

Peace River Water Use Plan

Monitoring Program Terms of Reference

- **GMSMON-2 Fish Index**

March 28, 2008

Terms of Reference for the Peace River Water Use Plan Monitoring Program: Fish Index

1.0 Monitoring Rationale

1.1 Background

The Peace Water Use Plan (WUP) Committee (hereafter known as the Committee) expressed concern about the status of fish habitat and fish productivity in the Peace River system. The Fish Index will evaluate the effectiveness of Peace River management plans, designed to improve fish habitat and productivity, by monitoring target fish populations to assess population abundance, distribution, and growth. These management plans include primarily the Peace River (PCR) Side Channel Plan and the PCR Ramping Plan, and secondarily, PCR Flood Pulse Plan.

The purpose of the PCR Side Channels Plan is to improve fisheries habitat downstream of the Peace Canyon Dam. This Peace River Fish Index program will monitor fish populations for changes (e.g., abundance, growth) that infer a positive response to habitat enhancement. An interim review in Year 5 of the PCR Side Channels Plan will determine if enhancement through physical works was a sufficient means of improving habitat, or if an alternative minimum base flow regime is required.

The PCR Ramping Plan is designed to maintain or improve fisheries productivity by investigating the impact of ramping at Peace Canyon Dam on downstream flows. The results of this work will in turn lead to exploration of other flow ramping regime options, and assess other potential flow-change programs. Results of the monitoring program will be used to evaluate the extent of the benefits of this management plan in terms of increased fish abundance due to channel contouring and/or increased base flow.

The PCR Flood Pulse Plan was developed in response to a perceived need for a periodic flushing flow to clear potential spawning habitat of fine sediments. Results of the monitoring program will be used to determine if a measurable impact on Peace River fish populations would occur as a result of expected habitat change from pulse flow regimes.

A fish community indexing program has been in place along a 92 km stretch of the Peace River since 2001 (Mainstream Aquatics Ltd. 2007) as part of the Large River Fish Indexing Program. BC Hydro initiated the Large River Fish Indexing Program to help define the effects of dam and reservoir operations on fish populations in flow regulated watersheds and to ensure operations are both environmentally and economically sustainable (Mainstream Aquatics Ltd. 2007). The fish community indexing program for the Peace will be integrated into the Peace Water Use Plan. Up to the present, mark-recapture has been used to estimate population size of the target species – mountain whitefish, bull trout, and Arctic grayling. Low abundance of the latter two species has impeded adequate data collection resulting in imprecise estimates of their respective population sizes. Biological characteristics, such as spatial distribution, age distribution and growth, of all three species on the Peace

River have also been documented through this program. However, uncertainty remains in the causal mechanisms for annual changes in the biological characteristics (i.e., growth) that have been observed in the populations. The WUP Fish Index study will build upon this previous research to reduce these uncertainties in the data and to ensure a continuous time series that will facilitate in detecting trends in the populations.

1.2 Management Questions

The key management question(s) is:

- 1) What is the population response of fish in the Peace River following the addition/modification of in-stream physical works or the implementation of an alternative minimum discharge regime?

1.3 Detailed Hypotheses about the Ecological Impacts

The primary hypotheses¹ to be tested are related to the abundance, distribution, body condition, and growth rates of target fish species observed in the fish indexing surveys. For each of the target fish species the following hypotheses will be tested:

H: Abundance, spatial distribution, body condition, and growth rates (length-at-age) of target fish populations in the Peace River are changing over time

It is expected that improvements in habitat would lead to more abundant populations, improved growth and body condition, and potential changes with regard to spatial distribution. Explanatory factors relating to physical works or operational change should be examined to account for the outcome of hypothesis testing. Approximately 10 years of fish indexing data will be available to provide information on the status of the fish populations in the river pre- enhancement of side channel (side channel enhancement is expected to be complete by Year 3 of 10-year PCR Side Channels Plan study period).

1.4 Key Water Use Decision Affected

The key water use decision affected by the results of the monitoring program is a potential change in the current minimum base discharge. This may occur after Year 5 of the PCR Side Channels Plan if the results of this study, in combination with other effectiveness monitoring studies, indicate that physical works are ineffective at improving fish habitat. Ramping regimes may also be affected if this monitoring program, in combination with other studies, indicates the projects within Peace River Ramping Plan are ineffective in improving fish productivity. In addition, management of flood pulse events could be affected if monitoring results of the fish index study, in combination with other monitoring studies conclude the Peace River Flood Pulse Plan is ineffective in improving fish productivity. The decision to alter the minimum base discharge has important implications for power generation and ecological values.

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

2.0 Monitoring Program Proposal

2.1 Objective and Scope

The objective of the monitoring program is to address the management questions identified in Section 1.2 by collecting the data necessary to draw inferences and to test the hypothesis outlined in Section 1.3. Additionally, the monitoring program will:

- 1) Collect a time series of data on the abundance, spatial distribution, and biological characteristics of nearshore and shallow water fish populations in the Peace River that will build upon previously collected data by Peace River fish community indexing program
- 2) Build upon earlier investigations for further refinement of the sampling strategy, sampling methodology, and analytical procedures required to establish a long-term monitoring program for fish populations
- 3) Identify gaps in understanding/data in current knowledge about fish populations and procedures for sampling them

The study area is the stretch of the Peace River from the Peace Canyon Dam to the confluence with the Pine River. Stratification of the study area should be reasonably consistent with stratified areas defined in the Peace River fish community indexing program (Table 2-1; P&E 2002; Mainstream Aquatics 2007). Monitoring will occur annually over 10 years. The target species of this fish indexing study include: mountain whitefish, bull trout, and Arctic grayling. Mountain whitefish and Arctic grayling are suitable species for monitoring as both are readily captured in nearshore areas and the abundance of the populations differ. Bull trout can also be captured in nearshore areas and its low abundance in the Peace River system is a conservation concern.

Table 2-1: Locations of sections used in the Peace River fish community indexing program. Note that these are approximate locations of the sections; location has varied slightly between years

Area	Section	Location*	Section Length (km)
Upstream of Halfway R.	1	Km 137.0 to 145.2	8.2
Upstream of Halfway R.	2	Km 119.7 to 125.2	5.5
Downstream of Halfway R.	3	Km 89.8 to 99.2	9.4
Downstream of Halfway R.	4	Km 70.3 to 83.9	13.9
Downstream of the Moberly R.	5	Km 53.4 to 64.8	7.8

*Based on distance upstream of BC/AB boundary (Km 0)

2.2 Approach

The general approach to this monitoring program is to collect a time series of data using consistent methodology over time in order to document relative changes and trends in the populations of the target fish species. As such, this study will largely follow the design and protocol that has been refined during the years of the Peace River fish community indexing program. A mark-recapture study will be employed using a boat electrofisher on the Peace River to obtain information on the characteristics of the fish community. Adjustments to design and protocol are based on the monitoring needs of the Peace Water Use Plan and recommendations of the

Peace River fish community indexing program. The outcome will ideally be a continuous time series of data dating back to 2001, the first year of the Peace River fish community indexing program.

The data collected as part of the field sampling program will be analyzed to provide estimates of biological characteristics (size and age distribution, growth rate, and body condition), spatial distribution, and abundance of the target species. Inferences about changes in the biological response of the target species will be made in relation to alterations (e.g., addition of physical works, change in minimum base flow) in the Peace River system.

2.3 Methods

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 Side Channels Plan, the Peace River Ramping Plan, and the Peace River Flood Pulse Plan.

2.3.2 Task 2: Selection of Study Sections and Sites

The sampling program will occur in 2–4 of the pre-defined sections (e.g., Table 1) of the Peace River to ensure that a representative sample of all target species is obtained. Sections should represent a continuum of habitat conditions, such that discrete sites (~14–20) selected for sampling within each section can be stratified by habitat (Mainstream Aquatics 2007). Sections 1, 2, and 3 are expected to be the most suitable for monitoring as these sections will most closely correspond to other WUP projects and monitoring sites. In addition, control sites will be selected from adjacent locations to the study sections as described in Mainstream Aquatics (2007).

2.3.3 Task 3: Field Sampling Program

The field sampling program will be consistent with design and protocol established during the Peace River fish community indexing program such that the following estimates for each target species can be obtained annually for the study area:

- Relative abundance
- Population estimate
- Spatial distribution
- Size distribution
- Age distribution
- Growth rate
- Body condition

The data required to provide these estimates will be collected over a series of repeated sampling sessions (~4–7). Sampling sessions will consist of collecting biological data for all fish species captured, as well as mark and recapture of target species. A waiting period of an appropriate number of days should occur between

sampling sessions. A summary of the sampling protocol is described below; see Mainstream Aquatics (2007) for a detailed description.

As part of a mark-recapture program, fish will be captured by boat electrofishing in nearshore and shallow water areas of the sites. Those fish belonging to the target species will be tagged with an individually-coded tag, as well as, a secondary tag (i.e., adipose clip) to identify tagged fish and estimate tag loss. Enumeration and identification of non-target species captured will be recorded. Sampling strategies should strive to avoid bias in the sample by not targeting specific species or size of fish.

Sampling Protocol Information

Information on the sampling protocol will be analyzed and/or stored for future reference. The following information will be collected to provide an indication of the reliability of the catch data:

- Date and time
- Sample method settings
- Effort (seconds/metres)
- Netter skill
- Observer skill

Physical Measurements of the Environment

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

- Water clarity
- Water levels (continuous measurements during study period)
- Water quality
- Water conductivity
- Water temperature (continuous measurements during study period)
- Light intensity
- Habitat characteristics of sampling sites (e.g., habitat category, type of physical cover, substrate type, water velocity, bank slope)
- Recent flow variation

Biological Information

Biological information to be collected from captured fish of the target species includes but is not limited to:

- Species
- Sex
- Fork length
- Weight
- Ageing structure

In the event of large numbers of fish captured, a random sub-sample will be selected for the ageing analysis.

2.3.4 Task 4: Data Entry and Analysis

The proponent will enter, check and store all data collected during the index study into a pre-existing Microsoft Access database developed during the Peace River fish community indexing program. Analysis will include species percent composition, catch per unit effort, length frequency, age frequency, growth rate, survival, age-cohort analysis, age-structured model (i.e., age-structured mark recapture analysis), and population abundance estimation techniques to discern trends in index species populations. The data will be compared, where appropriate, to data collected during previous study years dating to 2001. Methodology for the analysis is described in Mainstream Aquatics Ltd. (2007) and Golder Associates Ltd. (2008). Data collected as part of other monitoring studies (e.g., PCR Creel Survey, PCR Baseline TGP/Temp, and PCR Productivity) in the Peace WUP should be incorporated into analyses/discussion, when appropriate, to assist in explaining observations and trends. Consideration during the analysis will be given to confounding factors, sampling conditions, biases in methodology, and sampling effects that may affect results of the study.

2.3.5 Task 5: Reporting

Each year, a data report will be prepared outlining the following:

- a) an executive summary of the annual report;
- b) field methods, including mapping of assessment sites;
- c) analytical methods, model description, and assumptions used to estimate biological characteristics, catch rate, and population abundance;
- d) environmental data collected, presented in tabular and graphical form;
- e) estimates of abundance, spatial distribution, age and size distribution, growth rate, body condition, as well as any other notable observations;
- f) trends or changes occurring in the target populations over time;
- g) an assessment of the findings as they relate to the management question and hypotheses;
- h) summary of data gaps and recommendations for improving the program as a monitoring tool.

After the 10th year of monitoring, a final completion report will be prepared.

All reports will follow the standard format that is being developed for WUP monitoring programs. This includes providing a version of the report in Microsoft Word and Adobe Acrobat (*.pdf) and all maps and figures in their native format either as embedded objects in the Word file or as separate files. Raw data will be submitted in a Microsoft Access database. All photos will be submitted electronically.

2.3.6 Task 6: Large Rivers Workshop

The contractor will attend the annual Large Rivers Workshop to present and discuss results of the field season and overall trends of the monitoring program.

2.4 Interpretation of Monitoring Program Results

Monitoring results will be used to assist in determining the success of the Peace River Side Channels Plan, the Peace River Ramping Plan, and the Peace River Flood Pulse Plan in improving fish productivity and fish habitat. The measured biological responses (e.g., abundance, growth) of target populations over the study period will enable inferences to be made on the effect of changes to facility operations and/or physical works to the Peace River system.

2.5 Schedule

Monitoring is scheduled to occur annually in August and September over the 10-year study period.

2.6 Budget

The estimated total cost for the monitoring program is \$2,173,041. Table 2-2 summarizes the budget estimated in 2007 dollars.

Table 2-2 Estimated costs for the Fish Index monitoring program

Sub-total		\$1,853,000
Inflation	2%	\$216,563
Contingency	5%	\$103,478
Total		\$2,173,041

2.7 References

Golder Associates Ltd. 2008. Large River Fish Indexing Program - Lower Columbia River 2007 Phase 7 Investigations. Report prepared for BC Hydro, Burnaby, B.C. Golder Report No. 07-1480-0067D: 71 p. + 6 app

Mainstream Aquatics Ltd. and W.J. Gazey Research. 2007. Peace River Fish Community Indexing Program- Phase 6 Studies. Prepared for BC Hydro. Report No. 06011F: 116 p.+ appendices.