Peace Project Water Use Plan

Revised for Acceptance for the Comptroller of Water Rights

August 21, 2007

BC hydro

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Preface

The Water Use Planning process for BC Hydro's Peace facilities was initiated in February 2001 and completed in December 2003.

The proposed conditions in this Water Use Plan, for the operation of BC Hydro's Peace hydroelectric facilities, reflect the December 2003 consensus recommendations of the Peace Water Use Planning Committee.

BC Hydro thanks all those who participated in the process that led to the production of this Water Use Plan for their effort and dedication.

The proposed conditions for the operation of BC Hydro's facilities will not come into effect until implemented under the *British Columbia Water Act*.

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1.0 INTRODUCTION

The conditions proposed in this Water Use Plan, for the operation of BC Hydro's Peace River hydroelectric facilities, reflect the December 2003 consensus recommendations of the Peace Project Water Use Plan Committee.

The proposed terms and conditions, to be authorized under the *British Columbia Water Act*, for the beneficial use of water at the Peace hydroelectric facilities are set out in this document. Future reference to the Peace Project or power development includes G.M. Shrum and Peace Canyon generating stations, W.A.C. Bennett and Peace Canyon dams, and Williston and Dinosaur reservoirs.

This Water Use Plan describes the hydroelectric works considered during the process, the basin hydrology and the operating and non-operating activities that will be implemented when BC Hydro receives direction from the Comptroller of Water Rights.

The proposed conditions will change current operations at the Peace Canyon and Williston Reservoir and are expected to positively affect fisheries and wildlife habitat, shoreline conditions, flood control, and recreation interests. The proposed conditions are expected to decrease power generation revenues.

A monitoring program is proposed in order to study key uncertainties to enable improved operating decisions in the future. Refer to the *Peace Water Use Plan: Committee Report* dated December 2003 for details on the consultative process, interests, objectives, performance measures and for the values expressed, regarding operating alternatives, management plans and monitoring programs.

The proposed conditions for the operation of BC Hydro's facilities will not come into effect until implemented under the British Columbia Water Act.

2.0 DESCRIPTION OF WORKS

2.1 Location

The headwaters of the Peace River, a tributary of the Mackenzie River, are located in north-eastern British Columbia (Figure 2-1). The Peace River is formed by the confluence of the Finlay and Parsnip rivers flowing in opposite directions in the Rocky Mountain Trench. At the confluence, the Peace River flows east and is the only river to cut through the Rocky Mountains. Once out of the canyon the river maintains an easterly direction, crossing the B.C./Alberta border. The Peace River drains into Great Slave Lake and joins the Mackenzie River before it enters the Arctic Ocean.

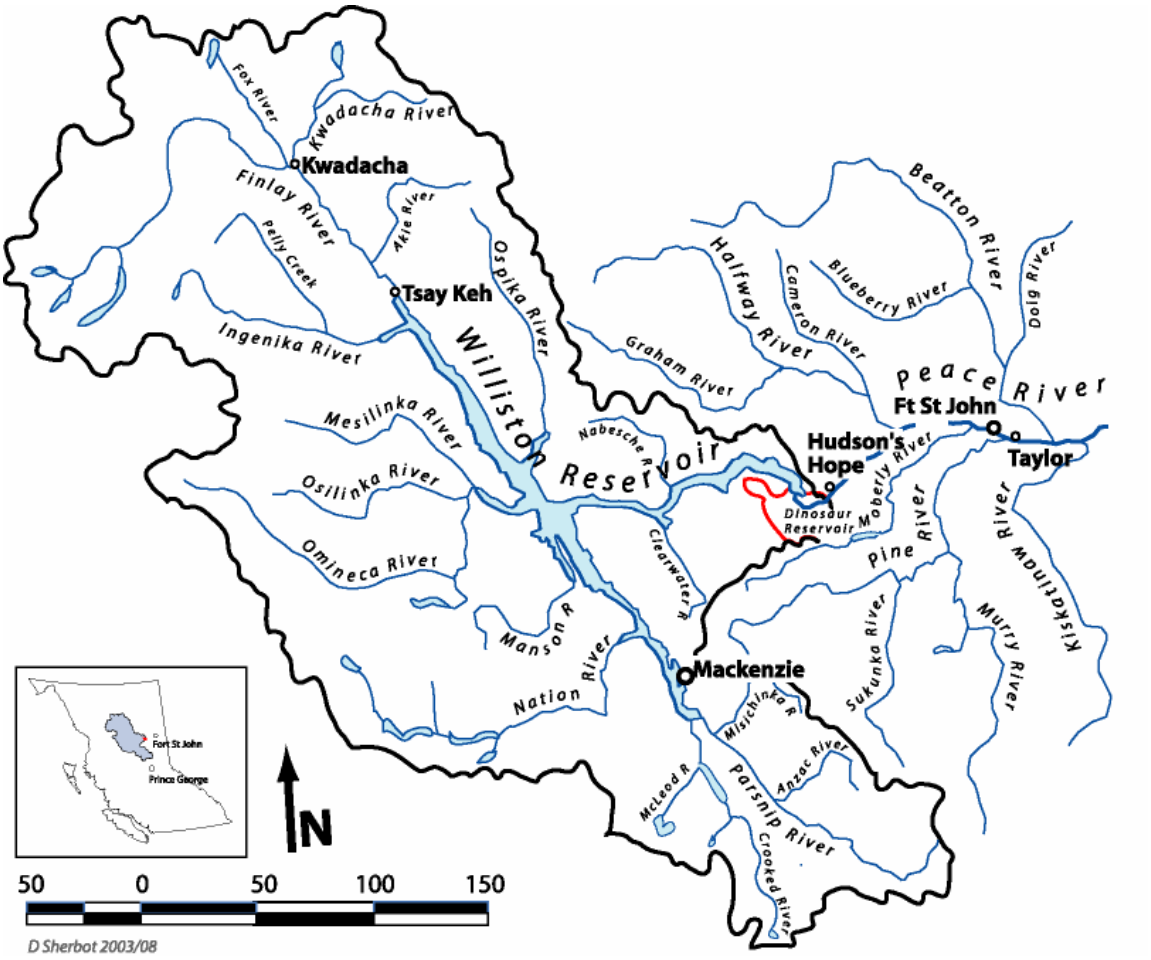

Figure 2-1: Place Names in Peace Water Use Plan

2.2 Existing Works

The existing works comprising the Peace Project include:

W.A.C. Bennett Dam:

- This dam, commissioned in 1967, is located at head of the Peace River canyon forming Williston Reservoir. The earthfill dam is 2040 m (6692.8 ft) in length at the crest and 183 m (600.4 ft) high with a crest elevation of 679.7 m (2230.0 ft) above sea level.

- Williston Reservoir covers approximately 1773 km^2 (684.6 square miles) at full pool and has an active storage of 39,471 Million cubic metres (Mm^3) (32 Million acre feet). The operating range of the reservoir for power generation is between 672.08 m (2205.0 ft) and 642.03 m (2106.41 ft).

- The spillway has three radial gates and nine sluice gates. The sill elevation for the radial gates is 653.53 m (2144.1 ft) and the sluice gates 641.60 m (2105 ft). The maximum discharge is 9200 m^3/s (325 000 ft^3/s) using the radial and sluice gates.

- Power Intakes: There is one power intake for each unit. They are located on the left side of the dam. Intakes are 3.96 x 5.94 m (13 x 19.5 ft). The sill elevation for intakes 1 to 3 is 594.36 m (1950.0 ft). The sill elevation of intakes 4 to 10 is 627.89 m (2060.0 ft).

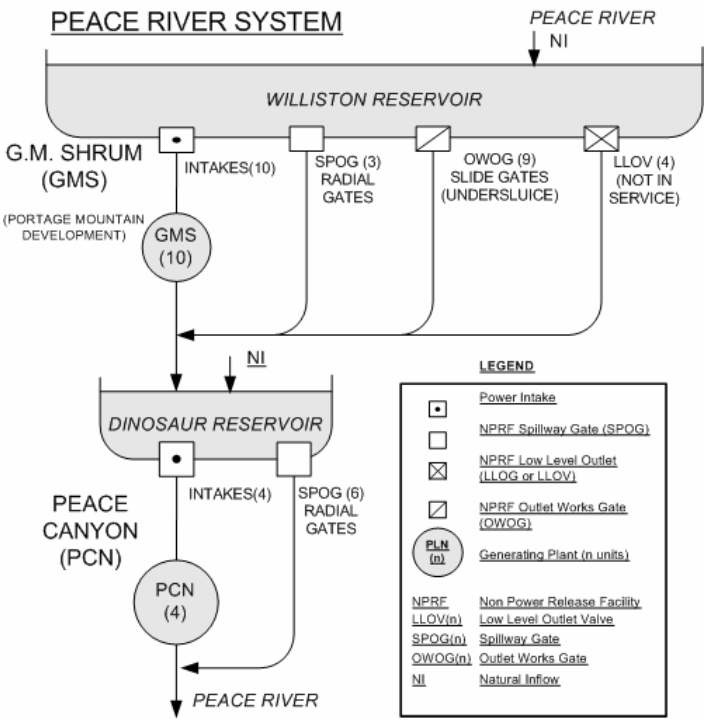

Figure 2-2 Peace: Project Schematic

G.M. Shrum Generating Station:

- The underground G.M. Shrum Generating Station has 10 units with a total installed capacity of ~2730 MW. Once through the turbines, the water is discharged through two manifolds, one for units G1 to G5 and one for G6 to G10, into the upper end of Dinosaur Reservoir.

Peace Canyon Dam:

- This dam is located at the foot of the Peace River canyon forming Dinosaur Reservoir. The Peace Canyon Dam consists of a concrete gravity dam and earthfill saddle dam on the right abutment. The main dam is 325 m (1066.3 ft) long and 61 m (200.1 ft) high with a crest elevation of 507.5 m (1665.0 ft) above sea level. The saddle dam is 200 m (656.2 ft) long and 20 m (65.6 ft) high.

- Dinosaur Reservoir covers approximately 9 km^2 (3.5 $miles^2$) at full pool. It has limited active storage (~24.69 Mm3). The shoreline length is 54.4 km (33.8 miles). The normal operating range is between 502.92 m (1650.0 ft) and 500.00 m (1640.4 ft).

- The spillway has six radial gates. The sill elevation for the radial gates is 491.3 m (1611.9 ft). The maximum discharge is 10 280 m^3/s (363 000 ft^3/s).

- Power Intake: There is one power intake for each unit. The intakes are 6.7 x 12.4 m (22.0 x 40.7 ft). The sill elevation is 426.3 m (1516.5 ft).

Peace Canyon Generating Station:

- The Peace Canyon Generating Station has four units with a total installed capacity of ~700 MW. The water is discharged from Dinosaur Reservoir into the Peace River.

3.0 HYDROLOGY OF THE PEACE RIVER BASIN

This section is a synopsis of the Peace Water Use Plan Hydrology of the Peace Basin memo provided in Appendix 1. The location of the Peace projects within the Peace Basin is shown in Figure 2-1.

3.1 Drainage Basin

The Peace basin is situated in north central British Columbia. The two major tributaries, the Finlay and Parsnip rivers, rise in mountainous regions in the north-west and south-east corners of the basin. These rivers drain into Williston Reservoir, a T-shaped reservoir with a total surface area of 1773 km^2 (684.6 $miles^2$). The reservoir occupies 260 km (161.6 miles) of the Rocky Mountain Trench, and an additional 120 km (74.6 miles) of the Peace valley through the Rocky Mountain range to the W.A.C. Bennett Dam. From W.A.C. Bennett Dam, the river flows immediately into the 23 km (14.3 mile) long Dinosaur Reservoir behind Peace Canyon Dam. The entire drainage area upstream of Peace Canyon Dam is approximately 70 400 km^2 (27 200 $miles^2$), of which 68 900 km^2 (26 600 $miles^2$) is situated above the W.A.C. Bennett Dam.

3.2 Run–off Distribution

Mean annual inflow into Williston Reservoir is ~1075 m^3/s. An additional 9 m^3/s is associated with inflow into Dinosaur Reservoir downstream of W.A.C. Bennett Dam. On average, 51 per cent of the annual inflows into the Williston are in the form of snow and rainfall contributes 49 per cent. The runoff pattern has low flows during the December through April period. Approximately 63 per cent of the inflow occurs in the May through July period with the peak typically occurring due to snowmelt in June.

Because Williston Reservoir has multi-year storage capability annual inflow/discharge volumes may vary. For example, in years of high inflows, extra water may be stored to fill or recharge the reservoir resulting in the discharge for those years being less than the inflow. The available storage at Williston Reservoir is approximately 14 per cent greater than the average annual inflow.

4.0 OPERATING CONDITIONS FOR FACILITIES

4.1 Role of Facilities in BC Hydro's System

The Peace generating stations are part of BC Hydro's integrated generation system. For more information on the BC Hydro electric system and how it operates, please refer to BC Hydro's publication *Making the Connection* (2000).

The Peace system is critical in ensuring a reliable electricity supply for the Province. Williston Reservoir is the largest storage reservoir in the BC Hydro system. Under average water conditions, the Peace hydroelectric facilities contribute approximately 35 per cent of BC Hydro's annual energy production. BC Hydro's generating facilities on the Peace are also a valuable asset for the electricity trade activities conducted through Powerex. The large storage capacity and the operating flexibility of these facilities allow Powerex to capitalize on daily and seasonal market opportunities. Williston and Dinosaur reservoirs are key swing reservoirs that allow BC Hydro to effectively manage fluctuations in demand as well as erratic inflows in other parts of the system.

In addition to generating electricity, the G.M. Shrum and Peace Canyon generating stations provide ancillary services to the provincial electricity grid. These services include automatic generation control, operating and spinning reserve, black start, voltage support and VAR compensation and rotating energy.

4.2 Use of Water for Power Generation at the Peace Hydroelectric Facilities

The Peace facilities are normally managed to meet provincial electricity demand. G.M. Shrum and Peace Canyon generating stations are generally operated over the day in hydraulic balance, however, Dinosaur Reservoir may be drafted or filled within the day to allow the combined operation of G.M. Shrum and Peace Canyon to be optimized to meet peak loads, respond to market opportunities and/or manage unit outages.

Maximum power output from G.M. Shrum is 2730 MW. Maximum licensed discharge is 1968.02 m^3/s (69 500 ft^3/s).

Maximum power output from Peace Canyon Generating Station is ~728 MW. Maximum licensed discharge is 1982.2 m^3/s (70 000 ft^3/s).

BC Hydro uses all the available inflow, within the storage and generation limits of the facilities. Spills occur when storage is full and inflows exceed or are expected to exceed the discharge capacity of the generating units.

4.3 Emergencies and Dam Safety

Emergencies and dam safety requirements shall take precedence over the proposed conditions outlined in this Water Use Plan. Emergencies include, but are not limited to, actual and potential loss of power to customers. Dam safety requirements for operations are outlined in the document titled *Peace: Operation, Maintenance and Surveillance Requirements for Dam Safety* that is issued by BC Hydro's Director of Dam Safety.

4.4 Conditions for the Operation of Works for Diversion and Use of Water

BC Hydro will plan the operation of its water storage and discharge facilities in accordance within the proposed conditions outlined below. BC Hydro may not be able to operate within these constraints during an emergency, dam safety requirement, or extreme hydrological events.

4.4.1 Williston Reservoir Planning and Operating Constraints

The Williston Variable Minimum Elevation Operating Rule (Appendix 2) will guide the planning and operation of Williston Reservoir. The Operating Rule establishes the terms and conditions that govern the annual allowable minimum elevation on Williston Reservoir. The objective is to permit lower drawdown elevations on Williston Reservoir during or immediately following periods when inflows to the province-wide BC Hydro generating system are significantly below normal (*Low Supply Event*) or a *Force Majeure* event occurs. The Operating Rule also ensures that higher elevations are maintained for the benefit of other Williston Reservoir users during normal inflow conditions.

4.4.2 G.M. Shrum Generating Station

Maximum instantaneous generation diversion quantity from Williston Reservoir into Dinosaur Reservoir is 1968.0.2 m^3/s (69 500 ft^3/s).

There are no other water management constraints on the operation of G.M. Shrum.

4.4.3 Dinosaur Reservoir Planning and Operating Constraints

502.92 m (1650.0 ft) Maximum Elevation: The maximum elevation for normal operations to which BC Hydro is permitted to store water in Dinosaur Reservoir for power purposes. Water levels may be higher than this maximum if and as needed for flood routing and dam safety purposes.

500.00 m (1640.4 ft) Minimum Elevation: The minimum elevation for normal operations.

4.4.4 Peace Canyon Generating Station

Maximum instantaneous generation diversion quantity from Dinosaur Reservoir into the Peace is 1982.2 m^3/s (70 000 ft^3/s).

During Peace ice formation and break-up, typically from November to April of each year, releases from Peace Canyon Generating Station are planned and operated in accordance with the procedures contained in *Operating Procedures for Influencing Freeze-up and Break-up of the Peace River at the Town of Peace River, Dunvegan and Taylor* 2nd edition, prepared by the Alberta-B.C. Joint Task Force on Peace River Ice (January 1994), and in the *1998 Adopted Recommendations of the Project Steering Committee*.

Each year, prior to freeze-up at the Town of Peace, BC Hydro Generation in consultation with Alberta Environment will determine the optimum control flow for building the ice cover.

The minimum flow releases from Peace Canyon facilities is 283.2 m^3/s (10 000 ft^3/s) as measured near Hudson's Hope in the vicinity of Water Survey Canada Gauge 07EF001.

There are no other water management constraints on the operation of Peace Canyon Generating Station.

4.4.5 Peace Spill Protocol

Communication about spill events at W.A.C. Bennett Dam or Peace Canyon Dam and the environmental monitoring and reporting will be conducted in accordance with the *Peace Spill Protocol (September 2003).* See Appendix 3 for a summary of the protocol. The complete protocol can be found in the *Peace Water Use Plan: Committee Report* (December 2003).

5.0 PROGRAM FOR ADDITIONAL INFORMATION

Development of proposed conditions for the Peace hydroelectric facilities was complicated by uncertainties, information gaps and constraints on the magnitude of change to operations the Province would accept. The December 2003 consensus recommendations of the Peace Water Use Plan Committee were

contingent on the implementation of the monitoring programs and management plans to reduce these uncertainties and information gaps over time.

The management plans are a combination of physical works, studies, projects and effectiveness monitoring intended to mitigate operational impacts at a lower cost than changing operations. The management plans evolved during the process, as it became apparent that managing one issue in isolation from others was not a productive approach. Consequently, components of implementation requirements and monitoring programs are applicable across multiple management plans.

The effectiveness monitoring components of the management plans are designed to address key questions that affected decision-making in the consultative process and audit costs and benefits associated with physical works opportunities.

The Committee was also aware that the management plans, monitoring and information studies should not overlap or replace programs under the Peace/Williston Fish and Wildlife Compensation Program. The Program is designed to conserve and enhance fish and wildlife in the Williston and Dinosaur reservoir watersheds. Launched in 1988, it is intended to compensate for the "footprint" impacts of the W.A.C. Bennett Dam that was constructed in 1967 and the Peace Canyon Dam that was constructed in 1980. Many of the environmental impacts relating to the Williston and Dinosaur reservoirs construction and operation of the facilities, however, are similar. Thus some of the programs to mitigate operating caused impacts may be similar to programs considered under the Peace/Williston Fish and Wildlife Compensation Program.

5.1 Recommended Non-Operating Alternatives for Williston Reservoir

The Williston Reservoir Integrated Management Plan includes six main components:

- **Riparian and Wetland Habitat Management Plan –** To improve foreshore habitat for fish and wildlife by identifying areas suitable for 'perched' wetlands that could be modified. Trial wetland(s) would be created during the first five years of implementing the Water Use Plan. Subsequent wetlands would be created depending on the success of the trial(s) in the following five years. Ancillary benefits include localized dust management (see Dust Control Management Plan below) and improved aesthetics.

- **Tributary Habitat Enhancement Management Plan –** To improve access to tributaries excluded by drawdown zone topography and/or debris fields, a management plan would be implemented to gauge effectiveness of restoring access to two demonstration tributaries and then maintain access through active (e.g., debris management) or passive (e.g., berm) measures. Subsequent tributaries would be selected for

restoration, if the program proves to be effective at restoring fish habitat and/or access, in the next five years.

- **Dust Control Management Plan** – To reduce the duration and magnitude of dust storms and their effect on the quality of life for people living adjacent to the reservoir. A dust source survey and conditional dust control trials are proposed. The survey will identify the impact in Tsay Keh Village and the relative contribution of dust source areas to prioritize dust control efforts over time. If cost effective opportunities exist, the current annual fall rye seeding program could be expanded on a trial basis to include perennial vegetation establishment in areas that contribute to dust storms. Complementary strategies (e.g., engineered wetlands, windbreaks, irrigation, soil consolidation techniques, targeted debris management, etc.) could be tested at the same time. Ancillary benefits include increased fish and wildlife habitat. Where possible, plans associated with the Riparian and Wetland Habitat Management Plan will be integrated into this strategy. Implicit in this plan is a program to assess the effectiveness of dust control strategies and air quality in target sites with a Dust Control Audit.

- **Erosion Control Plan –** To stop the erosion of the shoreline in front of the Tsay Keh Village. The first stage of this plan would review, design and select erosion control structure(s) from alternatives that include rip-rap, debris mats and breakwater structures. Subsequent work would assess the efficacy of the erosion control structures and maintenance efforts. The second stage would be to install the protective works.

  Performance of the works will be monitored. BC Hydro has a flowage easement that permits the flooding and erosion of the remainder of the shoreline on Williston Reservoir and on Dinosaur Reservoirs.

- **Williston Access, Navigation and Safety Plan –** To help maintain and enhance the safe and reliable access to and use of Williston Reservoir and its tributaries. A combination of targeted debris removal and boat launch improvements or construction are planned.

  The priority sites are:

  - Peace Reach: Dunlevy and Elizabeth Creek.
  - Parsnip Reach: Finlay Bay at 76 Mile, Cutthumb Creek at 38 Mile, Alexander Mackenzie's Landing at 22 Mile and 7 Mile Bay.
  - Finlay Reach: Tsay Keh Village, Ingenika and Fort Ware access at the Finlay River backwater.

  These measures would be implemented responsibly by considering wildlife and fisheries impacts associated with increased access.

- **Debris Management Plan –** To manage debris resulting from the operation of Williston Reservoir, principally from shoreline erosion. Other sources (i.e., forestry practices) also contribute to debris recruitment. Localized debris management is an important tool in successfully implementing all of the aforementioned management plans. Consequently, while debris management itself is not put forth as a separate management plan, it is a requirement in several of the implementation projects. Effectiveness monitoring will be conducted.

- **Peace/Williston Marine Radio Communication and Improved Signage Plan –** To maintain and enhance the quality and safety of the recreation experience in the Peace system a marine radio communication channel and improved signage will be provided. The radio channel would provide a valuable safety net for boaters. The signage is intended to provide information about the location of access facilities, hazards associated with operating hydroelectric facilities and the marine channel.

5.2 Recommended Monitoring Studies Program for Williston Reservoir

In addition to the monitoring associated with the management plans, three monitoring programs were identified for Williston Reservoir.

- **Industry Engineering Feasibility and Design Study –** To conduct an engineering feasibility and design study to find long-term solutions to the issues faced by the forest industry in Mackenzie and the District of Mackenzie. The study objectives are:

    - To determine whether there is a practical, cost-effective solution for the Abitibi and Pope & Talbot mills water supply (quantity and quality).
    - To determine whether there is a practical, cost-effective solution (technical and/or regulatory) for the Abitibi and Pope & Talbot mills and the District of Mackenzie effluent disposal.
    - To determine whether there is a practical and cost-effective solution to the log supply issue for the Slocan and Abitibi mills.

- **Heritage and Culture Monitoring Proposal** – To collect additional information about the location of sites and monitoring the site-specific operating related impacts to:

    - Confirm the broad assumptions made in developing the existing performance measures (or invalidate those assumptions and help develop more accurate hypotheses).
    - Provide a more accurate assessment of the impacts of BC Hydro operations on known and potential sites.
    - Assess the relative importance of impacted (or potentially impacted) sites.

- Assist in the development of any operating or non-operating proposals to address impacts at priority sites.
- Identify the need for and prioritize any further study or monitoring.

The objective is to protect heritage resources, access to known sites and maintain and enhance opportunities for community resource use activities and spiritual and ceremonial use.

Management and protective work (i.e., collection or capping sites) will be conducted separately in a program being developed at BC Hydro.

- **Finlay River Monitoring Study –** To determine whether the operation of Williston Reservoir causes or contributes to an increase in the deposition of silt in the Deserter's Canyon area making it more difficult to access traditional hunting, fishing and gathering areas.

5.3 Recommended Non-Operating Alternatives for Dinosaur Reservoir

The Dinosaur Reservoir Management Plan includes two activities.

- **Dinosaur Reservoir Tributary Habitat Enhancement –** To improve access for fish to tributaries excluded by drawdown zone morphology and/or debris fields. A management plan would be implemented to gauge the effectiveness of restoring access to two demonstration tributaries and then maintain access through active (e.g., debris management) or passive measures. Subsequent tributaries would be selected for additional restoration, if the program proves to be effective at restoring fish habitat and access in the next five years and other tributary opportunities exist.

- **Dinosaur Reservoir Access** – To provide safe and reliable access to and from the reservoir over the full operating range by relocating and improving the dock at Hudson's Hope Park. Extension of the existing breakwater is also required. Provision of electronic signage at Hudson's Hope Park to display information about current and forecast (within the day) reservoir levels.

5.4 Recommended Non-Operating Alternatives for the Peace

The Peace Management Plan is limited to the portion of the Peace within British Columbia between Peace Canyon Dam and the BC/Alberta border. The work would be primarily conducted from Peace Canyon Dam to the Pine River confluence. Following are the components of the Management Plan.

- **Peace Side Channel Plan –** To increase fisheries habitat by physically enhancing side channels to allow them to be effectively watered. Successful implementation of the demonstration side channel enhancement would reduce or remove the need for an increased base flow.

- **Peace Ramping Plan –** To increase fisheries productivity by implementing physical work solutions (e.g., physically complex side channel habitat, dig deeper channel inverts, etc.) and testing and monitoring the result. If successful, ramping rate changes would not be required.

- **Peace Flood Pulse Plan –** To improve fisheries productivity and riparian habitat for flora and fauna by investigating the feasibility of periodic "flood pulse" events to maintain side channel and riparian habitat downstream of Peace Canyon Dam. If it is determined that a flood pulse is required to maintain the vegetative community the frequency, magnitude, duration and seasonal timing of planned (and unplanned) events will be investigated. Integral to this plan is the development of a *Peace Spill Protocol (September 2003)* to address negative impacts associated with fish entrainment and Total Gas Pressure during spill events.

- **Peace Access –** To provide safe and reliable access to and from the Peace for the full operating range at Peace Canyon Generating Station. Four sites below Peace Canyon Dam were identified for the construction and maintenance of river access. They are: Lynx Creek, Halfway River, Peace Island Park and Clayhurst/Blackfoot Regional Park.

- **Water Supply Improvements for Fort St. John –** To design and install a new well in the Peace as an addition to the existing wells. The well will ensure the city's designed water supply capacity can be met when the flow releases from Peace Canyon Generating Station are at 283.2 m^3/s (10 000 ft^3/s). One-half, up to a maximum of $100 000, will be contributed to the cost of the well. Once the additional well is implemented, any future water supply capacity constraints at Fort St. John when Peace Canyon Generating Station discharge is at 283.2 m^3/s (10 000 ft^3/s) will be the sole responsibility of the City of Fort St. John.

5.5 Recommended Monitoring Study Program for the Peace

In addition to the monitoring associated with the management plans, one monitoring program was identified for the Peace.

- **Peace Water Quality Study** – To determine whether there is any relationship between Peace Canyon Generating Station flow releases and water turbidity and temperature for the Spectra Energy facility, Canfor Forest Products and the District of Taylor water supply. The study will determine:

    - If, during the spring freshet when releases from Peace Canyon Generating Station are at or near the minimum level 283.2 m^3/s (10 000 ft^3/s) the Pine River deposits excess silt in the vicinity of the Spectra Energy and District of Taylor water intakes; and

- If, during the periods when releases from Peace Canyon Dam are at or near the minimum level of 283.2 m^3/s (10 000 ft^3/s) the water temperature in the Peace increases. If an increase in temperature occurs it could reduce the cooling effectiveness for the industrial operations.

This information will be available for a future Water Use Plan review. The three participants indicated a willingness to contribute to the cost of the study program.

6.0 IMPLEMENTATION OF RECOMMENDATIONS

The proposed operating regimes, management plans and monitoring programs in this Water Use Plan will be implemented after BC Hydro receives direction from the Comptroller of Water Rights.

7.0 EXPECTED WATER MANAGEMENT IMPLICATIONS

The expected outcomes for the non-power water use interests considered during the preparation of this Water Use Plan are based on the best available information. After BC Hydro has been directed to implement the proposed conditions, BC Hydro will be responsible for meeting the operational parameters, but not for achieving the expected outcomes.

The expected outcomes, as described below, are based on the proposed operating regime, management plans and monitoring during the ten years following approval of the Water Use Plan.

7.1 Other Licenced Uses of Water

The proposed conditions in this Water Use Plan are not expected to affect other current licenced uses of water associated with the Peace system.

7.2 Riparian Rights

The proposed operating conditions, management plans or monitoring in this Water Use Plan are not expected to affect riparian rights associated within the Williston or Dinosaur reservoirs.

For the Peace, the new well, when installed is expected to address the water supply capacity for the City of Fort St. John. The proposed Peace water quality study is expected to provide information regarding the water supply for the Spectra Energy facility, Canfor Forest Products pulp mill and the District of Taylor.

7.3 Fisheries

The proposed operating conditions in this Water Use Plan are expected to have minimal affect on the fish resources in Williston Reservoir. Benefits are expected

as a result of the Riparian Wetlands and Tributary Enhancement Williston management plans.

The operating conditions for Dinosaur Reservoir are not changing, therefore, no effects on the fish resources in Dinosaur Reservoir are expected. Benefits are expected as a result of the Dinosaur Reservoir Management Plan.

With the formalization of the minimum flow, the proposed operating conditions for Peace River downstream of Peace Canyon are not changing, therefore, no effects on the fish resources in Peace are expected.

Fish populations in the Peace are expected to benefit from the Peace management plans to improve spawning and rearing habitat. An additional benefit is increasing the knowledge of fish and fish habitat in the Peace and possible implications of operations.

7.4 Wildlife Habitat

The proposed operating conditions are not expected to have any noticeable effect on wildlife habitat around Williston and Dinosaur reservoirs or along the Peace. The proposed physical works could provide benefits for some wildlife species (e.g., nesting sites) on Williston Reservoir.

The physical works proposed for the Peace could have negative and/or positive effects for wildlife, depending on the species in question. This will be monitored as part of the Peace management plans.

7.5 Flood Management

The proposed operating conditions in this Water Use Plan are not expected to significantly impact flood routing associated with Williston or Dinosaur reservoir operations or the Peace below the facilities.

7.6 Recreation

The proposed operating conditions in this Water Use Plan are expected to have a minimal affect on the access or recreation activities on Williston Reservoir. The proposed physical works (e.g., improving or constructing reliable and safe reservoir access, debris removal, etc.) are expected to improve the recreation opportunity and public safety on Williston Reservoir.

The Dinosaur Reservoir operating regime is not changing. The proposed physical works for Dinosaur Reservoir are expected to improve the safe and reliable access for people using the reservoir.

The Peace operating regime is not changing. The proposed physical works are expected to provide safe and reliable access on the river at four locations. These are Peace Island Park, Lynx Creek, Halfway River and Clayhurst/Blackfoot Regional Park.

The side channel works proposed for fisheries may also provide some ancillary benefits for recreation.

7.7 Water Quality

The proposed operating conditions in this Water Use Plan are not expected to affect the water quality of Williston Reservoir.

The operating regime is not changing for Dinosaur Reservoir or the Peace.

7.8 Industrial Use of Water

The proposed operating conditions in this Water Use Plan are expected to affect the pulp and paper mill's water supply from Williston Reservoir, although it is believed to be manageable. Should the reservoir be drawn down to elevation 654.14 m (2147.0 ft) the Abitibi and Pope & Talbot mills could experience similar water supply challenges as when the reservoir was drawn down for the sinkhole event.

The operation of the log transporter may be unusable for a longer period of time if the reservoir is drawn down to elevation 654.14 m (2147.0 ft) which could result in higher log supply costs.

The proposed operating condition to allow the Williston Reservoir to be drawn down to elevation 654.14 m (2147.0 ft) which may effect the ability of Abitibi and Pope & Talbot mills and the District of Mackenzie to dispose of effluent while meeting the conditions of their permits.

There is no industrial use on Dinosaur Reservoir.

7.9 First Nation Considerations

BC Hydro's Peace hydroelectric facility lies within the claimed traditional territories of the Tsay Keh Dene First Nation, Kwadacha Band, McLeod Lake Indian Band, Blueberry First Nation, Halfway River First Nation, Saulteau Indian Band and West Moberly First Nation. The Tsay Keh Dene First Nation, Kwadacha Band and McLeod Lake Indian Band are affected primarily by Williston Reservoir. The other territories generally lie downstream of the W.A.C. Bennett Dam.

The following are expected results from implementing the Water Use Plan recommendations:

- Study and identification of First Nation archaeological resources in the Williston and Dinosaur reservoir drawdown zone and the shoreline along the Peace.
- Study of traditional use in the Williston and Dinosaur reservoir drawdown zone.
- Study of traditional use along the Peace.
- Improve conditions for fish and wildlife in the Peace basin.

- Improved management of dust on Williston Reservoir.
- Improved management of debris on Williston Reservoir.
- Provide safe and reliable access to and use of Williston Reservoir.
- Prevent further erosion on Tsay Keh Beach.

7.10 Archaeological Considerations

BC Hydro's Peace hydroelectric facility lies within the claimed traditional territories of the Tsay Keh Dene First Nation, Kwadacha Band, McLeod Lake Indian Band, Blueberry First Nation, Halfway River First Nation, Saulteau Indian Band and West Moberly First Nation. First Nations interests included:

- Protect cultural sites and resources from erosion in the reservoir;
- Protect cultural sites and resources from exploitation in the reservoir;
- Provide opportunities for archaeological investigation in the reservoir; and
- Maintain the cultural, aesthetic and ecological context of important cultural resources and spiritual sites.

BC Hydro will work with the First Nations as required under the BC Heritage Act.

7.11 Power Generation

The proposed operations in the Water Use Plan associated with managing Williston Reservoir are expected to result in a significant loss of power benefits compared to licence rights.

8.0 RECORDS AND REPORTS

8.1 Compliance Reporting

BC Hydro will submit data as required to the Comptroller of Water Rights to demonstrate compliance with the conditions conveyed in the Water Licences. The submission will include records of:

- Generation discharge from G.M. Shrum and Peace Canyon Generation Stations;
- Spill discharge from W.A.C. Bennett and Peace Canyon Dams;
- Elevations on Williston and Dinosaur Reservoirs; and
- Monthly forecasts of Williston Reservoir elevations.

8.2 Non-compliance Reporting

Non-compliance with any operating condition will be reported to the Comptroller of Water Rights in a timely manner.

8.3 Monitoring Program Reporting

Reporting procedures will be determined as part of the detailed terms of reference for each study or undertaking.

9.0 PLAN REVIEW

A five-year review for Williston Reservoir operations to commence not later than four years and six months after the implementation of this Water Use Plan, will be convened by BC Hydro. The Peace Water Use Plan Committee will consider the results of the engineering feasibility and design study, any physical works installed or planned and any learning during the years of operation. The purpose is to recommend long-term operating constraints for Williston Reservoir to replace those in effect for the first five years.

The meeting will also be used to review the results of the management plans, physical works and monitoring. Adjustments to the programs will be considered as well as decisions about proceeding to conditional next steps.

A full review of the Water Use Plan will occur in the tenth year after implementation of the Water Use Plan.

10.0 NOTIFICATION PROCEDURES

Notification procedures for floods and other emergency events are outlined in the *Peace Area Generation Emergency Plan*. This document is filed with the Office of the Comptroller of Water Rights.

Appendix 1

Peace Water Use Plan Hydrology Memo

Inter-office memo

TO: Eric Weiss 18 August, 2003 (21 Aug 2007)

FROM: Chris Caryula File: GMSWUP C510

SUBJECT: Peace River Water Use Plan
Hydrology of Peace River Basin
(supersedes memo #wr234, dated 21 July, 2003)

1 INTRODUCTION

The Peace River project is a two dam hydroelectric project (W.A.C. Bennett and Peace Canyon dams) that regulates flows for power generation and flood control:

G.M. Shrum

- W.A.C. Bennett Dam is located on the Peace River approximately 167km upstream from the B.C./Alberta border.
- W.A.C. Bennett Dam impounds Williston Reservoir.
- Spill and all other non-power releases from W.A.C. Bennett Dam discharge into Dinosaur Reservoir.
- Power releases (turbine discharge) are at the G.M. Shrum power plant (10 units, max output ~ 2730 MW) below the dam.
- Discharge from G.M. Shrum power plant enters Dinosaur Reservoir.

Peace Canyon

- Peace Canyon Dam is located on the Peace River approximately 144km upstream from the B.C./Alberta border.
- Peace Canyon Dam impounds Dinosaur Reservoir.
- Spill and all other non-power releases from Peace Canyon Dam discharge into the Peace River.
- Power releases (turbine discharge) are at the Peace Canyon power plant (4 units, max output ~ 700 MW) at the toe of the dam.
- Discharge from Peace Canyon power plant enters the Peace River.

This report highlights the hydrology of the G.M. Shrum (GMS) and Peace Canyon (Peace) hydroelectric projects. Physiography and climatology are reviewed for the Peace River watershed.

Methods used to calculate reservoir inflows, such as BC Hydro's FLOCAL program, are discussed. Typical inflow hydrographs and summaries are provided. Flow records for the

Peace River system referred to in this report were used in power studies conducted for the Peace River Water Use Plan.

Procedures used to provide daily inflow and seasonal volume inflow forecasts are also described.

2 BASIN DESCRIPTION

2.1 Physiography[1]

The Peace River basin is situated in north central British Columbia. The two major tributaries, the Finlay and Parsnip rivers, rise in mountainous regions in the north west and south east corners of the basin. These rivers drain into Williston Reservoir, a T-shaped reservoir with a total surface area of 1770 km^2, which occupies 260km of the Rocky Mountain Trench, and an additional 120km of the Peace River valley through the Rocky Mountain Range to the W.A.C. Bennett Dam. From W.A.C. Bennett Dam, the river flows immediately into the 23 km long Dinosaur Reservoir behind Peace Canyon Dam. The entire drainage area upstream of Peace Canyon Dam is approximately 70,400 km^2, of which 68,900 km^2 is situated above Bennett Dam; therefore, the vast majority of natural inflows to the entire basin enter Williston Reservoir. Steep valley side slopes and short tributary streams that flow into Peace River and the reservoirs from all directions characterize the Peace River Basin. The drainage basin for the Peace River system is shown in Figure 1.

[1] Physiography information obtained from BC Hydro, "Williston Lake – Probable Maximum Flood", Hydroelectric Engineering Division report no. H2003, June 1988

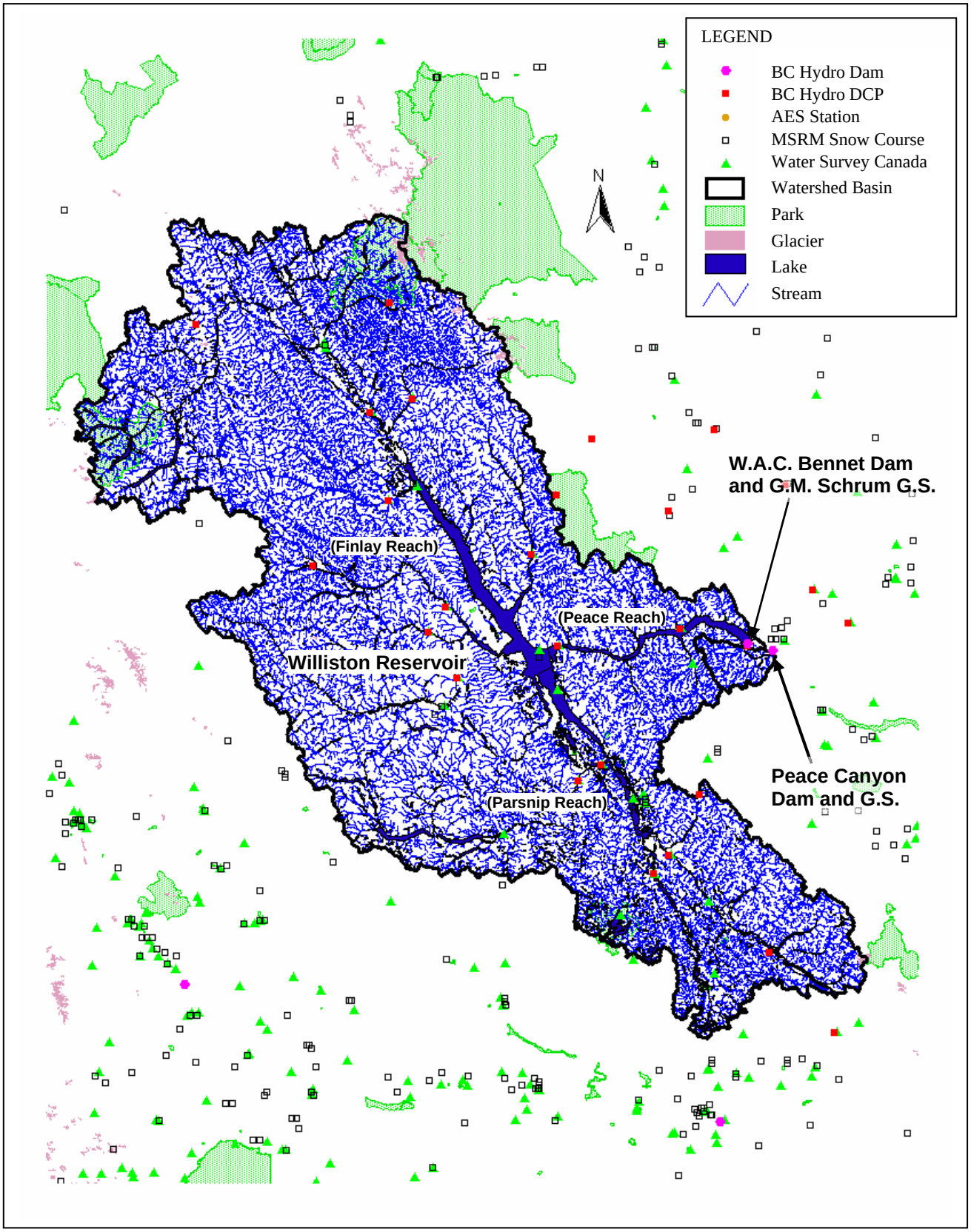

Figure 1: Watershed Map and Hydrometeorological Stations

The Williston Basin hypsometric (area-elevation) curve is shown in Figure 2.

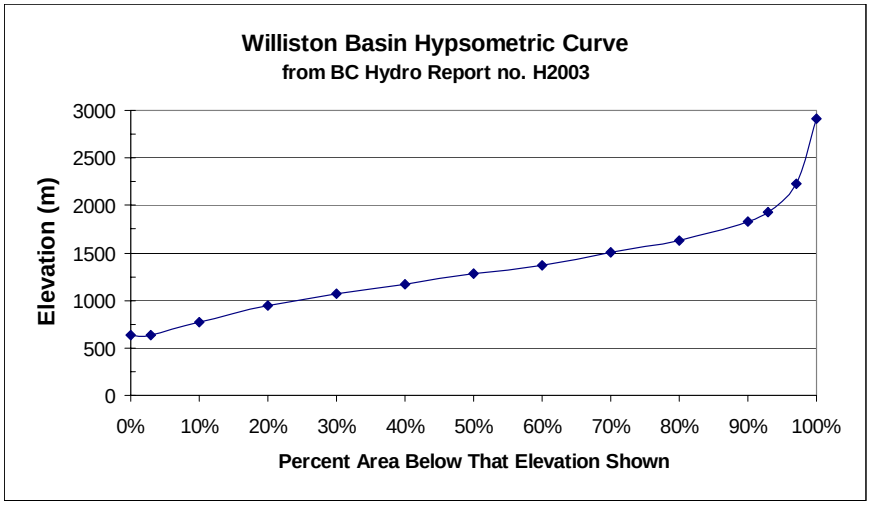

Figure 2: Hypsometric curve for the Williston Basin upstream of W.A.C. Bennett Dam

Between their normal maximum and normal minimum operating elevations the lakes have their live storage capacities summarized in Table 1.

Table 1: Peace River Project's Reservoir Live Storage Capacities

Reservoir	Live Storage Capacity (cms-d)
Williston Lake (GMS)	456,852 (39,472 million m^3)
Dinosaur Lake (Peace)	286 (25 million m^3)

Figures 3a and 3b shows the elevation-storage relationship for the reservoirs, used for determining the above storage capacities, within their normal reservoir operating ranges.

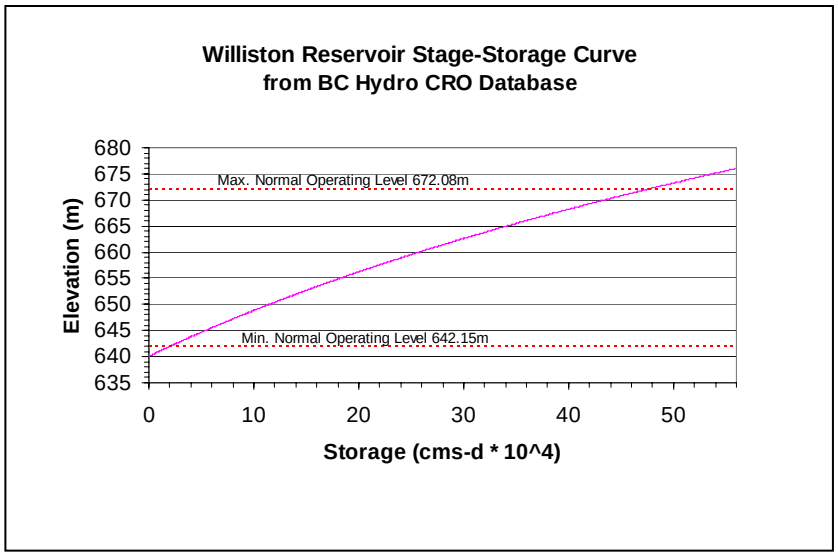

Figure 3a: Stage-storage relationship for Williston Reservoir

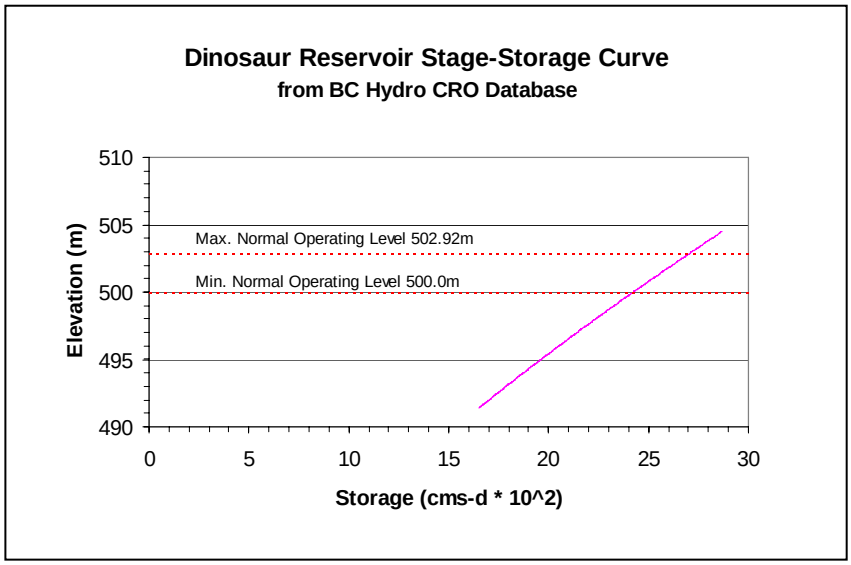

Figure 3b: Stage-storage relationship for Dinosaur Reservoir

2.2 Climatology[2]

The climate of the Peace River drainage is characterized by cold, snowy winters, and mild, rainy summers. The mean annual temperature at Germansen Landing in the centre of the basin is 0.5^{O}C, and the means for January and July are -18^{O}C and 13^{O}C respectively. Temperatures at Germansen Landing range between extremes of -47^{O}C and 32^{O}C. Snow accumulates in the basin during the winter, with depths ranging from approximately 1 m in the valleys to over 4 m in the mountains. The corresponding water equivalent ranges from approximately 250 mm to 1300 mm. Summer rainfall occurs most frequently in the period from July through September. Average annual precipitation is approximately 800mm, which is fairly evenly distributed between snow and rain.

The relatively colder and drier regime in the northern drainage area (Finlay) and the warmer and moister regime in the southern drainage area (Parsnip) characterize variations of the climate within the basin. Annual precipitation in the north of the basin averages 750 mm, while in the headwaters of the Parsnip area it reaches a maximum of 1500 mm.

Low flows prevail during the winter and are entirely from groundwater. The peak flood generally occurs in late May or early June. However, significant floods have also been recorded during the summer months.

[2] Climate information obtained from BC Hydro, "W.A.C. Bennett Dam – Comprehensive Inspection and Review", Hydroelectric Engineering Division report no. H1752, March 1985

Figure 4 shows the maximum, mean, and minimum daily precipitation at various locations in the Peace River basin.

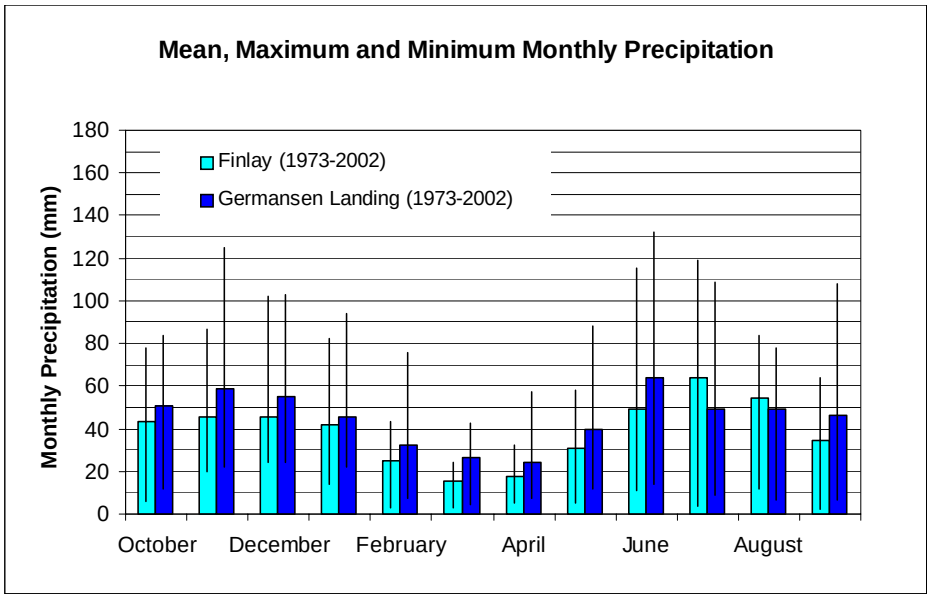

Figure 4: Maximum, mean and minimum monthly precipitation

Figure 5 shows the maximum, mean, and minimum daily temperatures at Germansen Landing in the Peace River basin.

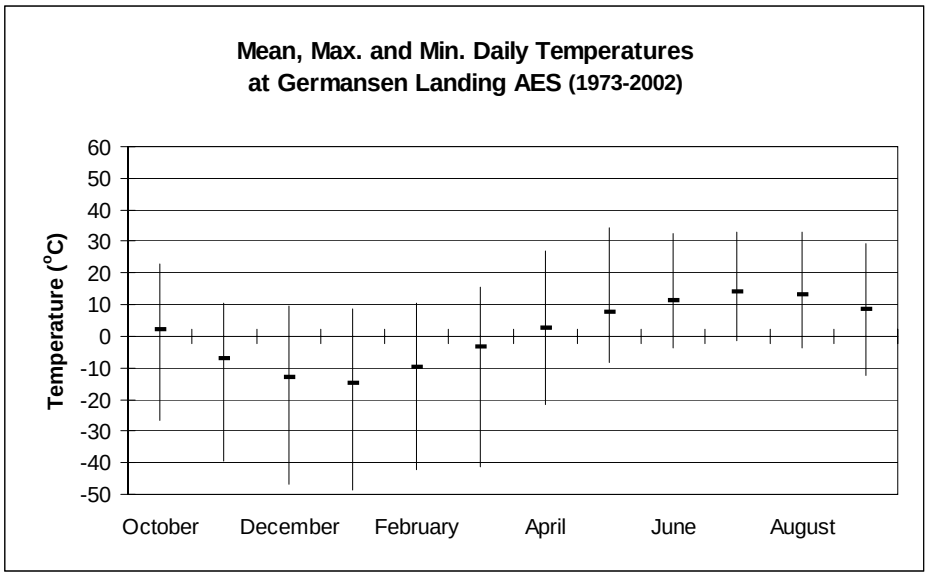

Figure 5: Maximum, mean and minimum daily temperature

Figure 6 shows the monthly snow water equivalent at various locations in the Peace River basin.

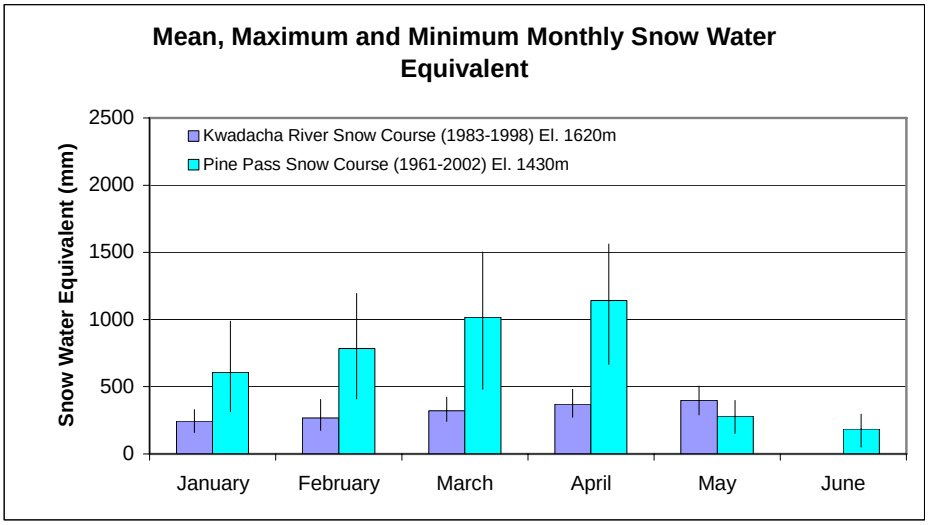

Figure 6: Maximum, mean and minimum monthly snow water equivalents

3 RESERVOIR INFLOWS

3.1 Inflow calculations

Reservoir inflow calculations: Inflow is the volume of water entering a reservoir within a given period of time. Reservoir inflows are calculated rather measured directly. Daily inflows may be derived from mean daily discharge from the reservoir and change in reservoir storage over a period of 24 hours. The generic formula is:

$$\text{INFLOW} = \text{OUTFLOW} + \Delta\ \text{STORAGE} \quad \ldots\ldots(1)$$

where INFLOW = average inflow over a one - day period
OUTFLOW = average outflow over a one - day period
Δ STORAGE = S2 - S1, where
S2 = reservoir storage at the end of the day
S1 = reservoir storage at the end of the previous day

Reservoir storage for a specific reservoir elevation is derived from a stage – storage curve unique to each reservoir.

The nature of the calculation of inflows can result in “noisier” hydrographs than observed at unregulated, natural river channels. Noisy inflows can arise due to various sources of error, such as wind set up on the reservoir, resolution of elevation measurements, errors in

reservoir elevation readings, errors in outflow measurements through turbines, spillways or valves, errors in stage-storage curves and errors in the rating curves for various outlet facilities. The impact of noise tends to reduce as the time interval over which inflow is computed increases.

Storage relationships: The storage relationships used to determine the volume of water in each Reservoir are shown in Figures 3a and 3b.

Outflow relationships: Flow through turbines at the various powerhouses is computed based on megawatt output and gross hydraulic head. "Gross hydraulic head" is a measure of the vertical distance between the water level in the reservoir and the water level immediately below the turbine outlet. Power output is proportional to head and turbine discharge. A generic relationship between these variables is shown in Figure 7.

Generic relationship between flow, generation and head for a turbine

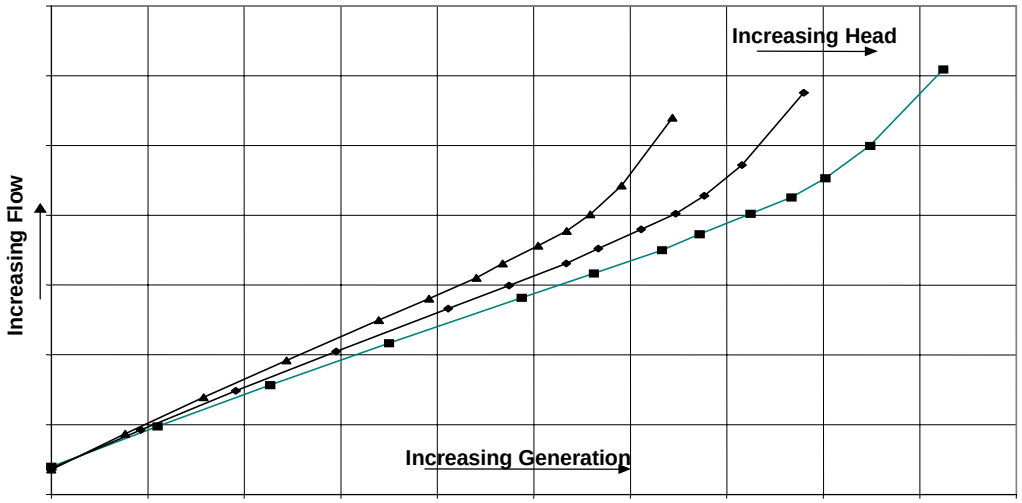

Figure 7: Generic relationship between flow, generation, and head for a turbine

Data records: BC Hydro computes inflow using a computer program called FLOCAL. Specifically;
Inflow to Williston Reservoir (GMS) is computed based on equation (1).
Total inflow to Dinosaur Reservoir (Peace) is computed using equation (1). Local inflow to Dinosaur Reservoir is equal to the total inflow to the reservoir less the regulated outflows from the GMS project.

Various information, including gate openings, reservoir and tailwater elevations, energy, spill, turbine flows, and inflows are stored in FLOCAL. A FLOCAL configuration for the Peace River system is shown in Figure 8.

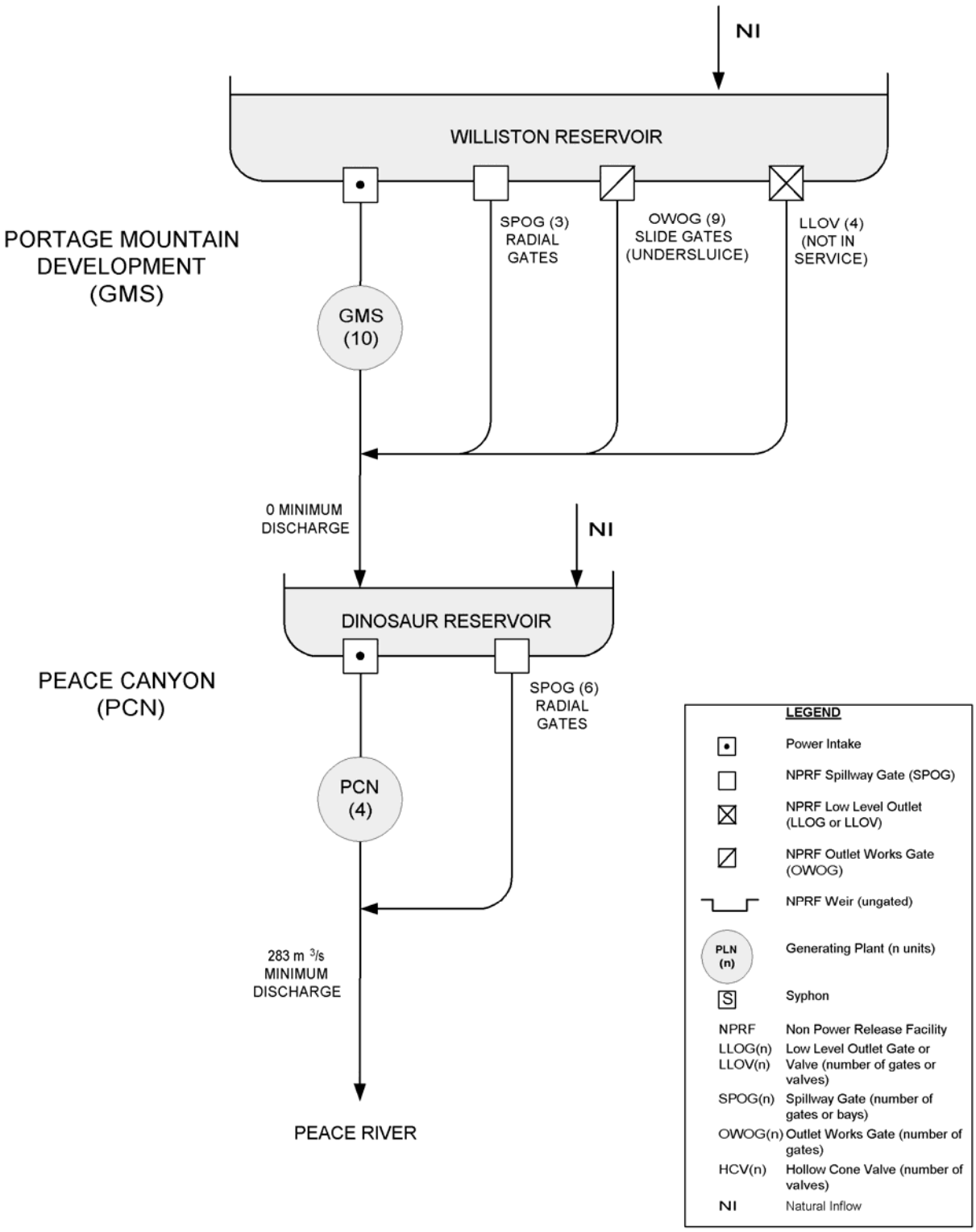

Figure 8: Schematic of the FLOCAL configuration for the Peace River system

3.2 Reservoir inflow characteristics

GMS Project:

Figure 9 and Table 2 summarizes the monthly inflows to Williston Reservoir.

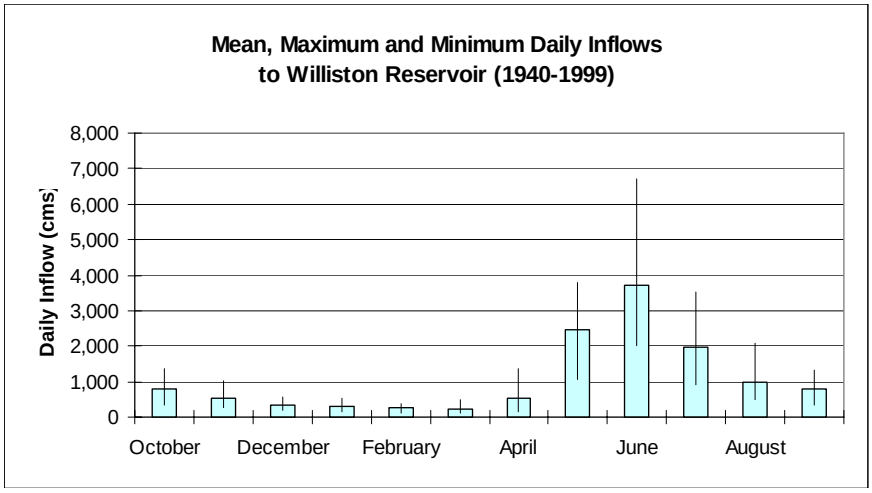

Figure 9: GMS Project monthly inflows

Table 2: GMS Project monthly inflows (1940-1999)

	Mean Monthly Inflow (cms)	Maximum Monthly Inflow (cms)	Minimum Monthly Inflow (cms)
October	795	1383	323
November	546	1031	251
December	351	550	189
January	300	545	137
February	255	379	129
March	245	486	120
April	517	1366	161
May	2475	3805	1071
June	3706	6708	2019
July	1974	3538	923
August	990	2075	496
September	787	1332	358

A “flow duration curve” indicates the percent of time that a flow is greater than a given discharge. Figures 10 shows a duration curve for annual inflows to Williston Reservoir.

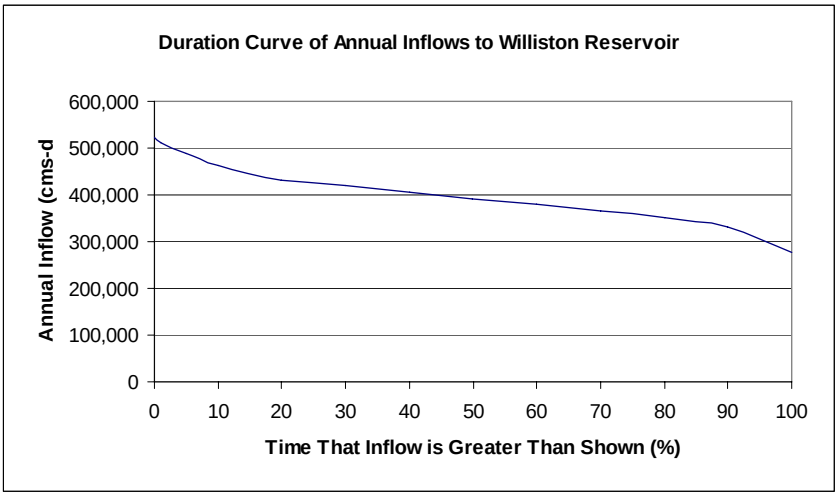

Figure 10: Duration curve of annual inflows to Williston Reservoir

Peace Canyon Project:

The non-regulated (natural) inflow to Dinosaur Reservoir is approximately 1% of that which flows into Williston Reservoir due to the small catchment of Dinosaur Reservoir compared to that of Williston Reservoir.

For reference, Figure 11 shows a comparison between the mean annual local inflow and total live storage available for selected BC Hydro and other hydroelectric projects. The GMS project is highlighted and shows that the available storage at Williston Lake reservoir is approximately 14% greater than the average annual inflow. Peace Canyon project (Dinosaur Reservoir) is a run-of-river dam and provides very little storage for inflows.

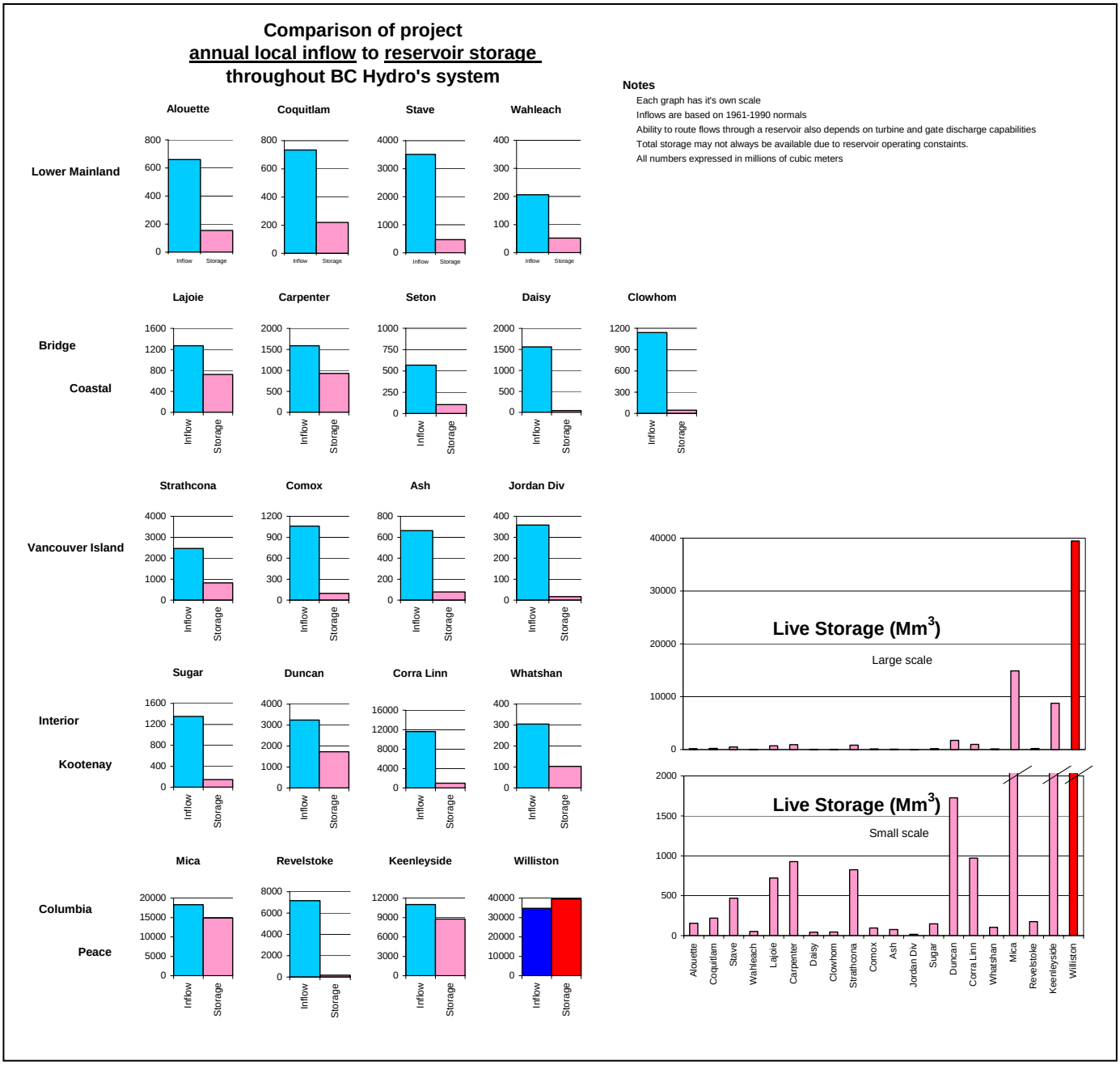

Figure 11: Comparison of Peace River system annual inflows to reservoir storage throughout BC Hydro's system

The ratio of average annual inflow to available reservoir storage provides a qualitative indication of how the inflow regulation and spill management capability varies from project to project: the higher the ratio, the lower the regulation capability. Figure 11 also shows the relative contribution of the Williston Lake reservoir to BC Hydro's total reservoir storage capacity.

4 OPERATIONAL INFLOW FORECASTING

BC Hydro's Resource Management produces two main types of hydrologic forecasts: daily inflow and seasonal volume inflow forecasts for the Peace River systems.

Daily inflow forecasts: Daily inflow forecasts are short-term forecasts that indicate the inflow expected over the next few days. The UBC Watershed Model is currently used to produce these forecasts. Each morning of each working day, Resource Management enters observed and forecast precipitation, temperature, and freezing level data into the model to forecast inflow over each of the next five days.

Volume inflow forecasts: Volume inflow forecasts estimate the volume of water that is expected to flow in to the Peace River system during a given period. BC Hydro typically produces volume forecasts for the period of February through September. The ability to forecast seasonal runoff for this period lies in the fact that much of the runoff during the forecast period is the product of snowmelt runoff. By measuring snow water equivalent in the mountain snowpack, as well as other parameters such as precipitation and streamflow up to the forecast date, a more accurate estimate of future runoff can be made than one based on historical inflow data alone. Volume inflow forecasts are issued beginning January 1 of each year. The forecasts are updated on the first of each month until August 1st.

5 HYDROMETEOROLOGIC NETWORK

Hydrometeorological data is required to plan, monitor, and operate facilities in the Peace River system's watershed. Characteristics of the hydrometeorological data collection stations, commonly referenced for the Peace River basin, are summarized in Table 3. Locations of hydrometeorological stations within the watershed are shown in Figure 1.

Table 3: Hydrometeorological stations referenced for forecasting, operations and planning.

Station	Type	ID	Elev (m)	Latitude	Longitude	Characteristics
Germansen Landing	AES	1183090	747	55°47'	124°42'	Temp./Precip.
Finlay River above Akie River	DCP	FIN	710	57°07'	125°15'	Temp./Precip/Flows
Ingenika R. above Swannell R.	DCP	ING	700	56°43'	125°06'	Temp./Precip/Flows
Prince George A	AES	1096450	676	53°88'	122°68'	Temp./Precip.
Mackenzie A	AES	1184790	695	55°30'	123°13'	Temp./Precip.
Fort St John	AES	1183000	695	56°14'	120°44'	Temp./Precip.
Pine Pass	DCP	PYN	1400	55°21'	122°38'	Temp./Precip./Snowpillow
Kwadacha River	DCP	KWA	1620	57°37'	125°04'	Temp./Precip./Snowpillow
Aiken Lake	DCP	AKN	970	56°25'	125°44'	Temp./Precip./Snowpillow
Pulpit Lake	DCP	PUL	1311	57°32'	126°44'	Temp./Precip./Snowpillow
Ware Upper	MSRM	4A03	1570	57°23'	125°41'	Snowcourse
Germansen Upper	MSRM	4A05	1500	55°49'	124°42'	Snowcourse
Pine Pass	MSRM	4A02	1430	55°21'	122°38'	Snowcourse

Prepared by:

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Reviewed by:

K. Groves, P. Eng.

Appendix 2

Williston Variable Minimum Elevation Operating Rule

Williston Variable Minimum Elevation Operating Rule

1. Introduction

The Peace Water Use Plan Committee reached a consensus agreement on 8 May 2003 on an operating regime for the Peace River hydroelectric projects (*Peace Water Use Plan Committee Report, September 2003*). The integral components of the agreement include an interim operating regime for five years on Williston Reservoir, a new methodology for determining the minimum annual elevations, physical works (i.e., infrastructure to provide a secure water supply, extending boat ramps to ensure access to the reservoir, protective works to prevent erosion, etc.) and studies to collect critical information to confirm a long-term operating regime.

During the Peace Water Use Plan process, and especially in the final meeting, the parties recognized four outcomes that must be met to achieve agreement on a long-term operating regime for Williston Reservoir:

- The forest industry based in Mackenzie, its employees, business partners and the community of Mackenzie must not be unduly harmed as a result of BC Hydro drawing Williston Reservoir down to elevations lower than have occurred during the first 30 years of operation (elevation 2146.9 feet) for normal operations.

- The other parties and interests living around and using the reservoir and the adjacent land base must not be unduly harmed as a result of Williston Reservoir drawdowns to elevations lower than have occurred during the first 30 years of operation (elevation 2146.9 feet) for normal operations.

- The province, which owns and receives the benefits from the Peace River hydroelectric facilities must not be unduly harmed as a result of operating constraints on Williston Reservoir.

- BC Hydro, which requires maximum operational flexibility on Williston Reservoir to help meet its legal obligation to serve the Provincial electricity customer load, must not be unduly harmed as a result of operating constraints on Williston Reservoir.

The agreement on the initial five-year operating regime was achieved by recognizing that there is uncertainty in the impacts of drawing down Williston Reservoir below elevation 2147 feet. This uncertainty relates to the impacts to the forest industry mills at Mackenzie and the amount of the expected reduction in impacts due to upgrades to or replacement of existing infrastructure, as well as to the impacts to others, including heritage resources, dust, fish, wildlife, access and recreation.

The parties agreed on a methodology, called the Williston Variable Minimum Elevation Operating Rule, to compute minimum annual elevations that are a function of the annual energy supply from inflows into BC Hydro reservoirs across the province.

The agreement also included a provision whereby approval from the Comptroller of Water Rights would be required before BC Hydro could draw Williston Reservoir down below an initial threshold elevation of 2147 feet. Adverse system energy supply conditions caused by low inflows into system reservoirs and/or Force Majeure event(s) within the electrical generating/transmission system, would provide the only reason for BC Hydro to seek approval for such a drawdown.

This condition would be in effect from the time the Comptroller of Water Rights directs BC Hydro to implement the conditions of the Peace Draft Water Use Plan until the Comptroller of Water Rights provides further direction following the scheduled five-year review of the Peace Water Use Plan. This review is scheduled to begin not later than four years and six months following implementation of the directed operating criteria. The review is expected to include the results of the industry and non-industry studies recommended by the Peace WUP Committee.

The five-year review is intended to provide a permanent threshold elevation plus make any necessary refinements to the Williston Variable Minimum Elevation Operating Rule. The Committee recognized that a long-term solution is in the interest of all parties and set the five-year time period in the expectation that the studies could be completed, any necessary infrastructure upgrades constructed, and management plans for the other impacts identified and put in place.

In the event that this is not achieved by the end of the five year period, it is anticipated that the Initial Minimum Elevation (2147 feet) will be maintained until it is, or until the scheduled 10-year full review of the Peace Water Use Plan when all issues can be revisited.

Having considered that the Province is the shareholder and recipient of the financial benefits from the operation of Williston Reservoir, the Committee recommended that the Province assume the costs for making the industry infrastructure upgrades. The Committee further recommends that the Province dedicate its share of the Williston Lake Drawdown Contingency Fund towards the cost of the industry infrastructure improvements.

2. Objective

This purpose of this document is to define the implementation of the Williston Variable Minimum Elevation Operating Rule that governs the annual allowable minimum elevation of Williston Reservoir.

The first objective is to permit lower drawdown elevations on Williston Reservoir during or immediately following periods when inflows to the province-wide BC Hydro generating system are significantly below normal or when a *Force Majeure Event* occurs. A second objective is ensure the reservoir elevations return to a normal range as system conditions return to normal. The third objective is operate Williston Reservoir in a manner that takes into consideration the values of other Williston Reservoir stakeholders.

The Williston Variable Minimum Elevation Operating Rule is intended to provide a transparent, predetermined process to determine the allowable annual minimum Williston Reservoir elevation. In operating Williston Reservoir under this process, BC Hydro Generation will make reasonable efforts to mitigate the effects of low inflow and Force Majeure Events through market purchases and/or operational changes.

3. Hydro System Inflow Energy Supply

The *Hydro System Inflow Energy Supply* is computed annually in October and is based on the measured inflows during the previous *Water Supply Year* (1 October through 30 September) for each basin in the province that contains BC Hydro generating facilities, as listed in Table 1.

Table 1: BC Hydro Hydroelectric Generation Facilities Included in the Heritage Contract

Aberfeldie*	Elko*	LaJoie	Shuswap
Alouette	Falls River*	Mica	Spillimacheen*
Ash River	G.M. Shrum	Peace Canyon	Stave Falls
Bridge River	Hugh Keenleyside	Puntledge	Strathcona
Buntzen/Coquitlam	John Hart	Revelstoke	Wahleach
Cheakamus	Jordan River	Ruskin	Walter Hardman*
Clowhom	Kootenay Canal	Seton	
Duncan	Ladore	Seven Mile	

The inflow for each basin is converted to energy in GWh using a standard conversion formula, and the results summed to obtain the Hydro System Inflow Energy Supply. For the small generating facilities with minimal storage, which are marked with an asterisk in Table 1, the measured 1 October to 30 September energy production will be used instead of the conversion from inflow. The Hydro System Inflow Energy Supply under normal water conditions is 46635 GWh, as specified in the Heritage Contract.

4. Force Majeure Event

A *Force Majeure Event* is the occurrence of an event or circumstance not within the reasonable control of the BC Hydro, and includes:

i) failure of or damage to dams, reservoirs, facilities or equipment included in the hydroelectric heritage assets (Table 1) owned by BC Hydro, that affects the ability to generate or supply power; or

ii) acts or omissions of federal, provincial or local governments or any of their boards or agencies, other than BC Hydro or entities controlled by BC Hydro, including delays in regulatory process, and orders of a regulatory authority or court of competent jurisdiction that affects BC Hydro's hydroelectric heritage assets (Table 1); or

iii) outages on BC Hydro's transmission systems and its interconnections with adjacent control areas.

A *Force Majeure Event* may only be declared by BC Hydro when an event as described above in sub-paragraphs i), ii) and iii) of the definition of *Force Majeure*, results in:

i) the reduction of the energy supply of Table 1 resources by a total of at least 450 GWh, whether within one or over two Water Supply Years, or

ii) BC Hydro having insufficient gross capacity to serve the load of its BC customers.

When BC Hydro declares a *Force Majeure* it will promptly notify the Comptroller of Water Rights and the parties identified in Section 17 of this document. The notice will identify the nature of the *Force Majeure*, its expected duration and the particular obligations affected by the *Force Majeure*. BC Hydro shall provide the Comptroller of Water Rights reports with respect to the *Force Majeure* at such intervals as the Comptroller of Water Rights may reasonably request while the *Force Majeure* continues. The parties will be copied on the reports. BC Hydro shall give prompt notice of the end of the *Force Majeure*.

BC Hydro shall use all commercially reasonable efforts, including increasing electricity imports, to remove the *Force Majeure* as soon as possible. BC Hydro shall promptly respond to any inquiry from the Comptroller of Water Rights regarding the efforts being undertaken to remedy the situation.

BC Hydro may not invoke *Force Majeure*:

i) for economic hardship or for lack of money, credit or markets (except that BC Hydro shall not be required to use more than commercially reasonable efforts to obtain or increase energy supply, including commercial reasonableness as to price and cost); or

ii) if the *Force Majeure* is the result of a breach by BC Hydro of a permit, certificate, licence or approval or of any applicable laws, regulations or orders; or

iii) if BC Hydro has failed to use all commercially reasonable efforts to prevent or remedy the situation and remove, so far as possible and with reasonable dispatch, the *Force Majeure*

5. Hydro System Energy Supply

The *Hydro System Energy Supply* for each Water Supply Year is computed as the Hydro System Inflow Energy Supply for the Water Supply Year, reduced by the total amount of energy losses due to declared *Force Majeure Event(s)* during that Water Supply Year.

6. Low System Supply Event

A *Low System Supply Event* is a period of one or more Water Supply Years in which the energy available is significantly less than normal due to low inflows into BC Hydro reservoirs and/or *Force Majeure Event(s).* A Low System Supply Event occurs when:

i) the Hydro System Energy Supply for the single previous Water Supply Year is at or below 83 per cent of normal (38707 GWh); or

ii) the average Hydro System Energy Supply for the three previous Water Supply Years is at or below 87 per cent of normal (40572 GWh); or

iii) the average Hydro System Energy Supply for the five previous Water Supply Years is at or below 91 per cent of normal (42438 GWh).

The "normal" period shall be the 30-year period as defined by Environment Canada.

In the event of a system spill, conditions (ii) and (iii) do not apply until three years (for ii) or five years (for iii) have elapsed since the system spill.

7. Initial Minimum Elevation

The *Initial Minimum Elevation* for Williston Reservoir is the annual minimum elevation to which BC Hydro may draft the reservoir without seeking prior approval of the Comptroller of Water Rights. The Initial Minimum Elevation is 2147 feet.

The Initial Minimum Elevation is subject to review, and will be re-considered in the five year Peace Water Use Plan Review, or such later date as appropriate as outlined in Section 1.

During the period in which the Initial Minimum Elevation is in force, the Planning Minimum Elevation will be deemed to be 2147 feet, and the Variable Minimum Elevation will be computed according to Table 2, with a Maximum Variable Minimum Elevation of 2147 feet, and an initial value of 2147 feet.

Table 2: Change in the Variable Minimum Elevation for the Year Relative to Previous Year as a Function of Hydro System Energy Supply when the Initial Minimum Elevation of 2147 Feet in Effect

Water Supply Year Hydro System Energy Supply (GWh)	Water Supply Year Hydro System Energy Supply (% Normal)	Previous Year Variable Minimum Elevation (feet)				
		2130 & below	2135	2140	2145	2147
≤ 34976	≤ 75%	-15.0	-15.0	-15.0	-15.0	-14.0
37308	80%	-15.0	-15.0	-15.0	-15.0	-14.0
39640	85%	-10.0	-7.5	-7.5	-5.0	-4.0
41972	90%	-5.0	-2.5	-2.5	0.0	0.0
46635	100%	7.5	7.5	5.0	2.5	1.5
≥ 60626	≥ 130%	15.0	15.0	10.0	5.0	3.0

Maximum Variable Minimum Elevation = 2147 feet
Planning Minimum Elevation = 2147 feet

8. Planning and Operating Minimum Elevation

Subject to Section 7, the *Planning Minimum Elevation* for Williston Reservoir is the annual minimum elevation to which BC Hydro may draft the reservoir under normal conditions. The Planning Minimum Elevation for Williston Reservoir is 2140 feet.

The *Operating Minimum Elevation* for Williston Reservoir is the governing annual minimum elevation to which BC Hydro may draft the reservoir. It is the lesser of the Planning Minimum Elevation and the Variable Minimum Elevation.

9. Variable Minimum Elevation

Subject to Section 7, the *Variable Minimum Elevation* for Williston Reservoir is the annual minimum elevation to which BC Hydro may draft the reservoir based on a formula related to the previous year's Variable Minimum Elevation and the Hydro System Energy Supply for the Water Year. The initial value of the Variable Minimum Elevation for April/May 2003, used to initialize the process for calculating the annual Variable Minimum Elevation, shall be deemed to be 2145 feet.

The Variable Minimum Elevation for a given year is determined by the Hydro System Energy Supply of the previous year. The Variable Minimum Elevation is calculated every year, regardless of whether or not a Low System Supply Event is in progress. The computation of the Variable Minimum Elevation for the year will take place in October each year, once the Hydro System Energy Supply has

been computed. The Variable Minimum Elevation for the coming year is computed using the interpolation scheme specified in Table 3.

Table 3: Change in the Variable Minimum Elevation for the Year Relative to Previous Year as a Function of Hydro System Energy Supply when the Initial Minimum Elevation is No Longer in Effect

		Previous Year Variable Minimum Elevation (feet)			
Water Supply Year Hydro System Energy Supply (GWh)	Water Supply Year Hydro System Energy Supply (% Normal)	2130 & below	2135	2140	2145
≤ 34976	≤ 75%	-12.5	-12.5	-10.0	-10.0
37308	80%	-12.5	-12.5	-10.0	-10.0
39640	85%	-10.0	-7.5	-7.5	-6.0
41972	90%	-5.0	-2.5	0.0	0.0
46635	100%	7.5	7.5	5.0	0.0
≥ 60626	≥ 130%	15.0	10.0	5.0	0.0

Maximum Variable Minimum Elevation = 2145 feet
Planning Minimum Elevation = 2140 feet

The following steps shall be used to determine the Variable Minimum Elevation (Variable Minimum Elevation) for the year:

Step 1. Locate the two rows and two columns which bound the Hydro System Energy Supply and the previous year's Variable Minimum Elevation.

Step 2. At the intersection of these rows and columns, linearly interpolate the Hydro System Energy Supply for each column to obtain two values corresponding to the change in Variable Minimum Elevation for each column.

Step 3. Linearly interpolate the previous year's Variable Minimum Elevation between the two values to determine the change in Variable Minimum Elevation for the year.

Step 4. Compute the new Variable Minimum Elevation as the Variable Minimum Elevation for the previous year plus the change in Variable Minimum Elevation for the year.

Step 5. If the resulting Variable Minimum Elevation is greater than the Maximum Variable Minimum Elevation, set the Variable Minimum Elevation to the Maximum Variable Minimum Elevation.

10. Declaration of Low System Supply and Force Majeure Events

A Low System Supply Event or Force Majeure Event, determined by BC Hydro Generation using the criteria and the calculation procedures outlined in this document, will be deemed to have occurred once it has been declared by BC Hydro. The Comptroller of Water Rights may review the declaration to ensure that the appropriate criteria and procedures have been followed.

11. Comptroller of Water Rights Approval

BC Hydro is required to obtain approval of the Comptroller of Water Rights to draw Williston Reservoir below the Initial Minimum Elevation during the period when the Initial Minimum Elevation is in force.

BC Hydro is required to obtain approval of the Comptroller of Water Rights to draw Williston Reservoir to an Operating Minimum Elevation that is lower than the Planning Minimum Elevation.

Approval by Comptroller of Water Rights will not be unreasonably withheld. To facilitate BC Hydro operations planning, a timely response to a request for approval of drawdown is necessary. For requests for approval issued during the period 1 May to 30 September, a response time of 30 business days is necessary. For requests for approval issued during the period 1 October to 30 April, a response time of 15 business days is necessary. If a response from the Comptroller of Water Rights has not been received within the aforementioned time period, BC Hydro may begin to execute an operating plan for its generating facilities assuming the approval will be granted.

12. Revision of Hydro System Energy Supply and List of Facilities

The Hydro System Energy Supply under normal conditions and the list of facilities in Table 1 shall be revised to match the Heritage Contract hydro energy supply and list of facilities whenever the Heritage Contract hydro energy supply value or list of facilities is revised. The left-most column of Table 2 and Table 3 and the energy equivalents to percent of normal in Section 6 shall also be revised to be equal to the percentage, as given in the second column from the left, of the Hydro System Energy Supply under normal water conditions. There is no requirement for a review of the terms of this document to enable these revisions to be made. The 30 year period for which the “normals” are calculated shall be revised to match the 30 year period used by Environment Canada following Environment Canada making such a change.

13. Measurement of Elevation

For the purposes of determining elevations under the Williston Variable Minimum Elevation Operating Rule, Williston Reservoir elevations shall be those recorded at the Water Survey of Canada Lost Cabin Gauge (07EF002) located at on the north arm of the Peace Reach of Williston Reservoir near the junction with the Finlay and Parsnip reaches. For the purpose of establishing

compliance with the requirements of Williston Variable Minimum Elevation Operating Rule, a quality-controlled measured value that falls within ±0.1 metres of an elevation limit shall be deemed to be in compliance with that limit.

14. Revision of Terms of this Document

A review of the Peace Water Use Plan, including the terms of this document will begin no later than four years six months following the date of the implementation of the Peace Water Use Plan. The review will involve the Peace Water Use Plan Committee and follow Steps 6 to 9 of the *Water Use Planning Guidelines*.

15. Forecast of Williston Elevations

BC Hydro will produce forecasts of projected Williston elevations based on the optimized simulation of the operation of the system. Forecasts of the Operating Minimum Elevation based on forecasts of system inflows will also be produced. Such forecasts will be issued on a monthly basis to the Comptroller of Water Rights and bona-fide interested parties. Since these forecasts may contain competitively sensitive information, they will be provided to interested parties under the proviso that each party agrees not to further distribute the information without the express written permission of BC Hydro.

Forecasts of Williston Reservoir elevations are based on BC Hydro forecasts of inflows, domestic load, markets and available generation resources. Due to the uncertainty in the inputs to these forecasts, the forecast of Williston Reservoir elevations is also subject to uncertainty.

16. Notification of Forecast Drawdowns below the Planning Minimum Elevation

In addition to the normal forecasts issued to the Comptroller of Water Rights and interested third parties, BC Hydro will bring to the specific attention of the Comptroller of Water Rights and interested parties any forecast that indicates there is greater than or equal to 50 per cent probability that Williston Reservoir may be drawn down below the Planning Minimum Elevation within the following 24 months.

BC Hydro will also bring to the specific attention of the Comptroller of Water Rights and interested parties any October calculation of the Variable Minimum Elevation that results in a Variable Minimum Elevation that is less than the Planning Minimum Elevation. The purpose of the notification is to ensure any actions required by the Comptroller of Water Rights, BC Hydro or other parties may be undertaken in a timely manner.

17. List of Interested Parties

The BC Hydro Peace Area Communications Manager will maintain a list of parties with legitimate interest in Williston Reservoir elevation levels. This list may include, but is not limited to, the following:

a. The Office of the Comptroller of Water Rights.
b. BC Hydro.
c. Ministry of Energy and Mines.
d. Crown Agency Secretariat.
e. Fisheries and Oceans Canada.
f. Ministry of Water, Land and Air Protection.
g. Canadian Forest Products Ltd.. in Mackenzie.
h. Pope & Talbot Limited in Mackenzie.
i. Abitibi-Consolidated Company of Canada in Mackenzie.
j. Canadian National Railway.
k. Williston Reservoir Contingency Planning Advisory Group.
l. Ministry of Forests.
m. BC Timber Sales.
n. District of Mackenzie.
o. Regional District(s) in the Peace/Williston area.
p. First Nations – Tsay Keh Dene, Kwadacha, McLeod Lake, Treaty 8 members.
q. Portage Mountain Yacht Club.
r. Others as determined by the Comptroller.

18. Monitoring Programs

BC Hydro will initiate monitoring programs when all three of the October, November, and December forecasts in any calendar year indicate that there is a probability of 50 per cent or more that the actual minimum elevation of Williston Reservoir in the next calendar year will be below 2150 feet.

In the event the reservoir level is drawn down below elevation 2150 feet, the monitoring programs to be conducted include:

a. Assess the social impacts on the communities adjacent to Williston Reservoir.
b. Assess impacts to the water supply systems for the pulp and paper mills at Mackenzie, the effluent systems for the mills and the District of Mackenzie, and the log supply.
c. Identify the location, size and duration of exposure of dust producing sites on the reservoir.
d. Determine the effectiveness of reservoir access sites.
e. Identify and catalogue heritage and cultural sites.
f. Assess impacts to fish and wildlife.

BC Hydro will prepare a report summarizing the results of the monitoring programs for the Comptroller of Water Rights.

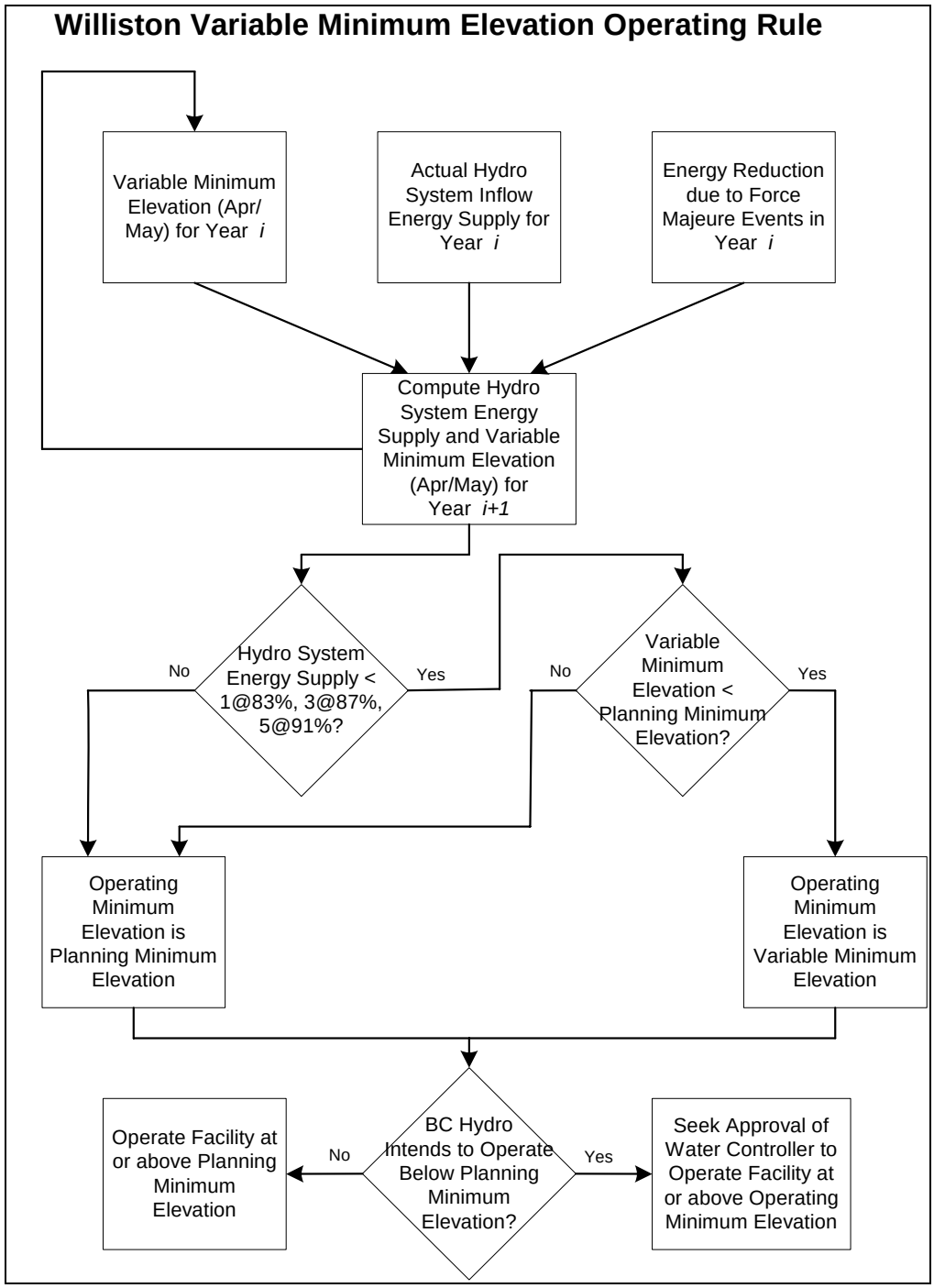

Figure 1: Flowchart for Determination of Operating Minimum Elevation

We, the undersigned, agree in principle with the Williston Variable Minimum Elevation Operating Rule dated, October 1, 2004. The Operating Rule is an appendix of the Draft Peace Water Use Plan that will be submitted to Cabinet this autumn. This is a non-binding agreement, without prejudice to the parties' rights to change their position.

Tom Lloyd

~~Les Skaalid~~, Abitibi-Consolidated Inc.
Ken Lloyd

Oct. 6/04.

Gary Rodford, BC Hydro

George Stedeford, Canadian Forest Products Ltd.

Tom Briggs

Tom Briggs, Mayor, District of Mackenzie

Bruce Bennett

Bruce Bennett, Mackenzie and Area Task Force

12-11-04

Tom Boughner, Pope & Talbot Ltd

Appendix 3

Peace Spill Protocol

Peace Water Use Plan:

Peace Spill Protocol Summary[1]

The Peace Spill Protocol formalises agency notification and identifies monitoring programs to quantify the environmental response of spill releases. The Peace Spill Protocol is designed to be implemented as discrete programs in the Peace Water Use Plan but, if amenable, may co-ordinate program components with several other management plans following approval of the Water Use Plan. Recommendations from the ten year Peace Spill Protocol monitoring components (if an event occurs) and from other management plans will be used, if appropriate, to revise future spill risk strategies and environmental audit procedures upon review of the Water Use Plan.

1.0 Peace Spill Protocol: Decision Tree

The **Peace Spill Protocol (PSP)** is grouped into four contingent tasks (Tasks 1-4) and seven associated decision criteria (A-G). BC Hydro operates the Peace Project to an adverse **Spill Risk (A)** level from year to year. Within year operations and local environmental conditions change the daily level of spill risk. **Daily Operations (1)** permit calculation of a daily **Spill Probability (B)** according to the constraints defined in

[1] The full Peace Spill Protocol is included in the Peace Water Use Plan: Committee Report (November 2003)

Criteria B. If the likelihood of spilling exceeds any of the **Spill Flag (C)** criteria, the protocol advances to the next task, **Spill Preparation (2)**, for notification and spill monitoring preparation. If a **Spill Event (3a)** subsequently occurs, depending on the spill release type (**Spill Definition: D**), the requirements of a predetermined **Conditional Monitoring (E)** are implemented. The spill, itself, is managed to dam safety requirements and, if not in conflict, any environmental constraints such as a spill **Ramping Regime (F)**. Following the spill event, the monitoring data is evaluated in a joint **Spill Audit (4)** by Ministry of Water, Land and Air Protection, Fisheries and Oceans Canada, and BC Hydro. Information from the interim audit(s) and from ongoing **Required Monitoring (E)** will be used to reassess the protocol at the end of the **Review Period (G)**.

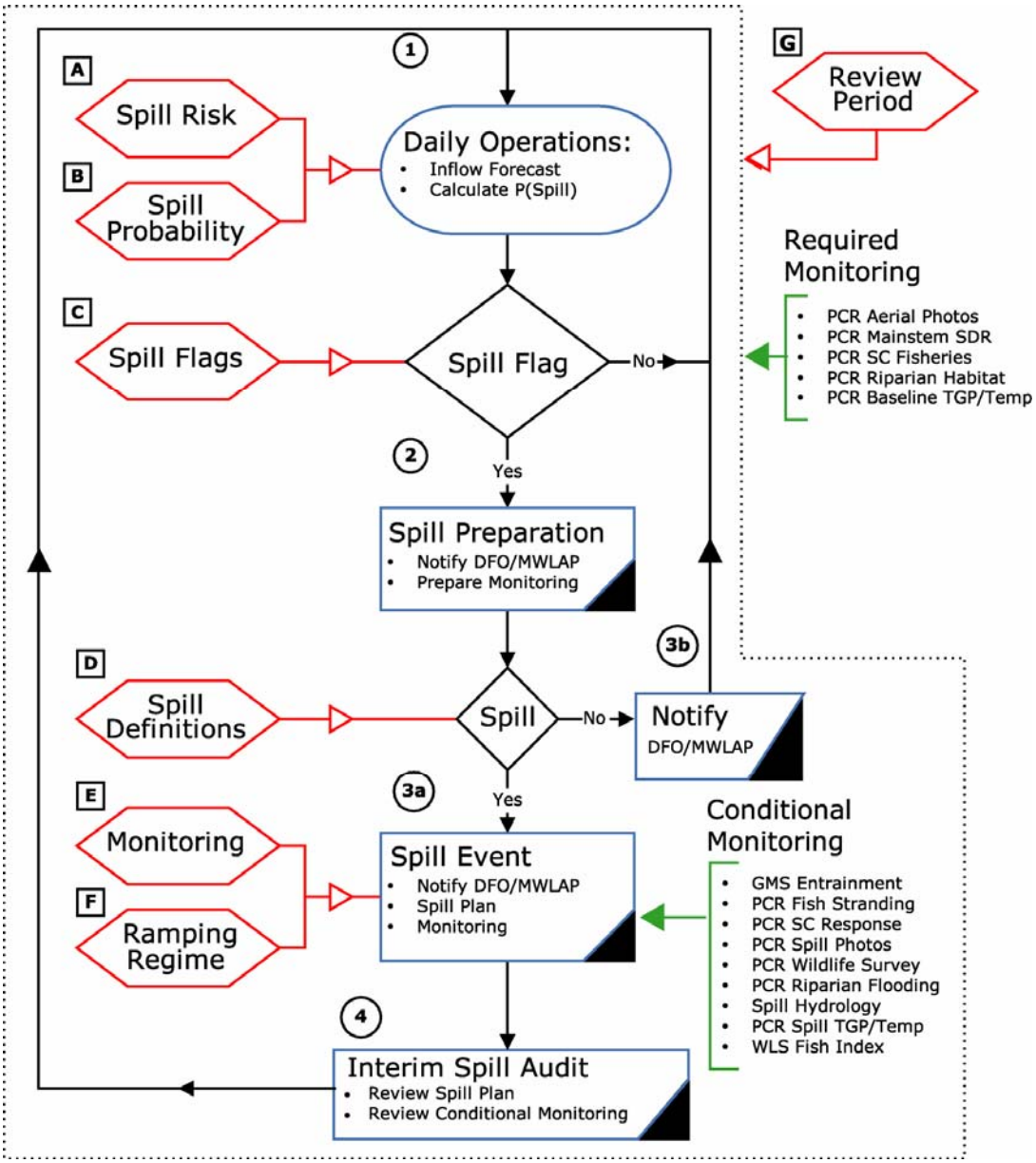

Figure 1-1 Peace Spill Protocol: Decision Tree

Protocol Criteria

(A) Spill Risk

The **Spill Risk** (Criteria A: Figure 1-1) defines the mean level of spill risk G.M. Shrum operates to, methods for calculating near future spill risk, and notification thresholds to the agencies for spilling at either G.M. Shrum or Peace Canyon. Within social, economic, and environmental constraints, decision rules regarding average annual generation demand, reservoir levels, and forecasted inflows can be combined to estimate an average level of risk spill at G.M. Shrum. This risk is defined in the Peace Spill Protocol as the Spill Risk Criteria. BC Hydro currently operates both G.M. Shrum and Peace Canyon to avoid most spills (i.e. adverse risk strategy). Within the Peace Spill Protocol, it is expected that BC Hydro manage spill risk at G.M. Shrum within the bounds determined under the Spill Risk Criteria each year.

(A) Under historical operations, BC Hydro has currently estimated the average **Spill Risk** for the Peace Project to be: $P(Spill/YR) = 15\% \pm 5\%$.

(B) Spill Probability

The Spill Risk criteria is, of course, an expected operation target. Variation in inter annual reservoir levels, snowpack conditions, seasonal inflows, and generation demands will cumulate in situations that result in changing levels of **Spill Probability** throughout the season. Spill probability is not fixed and will change both in magnitude and certainty as a function of time. Spill probability approaches zero during winter drawdown and is highest during freshet and, of course, is 100% during a spill event. For purposes of the Peace Spill Protocol, Spill Probability shall be estimated for a duration no further than two weeks in advance of the day it is calculated for either project and/or system spills at G.M. Shrum.

(B) **Spill Probability** is estimated, daily, as the risk of spill within the next 14 days for either project and/or system spills: $P(Spill \mid t < 14d)$

(C) Spill Flags

Daily calculation of spill probability is compared to three **Spill Flags.** One against a daily spill risk, the second against daily change of risk, and the third for planned spills. If any of the Spill Flags are exceeded, notification and monitoring preparation tasks are implemented:

(1) $P(Spill_{(t)}) \geq 25\%$: Probability of spill over the next 14 days exceeds 25%;

(2) $dP/dt \geq 10\%$: Daily change in spill probability has increased by +10%; OR

(3) $P(Spill_{(t14)}) = 100\ \%$: Planned spill in over the next 14 days.

(D) Spill Definition

Minimum spill requirements to invoke the monitoring phase of the Peace Spill Protocol are defined under **Spill Definition** (Criteria D: Figure 1-1). These criteria cover any spill other than short term spills associated with unit outage(s) at G.M. Shrum or Peace Canyon. If any of the following criteria are expected to be exceeded or subsequently exceeded, the conditional monitoring portions of the spill protocol will be implemented.

(1) Expected Q_{OUT} Peace Canyon $\geq$ 1982 m^3/s for 2d+;

(2) Expected Q_{SDI} G.M. Shrum > 205 m^3/s for 2d+;

(3) Expected Q_{SDI} Peace Canyon > 1500 m^3/s for 2d+; OR

(4) Expected Q_{SDI} Peace Canyon > 500 m^3/s for 7+ days.

(E) Monitoring Plan

Embedded in the Peace Spill Protocol are monitoring plans (Criteria E: Figure 1-1) to collect environmental effects information prior, during, and post spill events. The Peace Spill Protocol has both **Required** and **Conditional Monitoring** criteria. Required tasks will be implemented at the start of the program and continued, as appropriate, throughout the entire Review Period. Conditional Monitoring tasks will be implemented during spill events. The scope of Conditional Monitoring is contingent on the spill release types. If the spill release satisfies more that one definition, all the unique programs associated with each qualifying definition shall be implemented.

Table 1 Required Monitoring Components

Components listed for program, regardless of spill events.

Required Monitoring
Peace River Aerial Photos
Peace River Baseline TGP/Temp
Peace River Mainstem Stage Discharge
Peace River Riparian Habitat Assessment
Peace River Side Channel Fisheries

Table 2 Conditional Monitoring Components

Components listed for each spill type. Total project discharge (QOUT) and spill discharge (QSDI): Discharge in m^3/s. Minimum duration in days.

Q_{OUT} Peace Canyon > 2500 (2d)	Q_{OUT} Peace Canyon > 2000 (2d)	Q_{SDI} G.M. Shrum > 205 (2d)	Q_{SDI} Peace Canyon > 1500(2d) Q_{SDI} Peace Canyon > 500(7d)
Peace River Fish Stranding	Peace River Fish Stranding	G.M. Shrum Entrainment	Spill TGP/Temp
Peace River Riparian Flooding	Spill Hydrology	Spill Hydrology	
Peace River SC Response	Peace River Spill Photos	Spill TGP/Temp	
Spill Hydrology	Spill TGP/Temp	WLS Fish Index	
Peace River Spill Photos	Peace River Wildlife Survey		
Peace River Spill TGP/Temp			
Peace River Wildlife Survey			

Monitoring requirements require information collection prior to the spill, if possible, when the Peace Spill Protocol reaches Spill Preparation phase (Task 2: Figure 1-1). For example, such data includes the establishment (if not already done) of downstream TGP and temperature gauges, pre-spill aerial photos of the river implementation of the actual spill Conditional Monitoring.

(F) Spill Ramping Regime

Current constraints in BC Hydro SOO (4P-13) impose spill ramping restrictions measured as stage changes at the Water Survey Canada (07EF001) gauge at Hudson's Hope. The Ramping Regime criteria in the Peace Spill Protocol is to be implemented during any spill where total discharge from Peace Canyon (spill discharge and turbine discharge) exceeds 1982 m^3/s. These ramping criteria are presently implemented during any spill, regardless of the concurrent magnitude of combined generation, spill release, and downstream tributary contributions:

Project	Value	Unit	Duration	Note
Peace Canyon	-0.10	m/hr	Peace Canyon Spill: Q_{OUT} > 1982 m^3/s	-dQ/dt at WSC 07EF001: Hudson'sHope.
Peace Canyon	+0.15	m/hr	Peace Canyon Spill: Q_{OUT} > 1982 m^3/s	+dQ/dt at WSC 07EF001: Hudson'sHope.

(G) Review Period

The proposed review period for the Peace Water Use Plan is ten years. Recommendations from the Spill Audit Task (Task 4) for any spill event(s) during the ten year period following implementation of the WUP are to be considered at the next review. If, following a spill audit prior to the ten year review, by Ministry of Water, Land and Air Protection, Fisheries and Oceans Canada, and BC Hydro agree to change the protocol structure and/or required monitoring components, changes can be added as an addendum providing they do not increase the net cost of the Peace Spill Protocol.

2.0 Protocol Tasks

(1) Daily Operations and Weekly Forecast Information

BC Hydro monitors operation parameters (e.g. reservoir levels, generation demand, inflows) for G.M. Shrum and Peace Canyon in real time. Inflow, reservoir levels, and generation forecasts for G.M. Shrum are made weekly or as novel information becomes available. These data allow daily estimates of Spill Probability for the project to be calculated for the near future, and for system spills, further in advance phase (Task 1: Figure 1-1).

(2) Spill Preparation

Daily interpretation of near future Spill Probability shall be compared to the Spill Flags (see Criteria C: Figure 1-1). If operation forecasting suggests that the daily Spill Probability forecast at G.M. Shrum, Peace Canyon or G.M. Shrum and, Peace Canyon exceeds any of the three Spill Flags, the Peace Spill Protocol advances to the Spill Preparation phase (Task 2: Figure 1-1). There is no notification or preparedness required if daily Spill Probability does not exceed the Spill Flag threshold. If a planned project spill is scheduled, Spill Preparation should be implemented in a timely fashion prior to the spill. Lastly, if an unplanned spill occurs, the task should be initiated within 24 hours.

Within this task, Fisheries and Oceans Canada, Ministry of Water, Land and Air Protection, and affected First Nations shall be notified by the Environment and Social Issues Department of Peace River Generation in co-operation with Resource Management. Pre spill components of the Conditional Monitoring Plan shall be initiated and preparation shall be made to implement the remaining portions of the Conditional Monitoring Plan. Information supplied to Fisheries and Oceans Canada and Ministry of Water, Land and Air Protection shall be updated daily until Spill Probability fails the Spill Flag thresholds. These data should include:

- Spill Probability.
- Reservoir Level History (t = -6 months to present).
- Projected Inflow (t = 1 months) and Inflow History (t = -6 months to present);

- Spill Timing (forecast of when);
- Spill Magnitude (discharge forecast at Hudson's Hope, Taylor, and Dunvegan); and
- Spill Duration (forecast of spill length).

Within BC Hydro, appropriate measures shall be undertaken to ensure that the event components of the Conditional Monitoring Plan can be implemented in its fullest intent, should a spill event occur. Pre spill information required under the Conditional Monitoring Plan should be gathered prior to the spill if possible. Agency participation in the monitoring plan, if requested, should be co-ordinated at this time.

(3) Spill Event

A spill is defined as any water release from G.M. Shrum, Peace Canyon, or G.M. Shrum and Peace Canyon excluding turbine discharge. In practice, minimum and maximum flow/generation constraints on turbine releases, radial gate operation, and spillway channel characteristic prevent spill events less than 340 and 150 m^3/s, respectively, at G.M. Shrum and Peace Canyon. Alternatively, under flood routing conditions spills could exceed 10 000 m^3/s at G.M. Shrum and, subsequently, Peace Canyon.

If a spill event occurs, the Peace Spill Protocol advances to the Spill Event Task (3a Figure 1-1): Fisheries and Oceans Canada and Ministry of Water, Land and Air Protection will be notified upon spilling and the event component of the Conditional Monitoring Plan (Criteria B) shall be initiated. Information supplied to Fisheries and Oceans Canada and Ministry of Water, Land and Air Protection will be updated daily until the spill ends and will include:

- BC Hydro Spill Plan (Operational plan for magnitude, timing, and release rate);
- Spill Magnitude (daily and event forecast at Hudson's Hope, Taylor, and Dunvegan); and
- Spill Duration (event forecast).

Real time information collected under the Conditional Monitoring Plan will be shared freely with Fisheries and Oceans Canada and Ministry of Water, Land and Air Protection upon request during the task. Formal presentation of the information will follow in a timely fashion after the conclusion of the spill and post spill components of the Conditional Monitoring Plan. These information will be used in the following Spill Audit Task (4).

If operations and/or environmental factors cumulate in a significant decrease in spill probability, Fisheries and Oceans Canada and Ministry of Water, Land and Air Protection shall be notified that spilling is now unlikely and the Peace Spill Protocol will be reset to Daily Operations Task (1) of the Peace Spill Protocol. Real time information collected under the Spill Preparation Task (2) pre spill components of the Conditional Monitoring Plan will be shared freely with Fisheries and Oceans Canada and Ministry of Water, Land and Air Protection upon request in a timely fashion following the conclusion of the program.

(4) Spill Audit

Upon completion of the Conditional Monitoring Plan (pre, event, and post components), the information shall be disseminated to Fisheries and Oceans Canada, Ministry of Water, Land and Air Protection, and BC Hydro and jointly reviewed. Two key areas will be examined:

- BC Hydro Operations during the spill and leading up to the spill; and
- Environmental impacts associated with the spill event.

Great uncertainty currently exists with the significance of environmental effects (positive and/or negative) associated with spill events. Information from the Conditional Monitoring Plan is intended to quantify these uncertainties and put the spill event into perspective with the current BC Hydro Spill Risk Criteria. Information from the Conditional Monitoring Plan may also result in consensus (BC Hydro, Fisheries and Oceans Canada, and Ministry of Water, Land and Air Protection) changes to decision rules and/or constraint criteria used to guide future spill events under the Peace Spill Protocol.