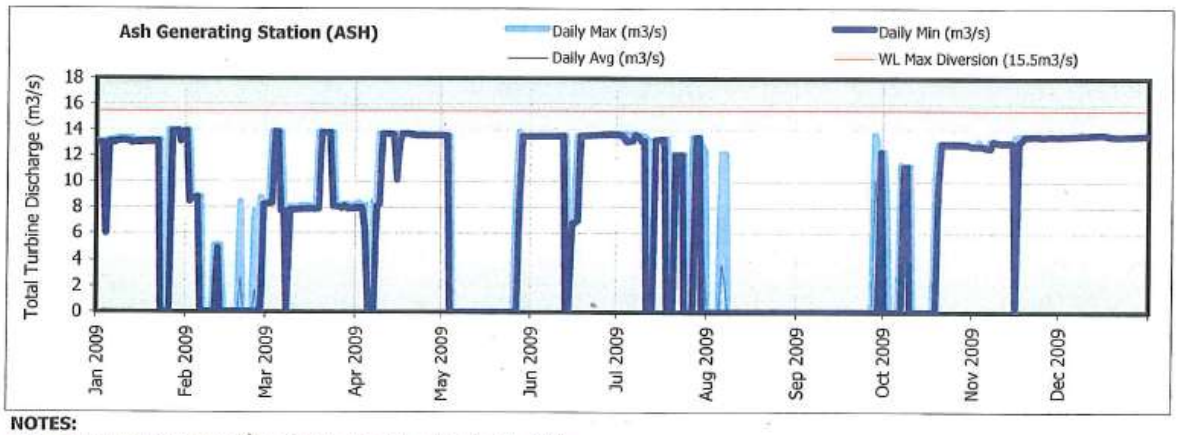


NOTES:

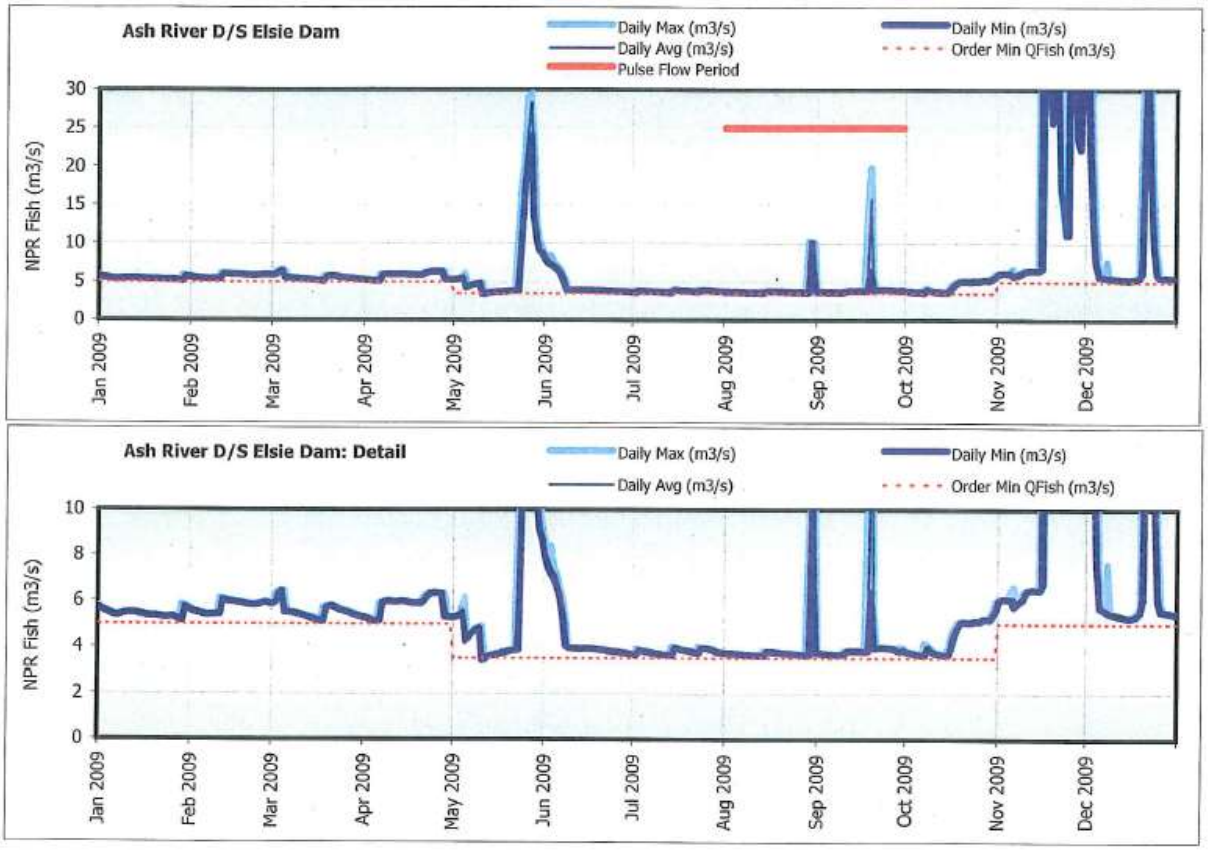
Maximum reservoir elevation controlled by freespill weir at 330.71 m.

There are no reportable exceptions for the period Jan 1 to Dec 31, 2009



NOTES:

There are no reportable exceptions for the period Jan 1 to Dec 31, 2009



NOTES:
Min flow 3.5 m3/s May 1 to Oct 31 and 5.0 m3/s November 1 to April 30 provided by the HCV or the sluice gate.
Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September.
29-Aug-09 Ramping requirement not met. CWR notified 21 Sept 2009. EIR FISH2009083101

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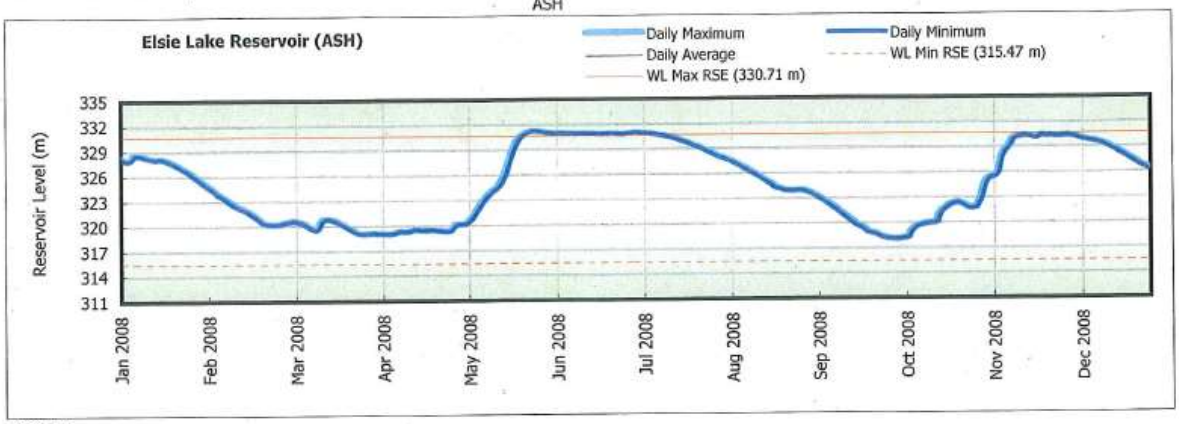
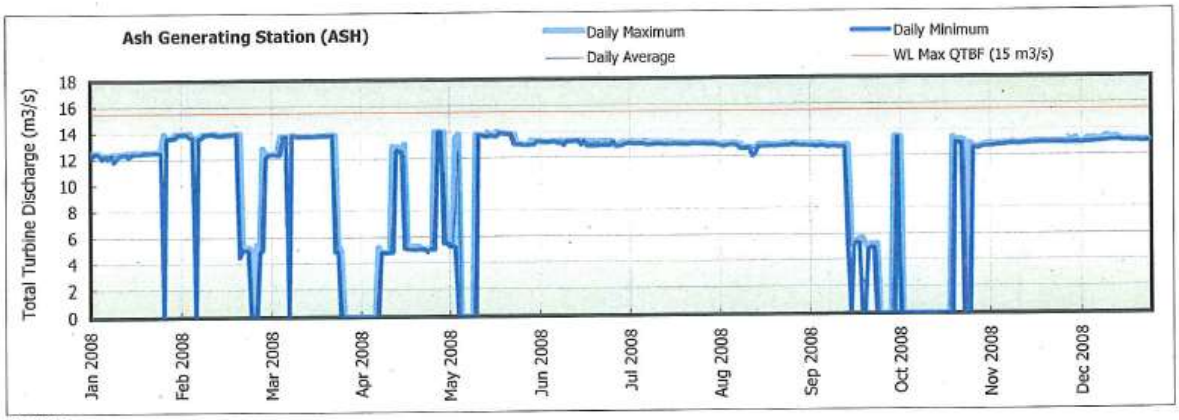
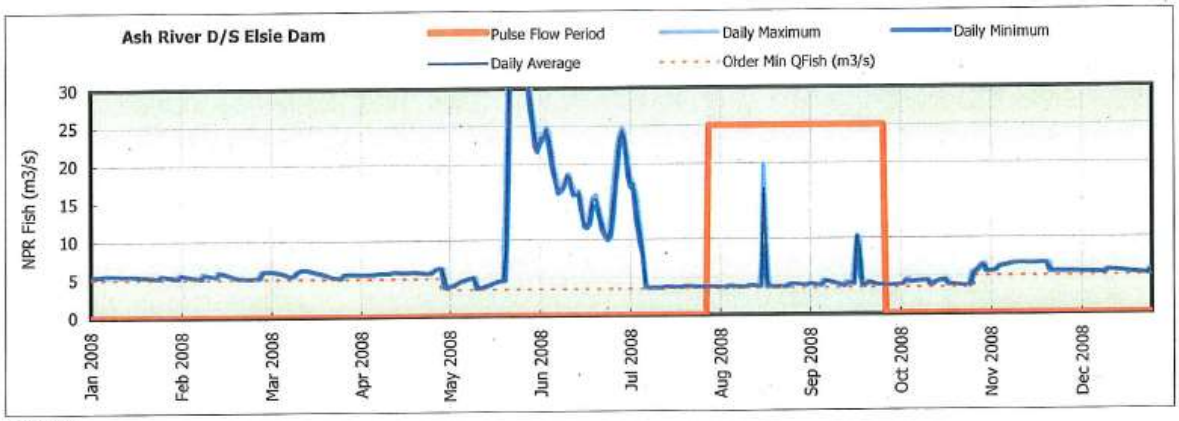
ASH



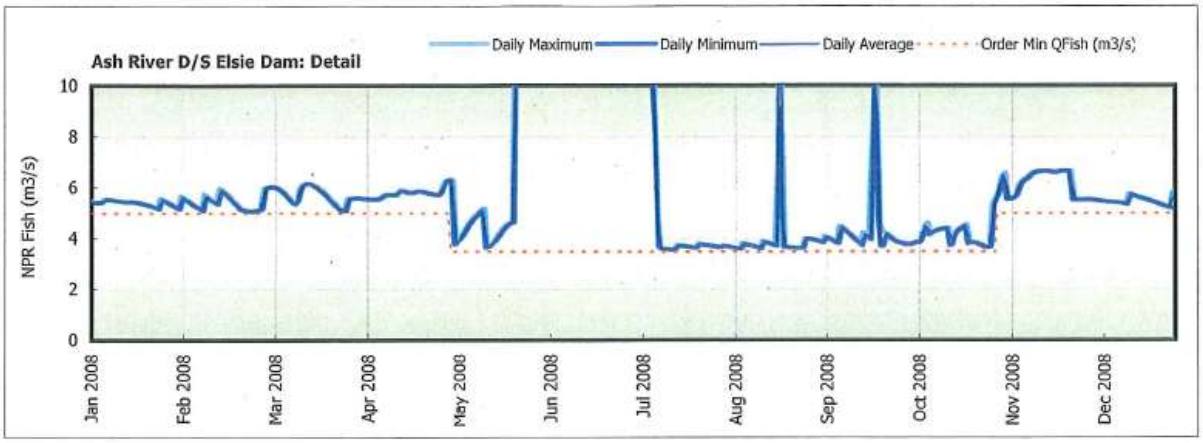
NOTES:
Maximum reservoir elevation controlled by freespill weir at 330.71 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2008.



NOTES:
There are no reportable exceptions for the period Jan 1 to Dec 31, 2008.



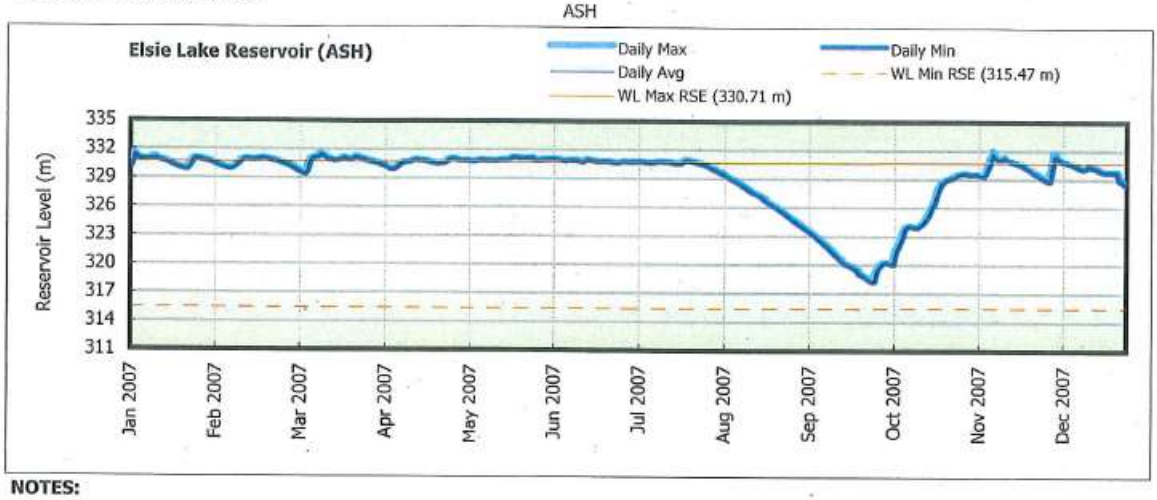
NOTES:
Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2008.



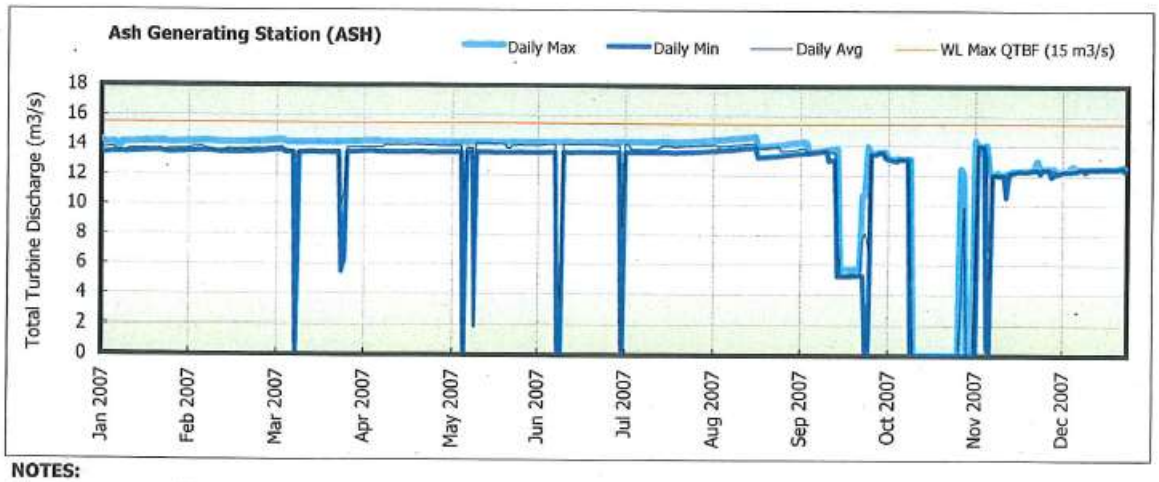
NOTES:
Min flow 3.5 m3/s May 1 to Oct 31 and 5.0 m3/s November 1 to April 30 provided by the HCV or the sluice gate.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2008.

ASH PROJECT
WUP Order Issued Oct 4, 2004

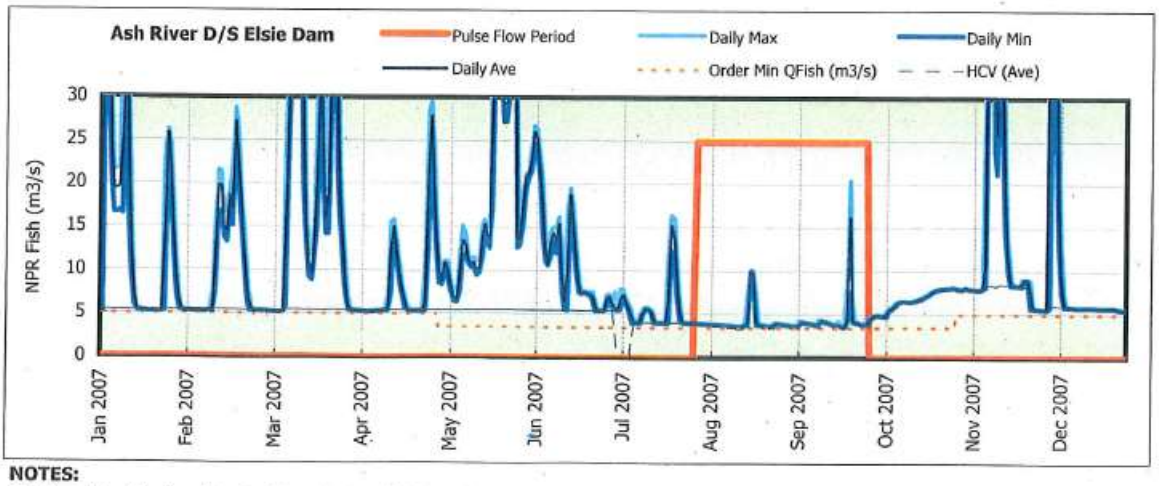
ASH



NOTES:
Maximum reservoir elevation controlled by freespill weir at 330.71 m.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2007.



NOTES:
There are no reportable exceptions for the period Jan 1 to Dec 31, 2007.



NOTES:

Min flow 3.5 m3/s May 1 to Oct 31 and 5.0 m3/s November 1 to April 30 provided by the HCV and/or weir.
Flows transferred from HCV to weir July 4 - 8, 2008 to acccmmodate maintenance.
Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September.
There are no reportable exceptions for the period Jan 1 to Dec 31, 2007.

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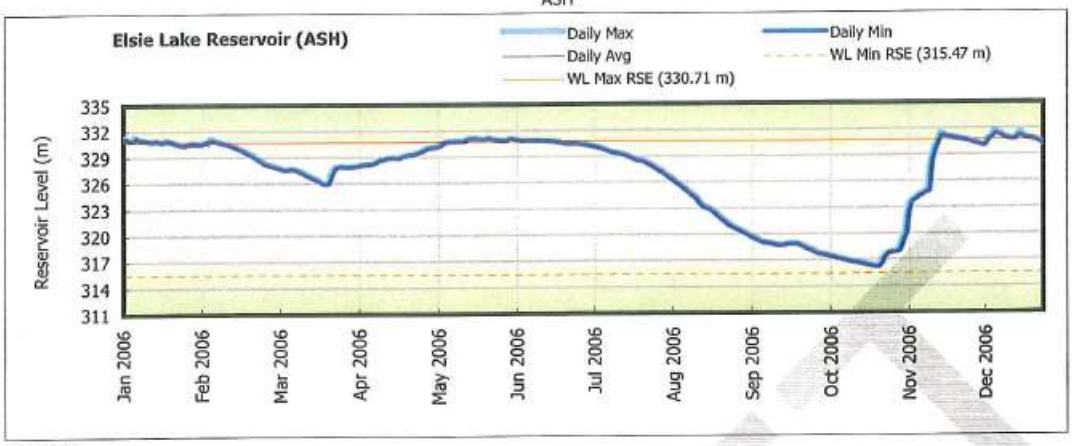
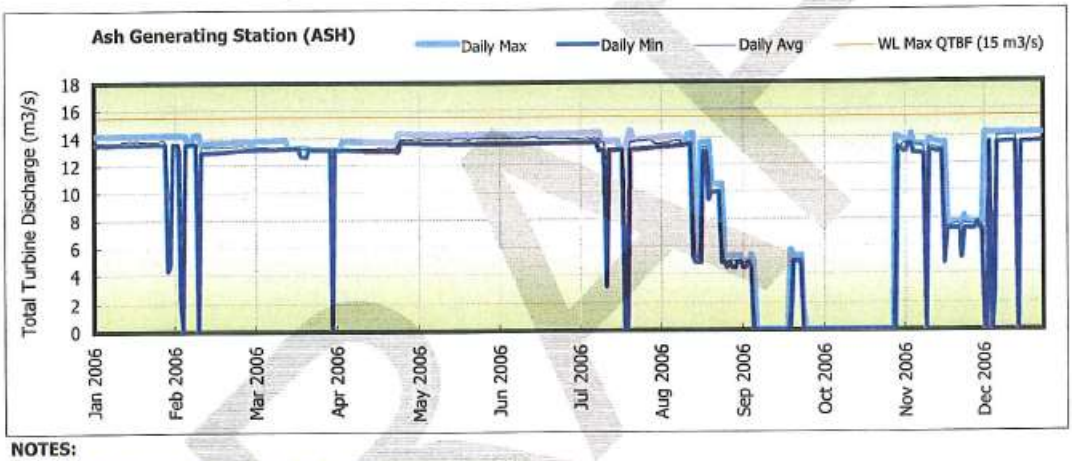
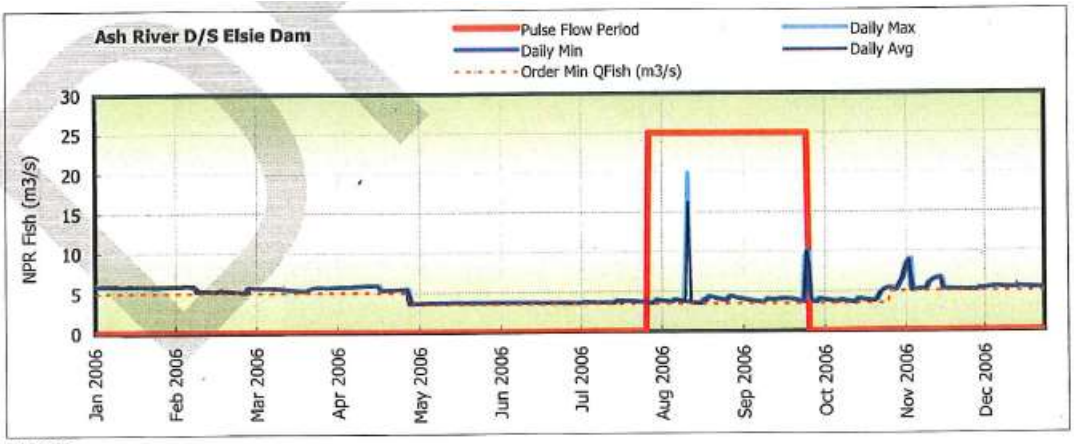
ASH



NOTES:
Maximum reservoir elevation controlled by freespill weir at 330.71 m.
There are no reportable exceptions for the period Jan to Dec 2006.



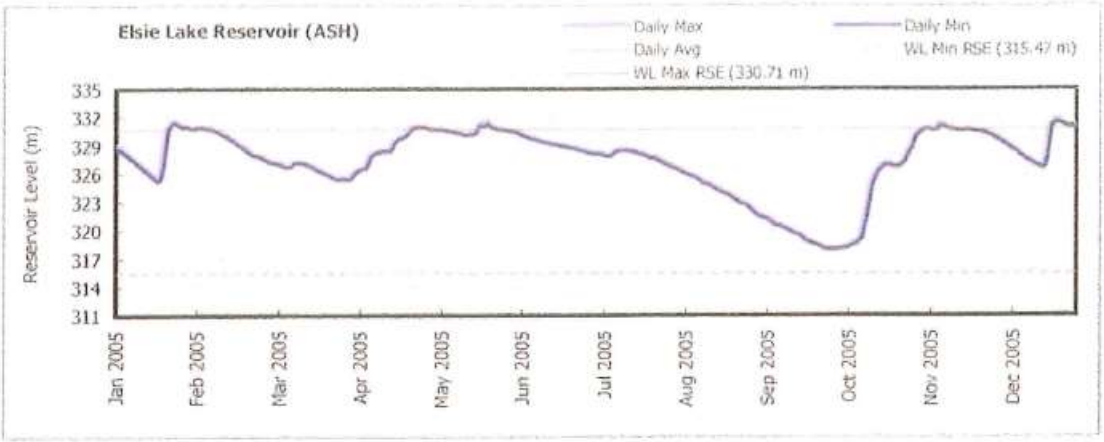
NOTES:
There are no reportable exceptions for the period Jan to Dec 2006.



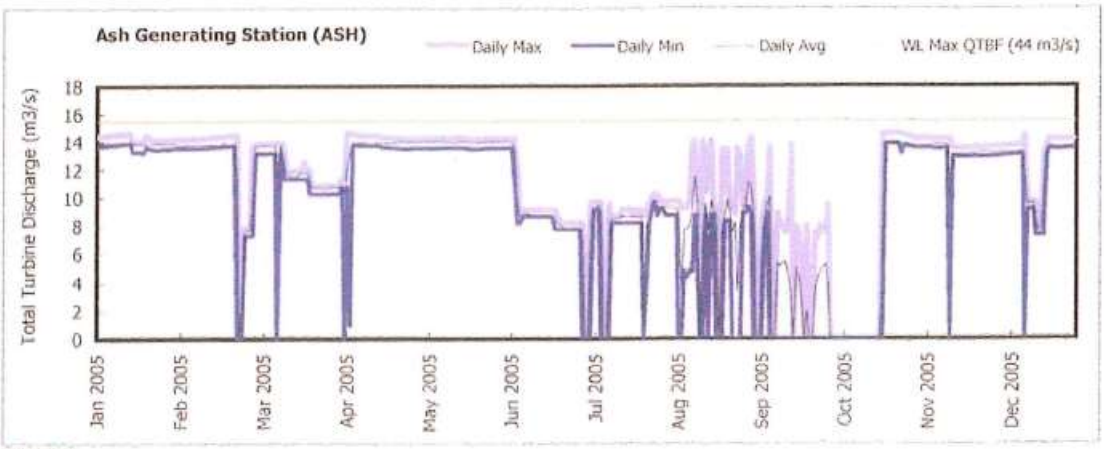
NOTES:
Min flow 3.5 m3/s May 1 to Oct 31 and 5.0 m3/s November 1 to April 30.
Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September.
There are no reportable exceptions for the period Jan to Dec 2006.

ASH PROJECT
WUP Order Issued Oct 4, 2004

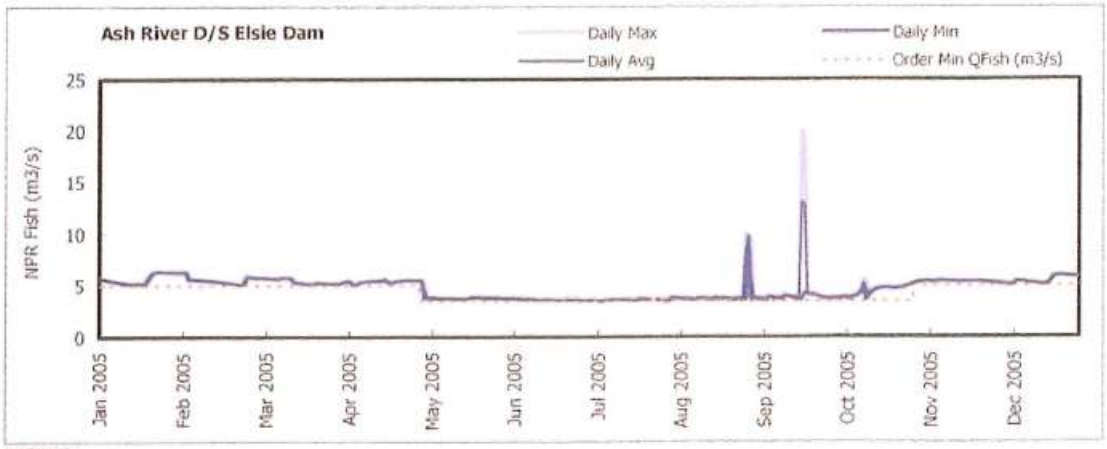
ASH



NOTES:
Maximum reservoir elevation controlled by free spill weir at 330.71 m.
There are no reportable exceptions for the period July 1 to Dec 31, 2005.



NOTES:
There are no reportable exceptions for the period July 1 to Dec 31, 2005.



NOTES:

Order (Oct 4, 2004) requires pulse flow between August and September. Pulse flows delivered in August and September.

There are no reportable exceptions for the period July 1 to Dec 31, 2005.