

Peace Project Water Use Plan

Monitoring Program Terms of Reference

Peace Spill Protocol

- **GMSMON-8 Peace River Side Channel Response**

February 9, 2008

Terms of Reference for the Peace Project Water Use Plan Monitoring Programs Peace Spill Protocol

1.0 OVERVIEW

This document presents Terms of Reference for the effectiveness monitoring programs for the Peace Spill Protocol (Table 1). These programs will monitor and quantify the environmental effects of spills. Information collected through the Peace Spill Protocol will be used, if appropriate, in the revision of future spill strategies. This document provides detailed Terms of Reference for the following programs:

- 1) **GMSMON-3 Peace River Fish Stranding:** A conditional monitoring program to be implemented immediately following a spill event that will assess the magnitude of fish stranding in the Peace River.
- 2) **GMSMON-4 WAC Bennett Dam Entrainment Study:** A conditional monitoring program to be implemented for a spill event that will estimate the number of fish entrained through WAC Bennett Dam and the rate of mortality experienced by entrained fish. Formerly known as the GMS Entrainment Study. The original project title was misleading as the focus of the study is spillway entrainment and not turbine entrainment.
- 3) **GMSMON-6 Peace River Riparian Flooding:** A conditional 2-year monitoring program to be implemented in Years 9 and 10 of the Peace Project Water Use Plan should a spill event occur during the 10-period.
- 4) **GMSMON-7 Peace River Side Channel Fisheries:** A 10-year required program to provide baseline data on flow, fish use, and substrate changes in side channels as well as to assess the response of trial sites (a physical works project).
- 5) **GMSMON-8 Peace River Side Channel Response:** A conditional monitoring program to assess the response of side channels to spill events in terms of flow, fish use, and substrate.
- 6) **GMSMON-9 Peace River Spill Hydrology:** A conditional program to ensure the collection and reporting of hydrological data associated with a spill event.
- 7) **GMSMON-10 Peace River Spill Photos:** A conditional monitoring program that captures the Peace River at five different flows during a spill event.
- 8) **GMSMON-11 Peace River Spill TGP/Temp:** A conditional monitoring program that monitors TGP and temperature levels of the Peace River during a spill and two weeks following.
- 9) **GMSMON-12 Peace River Wildlife Survey:** A conditional monitoring program that assesses the impact of a spill event on ungulates, beavers, riparian birds, and toads.
- 10) **GMSMON-13 Williston Fish Index:** A study that will estimate the abundance of fish in the pelagic area of the Peace Arm of the Williston Reservoir to assist in assessing the impact of entrainment on fish populations during a spill.

Table 1 Peace Spill Protocol Monitoring Program Terms of Reference Submission Information

Name of Monitoring Program	Order Clause Fulfilled	Submitted with this Package	Previously Submitted To CWR	Ordered Submission Date
GMSMON-3 Peace River Fish Stranding	Schedule D 3(a)	Yes	No	February 2008
GMSMON-4 WAC Bennett Dam Entrainment	Schedule D 3(b)	Yes	No	February 2008
GMSMON-6 Peace River Riparian Flooding	Schedule D 3(c)	Yes	No	February 2008
GMSMON-7 Peace River Side Channel Fisheries	Schedule C 4(d)	Yes	No	August 2008
GMSMON-8 Peace River Side Channel Response	Schedule D 3(d)	Yes	No	February 2008
GMSMON-9 Peace River Spill Hydrology	Schedule D 3(e)	Yes	No	February 2008
GMSMON-10 Peace River Spill Photos	Schedule D 3(g)	Yes	No	February 2008
GMSMON-11 Peace River Spill TGP/Temp	Schedule D 3(f)	Yes	No	February 2008
GMSMON-12 Peace River Wildlife Survey	Schedule D 3(h)	Yes	No	February 2008
GMSMON-13 Williston Fish Index	Schedule D 3(i)	Yes	No	February 2008

Monitoring Program No. GSMON-8 Peace River Side Channel Response

1.0 MONITORING RATIONALE

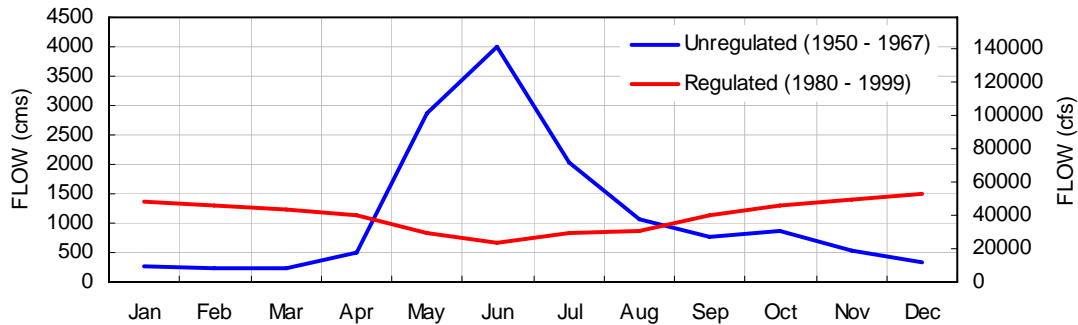
1.1 Background

Regulation of the Peace River (PCR) has resulted in changes to flow and sediment transfer (Church 2005). Changes include a reduction in the mean annual flood by a factor of three at the dam, an increase in winter flow, and reduced variability in seasonal flows (30-50%) (Figure 8-1). Normal operational flows lack the competence to move bed material; specifically, upstream of the confluence with the Pine River where no significant movement of material occurs. When investigating the impact of these changes on the morphology of the river, Church (1995) identified a reduction in channel width by abandonment of seasonally inundated channel bar surfaces and secondary channels, as well as sediment accretion. These changes to channel width are encouraged by the establishment of vegetation in active channel areas (Church 1995).

The Peace River Water Use Plan (WUP) Committee (hereafter known as the Committee) recognized that the changes in river morphology due to reduced peak flows are creating loss and continued degradation of fish habitat in side channels. Spill events are a means of changing fish habitat by scouring new channels and modifying the riverbanks. Thus, the Peace River Side Channel Response monitoring program will include monitoring of hydrology, physical properties, and fish utilization of the side channels following a spill event.

The Peace River Side Channel Response monitoring program was recommended by the Committee as one measure for assessing the effectiveness of the Peace River (PCR) Ramping Plan and the Peace Spill Protocol. The PCR Ramping Plan aims to maintain or improve downstream fisheries productivity, so this monitoring program will address the effect of a spill on fish abundance and distribution in side channels. The Peace Spill Protocol will attempt to quantify the environmental effects of a spill by collecting information through a variety of monitoring programs. This particular monitoring program will assess water flow, channel morphology and fish abundance in side channels following a spill and quantify change in side channels using baseline data collected as part of the Peace River Side Channel Fisheries monitoring program. Information gained from this program will aid future decision-making related to spill risk strategies.

Figure 8-1: Mean monthly flow pre (1950–1967) and post (1980–1995, 1998–1999) regulation of the Peace River at Hudson’s Hope: 1996 and 1997 data excluded because of sinkhole investigation spills (BC Hydro 2003).



1.2 Management Questions

The key management question(s) are:

- 1) What is the effect of a spill on the physical state of the side channels? In particular, what processes occur, what changes are evident, and are the changes beneficial to fish?
- 2) What changes occur in fish use of side channels as a result of a spill?

1.3 Detailed Hypotheses about the Ecological Impacts

The primary hypotheses¹ to be tested are:

H₁: Morphology of side channels before a spill event is different than after a spill event;

H₁: Bed-material armouring as measured by the median particle size in side channels before a spill event is different than after a spill event;

H₃: The relative abundance of fish species, age class structure, fish numbers, and species present in side channels before a spill event is different than after a spill event.

The testing of all hypotheses is dependent on the occurrence of a spill during the 10-year monitoring period. Data will be collected immediately following a spill as part of the PCR Side Channel Response. Response to spill events is expected to vary by location within a side channel so the overall change to the channel, coupled with site specific changes, should be examined. The third hypothesis of fish use may only be testable if the spill occurs in a similar sampling season as the baseline monitoring; otherwise temporal variation of fish use in side channels may be a confounding variable.

1.4 Key Water Use Decision Affected

The key water use decision affected by the results of the monitoring program is a revision of future spill strategies. Decisions regarding future spill strategies will be implemented based on this monitoring program and other studies within the Peace Spill Protocol. Ramping regimes may also be affected if this monitoring program, in

¹ For clarity, the hypotheses are stated as the alternate hypotheses. Analyses will test the null hypotheses of no effect or difference.

combination with other studies in the Peace River Ramping Plan did not improve fish productivity. These decisions have important implications for power generation and ecological values. Results of the monitoring could affect power generation as well as fish, wildlife, and vegetation downstream of the Peace Canyon Dam.

2.0 MONITORING PROGRAM PROPOSAL

2.1 Objective and Scope

The objective of this monitoring program with respect to a high flow rate in the side channels is to:

- 1) Assess the changes to channel morphology and physical dimensions of the side channels;
- 2) Assess the textural changes to the bed;
- 3) Determine abundance and distribution of fish species, and relative importance of fish species life stage use within side channels;
- 4) Assess changes relative to pre-spill conditions in the side channels.

This monitoring program will characterize the side channels of the Peace River in terms of morphology and fish presence and distribution following a spill event. Changes to the side channels will be quantified by comparing this data to baseline data collected as part of the PCR Side Channel Fisheries monitoring program. As part of the investigation, inferences on the impacts (positive and negative) to fish populations should be made where possible using both the fish survey data and observed changes in the physical state. Field and office methodologies will be consistent with those established in the PCR Side Channel Fisheries monitoring program.

The study area includes the Peace River from Peace Canyon Dam to the confluence with the Pine River. Study sites will be the same, two trial (habitat manipulation) side channels and two control side channels, as those monitored in the PCR Side Channel Fisheries program. Implementation of this monitoring program is conditional on a spill event occurring where total discharge (Q_{out}) from Peace Canyon Dam exceeds 88287 cfs (2500 cms) for two or more days. It will be implemented following each spill that meets this criterion during the 10-year study period.

2.2 Approach

Monitoring of the study sites will take place immediately (i.e., within a month) following a spill that meets the spill criterion. Monitoring will include cross-section surveys, an assessment of bed-texture change (substrate armouring), and a survey of fish abundance and distribution. Statistical comparisons will test for significant differences in data collected following a spill and baseline data collected as part of PCR Side Channel Fisheries monitoring program.

2.3 Methods

Methodology will follow the methods established for the PCR Side Channel Fisheries monitoring program to facilitate sound statistical comparisons. Photo documentation of field activities and the side channel will be required at photopoints established in PCR Side Channel Fisheries monitoring program.

2.3.1 Task 1: Project Coordination

Project coordination will involve the general administrative and technical oversight of the monitoring program. This task will include but not be limited to: 1) budget management, 2) study team management, 3) logistic coordination, 4) technical oversight of field and analysis components, and 5) facilitation of data transfer among other investigators associated with the Peace River Ramping Plan and the Peace Spill Protocol. Specifically, project coordination between PCR Side Channel Fisheries and PCR Side Channel Response is necessary to assess the response of the side channels to a spill.

2.3.2 Task 2: Survey Cross-Section Sites

The post-spill survey will include a re-survey of cross-section sites selected in PCR Side Channel Fisheries monitoring program. These sites will be identifiable by the presence of physical markers and will be georeferenced. Methodology will be consistent with PCR Side Channel Fisheries monitoring program. Surveys will consist of both channel and bank surveys. Cross-sectional surveys are intended to measure bank and channel erosion and channel deposition and therefore will include sufficient detail to measure changes to the cross-section.

2.3.3 Task 3: Survey of Substrate Texture

Bed texture changes will be assessed through a series of surface substrate measurements. Surface substrate will be assessed along transects using a Wolman pebble count (Wolman 1954) or equivalent sampling method. Number and location of transects will be the same as location those used in PCR Side Channel Fisheries monitoring program.

2.3.4 Task 4: Fish Survey

The fish survey will focus on young-of-the-year and juveniles of large fish species as well as small fish species. Estimates of the following will be determined for each side channel post-spill:

- Relative abundance
- Spatial distribution
- Size distribution

The data required to provide these estimates will be collected at the same sites as those monitored in PCR Side Channel Fisheries monitoring program. Biological information to be collected from captured fish includes, but is not limited to:

- Species
- Sex (if possible)
- Fork length
- Weight

Methodologies established as part of PCR Side Channel Fisheries monitoring program will be followed to acquire the biological and physical information. Consistent protocols relating to capture methods and sampling design between this monitoring program and PCR Side Channel Fisheries will facilitate sound statistical comparisons. Information on the sampling protocol will be analyzed and/or stored for future reference. Special note should be made of captured fish with marks or tags

and the information distributed to the project coordinator of relevant mark-recapture programs.

The following information will be collected to provide an indication of the reliability of the catch data:

- Date and time
- Crew and skill level
- Capture method and equipment specifications
- Effort

Physical measurement of the study area during the study period will be taken to determine sampling conditions. Data will be analyzed and stored for future reference. Sampling conditions may provide insight into potential bias and variability, introduced by environmental changes, in estimates of abundance and distribution. Parameters to be measured include but are not limited to:

- Water clarity
- Water temperature
- Water velocity
- Water depth
- Light intensity
- Habitat characteristics of sampling sites (i.e., % cover, substrate composition, habitat description: glide, pool, riffle)
- Recent flow variation (i.e., is sampling occurring during a falling or rising stage)

2.3.5 Task 8: Data Entry

The proponent will enter, check and store all data collected during the study into a Microsoft Access database. The database will be compatible, and should contain the same fields, with the PCR Side Channel Fisheries Monitoring Program's database.

2.3.6 Task 9: Analysis

The proponent will enter, check and store all data collected during the study into a Microsoft Access database. Analyses will be performed in the context of the hypotheses and include but are not limited to:

- a) assess the vertical and lateral stability of the cross-sections (e.g., aggradation, degradation, narrowing, widening);
- b) estimation of bed-texture changes of side channels;
- c) estimation of relative fish (juveniles and small fish species) abundance (catch rate such as fish/m² for each species based on habitat type) in side channels;
- d) estimation of fish (juveniles and small fish species) spatial distribution in side channels;
- e) estimation of standard life history summaries including length-frequency distribution, length-weight relationship of fish (juveniles and small fish species) in side channels;
- f) regression curves to compare condition of fish approximately the same length
- g) *Section 2.3.8 (a-e)* comparison of data collected in this program with data collected from Peace River Side Channel Fisheries monitoring program;

Analysis of variance or other suitable statistical testing will be used to test for differences in baseline conditions to conditions immediately after a spill.

2.3.7 Task 10: Reporting

A report will be compiled which will include:

- a) an executive summary of the project;
- b) field methods, including maps indicating study site locations and photographs showing equipment setup and channel characteristics;
- c) analytical methods and assumptions;
- d) environmental data collected, presented in tabular and graphical form;
- e) estimates of side channel morphology and surface substrate distribution;
- f) estimates of fish abundance, spatial distribution, age/size distribution, as well as any other notable observations;
- g) an assessment of the findings as they relate to the management question and hypotheses;
- h) discussion of impacts (positive and negative) of spill to fish populations in side channels inferred using both the fish survey data and observed changes in the physical state
- i) summary of data gaps and recommendations for improving the program as a monitoring tool.

A report will be provided in hard-copy and as Microsoft Word and Adobe Acrobat (*.pdf) format. The required maps and figures will included as embedded objects in the report. All maps and figures will also be provided in their native format as separate files. Raw data will be submitted in a Microsoft Access database. All photos will be submitted electronically.

2.4 Interpretation of Monitoring Program Results

The key result of the monitoring is to describe the impact of a spill event on side channels. Results will need to be interpreted in the context of the results from the PCR Side Channel Fisheries monitoring program as this program will have a larger dataset that describes pre- and post-spill conditions of side channels (10 years) and thus provides a context and baseline for assessing the magnitude of the changes measured during this project. If results indicate a negative impact to fish or fish habitat, then review of spill strategies may be required to mitigate the negative impacts on fish populations in the Peace River.

2.5 Schedule

Monitoring is to be completed within one month of a spill event. Implementation of the program is conditional on the occurrence of a spill event where $Q_{out} > 88,287$ cfs (or 2500 cms) for two days or longer. The monitoring program is to be implemented after each spill in the 10-year study period that meets the spill criterion.

2.6 Budget

The estimated cost per spill event for the monitoring program is \$53,034. Table 8-1 summarizes the budget estimated in 2007 dollars.

Table 8-1: Estimated costs for the Peace River Side Channel Response

Sub-total		\$44,850
Inflation	2%	\$5,658
Contingency	5%	\$2,525
Total		\$53,034

2.7 References

- Ayles, C.P. 2001. Regulation-induced channel gradation in the Peace River. University of British Columbia. M.Sc Thesis December 2001.
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