

Peace Project Water Use Plan

Monitoring Program Terms of Reference

Peace Spill Protocol

- **GMSMON-13 Williston Fish Index**

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 GMSMON-13 Williston Reservoir Fish Index

1.0 MANAGEMENT STUDY RATIONALE

1.1 Background

The Williston Reservoir (WLL) Fish Index study recommended by the Peace Water Use Plan Committee (hereafter known as the Committee) addresses two management plans, the Peace Spill Protocol (PSP) and the Peace River Flood Pulse Plan. The PSP and the Peace River Flood Pulse Plan were developed by the Committee to assess the impacts of flood pulse events and/or spills through a combination of studies.

The PSP attempts to quantify the environmental effects of a spill. Together with the WAC Bennett Dam Entrainment study, the WLL Fish Index will establish the relative magnitude of the negative impact of the spill on reservoir fish populations. The WLL Reservoir Fish Index study will estimate fish abundance and distribution in the Peace Arm of the reservoir. This study complements the WAC Bennett Dam Entrainment study which will estimate the number of fish from the reservoir entrained through the spillway. Information gained from these PSP studies will aid future decision-making related to spill risk strategies.

The Peace River Flood Pulse Plan was developed to improve downstream 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 (PCN) Dam. As part of the PCR Flood Pulse Plan, the results from WLL Fish Index, in combination with WAC Bennett Dam Entrainment study, may act as a weighting against the ecological merits of flood pulses.

Previous investigations on fish abundance and distribution in the Williston Reservoir occurred in 1974-75 (Barrett and Halsey 1985), 1988 (Johnson and Yesaki 1989; Blackman 1992), and 2000 (Phillipow and Langston 2002; Sebastian et al. 2003) using a combination of hydroacoustic, trawl, and gillnet surveys. However, differences in study objectives have not been conducive for comparing results of these studies. The most recent (2000) hydroacoustic, trawl, and gill net survey provides baseline information on the species composition, spatial distribution, and abundance of fish in pelagic habitat of the reservoir. Insufficient bathymetric information resulted in highly uncertain estimates of reservoir area and consequently precision of fish abundance estimate was poor. Additionally, equipment availability limited the ability to sample near-surface habitat potentially biasing results. The Williston Fish Index will attempt to improve upon the 2000 study through the use of improved bathymetric data (Williston Reservoir Bathymetry project implementation beginning in Year 1) and address problems encountered in sampling.

1.2 Management Questions

The key management question is:

- 1) What is the species composition, abundance, and spatial distribution of fish in the Peace Arm of the Williston Reservoir?

1.3 Detailed Hypotheses about the Ecological Impacts

No specific hypotheses will be tested as part of this study.

1.4 Key Water Use Decision Affected

The key water use decisions affected by the results of the study are the revision of future spill strategies, and the necessity of flood pulse events to maintain side channel and riparian habitat. Results of the study could affect power generation as well as fish, wildlife, and vegetation downstream of the Peace Canyon Dam.

2.0 MANAGEMENT STUDY PROPOSAL

2.1 Objective and Scope

The objectives of the management study include:

- 1) Determine species composition, abundance, and biomass of fish in the pelagic zone of the Peace Arm of the Williston Reservoir;
- 2) Determine the spatial distribution fish in the pelagic zone of the Peace Arm of the Williston Reservoir;
- 3) Assess age and size distribution of fish species in the pelagic zone of the Peace Arm of the Williston Reservoir.

The objective of the study is to collect data on the composition, abundance, and spatial distribution of fish species. Implementation of this study was recommended by the Committee to be conditional on the occurrence of a spill, such that the fish survey would commence following a spill. However, a more appropriate design evolved during the development of these terms of reference that would provide better information on the impact of a spill on reservoir fish. Thus, the focus of this study has been modified to collect one year of baseline information on the fish populations under normal operating conditions at the dam instead of completing a survey of fish populations under post-spill conditions. A baseline survey conducted at an optimal period for sampling will provide a best estimate of the total number of reservoir fish and their spatial and size distribution under normal operating conditions. As this survey is a one-time event, the major assumption is that interannual variability of these estimates is not extremely large. The impact of the spill to reservoir fish may then be assessed based on the results of this study in combination with WAC Bennett Dam Entrainment study which estimates the number of fish entrained through the spillway.

The study area is limited to the Peace Arm of the Williston Reservoir as the populations in this area are expected to incur the greatest impact of a spill. Additionally, the survey will be limited to the pelagic zone of the Peace Arm where pelagic is defined as open waters where water is ≥ 20 meters deep at the time of survey. Nearshore habitat, which is <20 meters deep will be excluded from the study. The study will be conducted in August, as this has been identified as an optimal time of year by previous assessments (Sebastian et al. 2003) to estimate fish abundance.

2.2 Approach

Assessment of the fish population in the Peace Arm will be based on a hydroacoustic survey supplemented by a trawl net survey and surface gill net survey. The net surveys will provide species verification for the hydroacoustic survey, as well as

population age and size structure data. The data collected as part of the field sampling program will be analyzed to provide estimates of various population characteristics (growth and age distribution), spatial distribution, and abundance of pelagic species. Inferences about impacts of a spill on reservoir fish species will be made in conjunction with the WAC Bennett Dam Entrainment study.

2.3 Methods

2.3.1 Task 1: Project Coordination

Project coordination will involve the general administrative and technical oversight of the study. 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 Williston Management Plans, Peace Spill Protocol and the Peace River Flood Pulse Plan.

2.3.2 Task 2: Data Collection

A stratified systematic transect design or similar statistically sound methodology will be used to conduct the hydroacoustic assessment and net surveys. A previous hydroacoustic survey divided the Peace Arm into upper and lower sections based on morphometry of reservoir and fish density, as well as habitat stratification by depth layers (e.g., five meter layers) (Sebastian et al. 2003). This previous hydroacoustic assessment may assist in determining allocation of effort within strata. Additionally, maps developed as part of the Williston Bathymetric Mapping implementation project will assist in the selection of transect locations (i.e., in waters ≥ 20 meters depth). Transects will be surveyed at night using hydroacoustic equipment and trawling. Replicate trawls are required. Information on the acoustic and trawl sampling for a given transect should include but not be limited to:

- Transect number
- Transect location (GPS coordinates)
- Transect length
- Acoustic specifications
- Trawl speed
- Net size specifications
- Net depth
- Vertical temperature profile
- Reservoir level

Gill net stations (minimum of four) will be set up in close proximity to hydroacoustic survey transects. Gill nets will be set near the surface where trawl nets cannot capture fish (Phillipow and Langston 2002). The number and location of gill net stations is at the discretion of the researcher and subject to the available budget. However, a clear rationale for the determination of the exact number and location is expected. Data gathered relating to gill net sampling will include but not be limited to:

- Station number
- Net location (GPS coordinates)
- Net size specifications (mesh size, panel length, depth, etc.)
- Net depth
- Soaking time

Biological information collected from each mid-water trawl or net set should include but not be limited to:

- Species composition
- Species count
- Sex
- Maturity
- Length
- Weight
- Ageing structure

Methodologies for biological sampling will follow RIC standards (1997). Both scale and otolith samples are recommended for ageing of captured sportfish (i.e., whitefish, bull trout, rainbow trout, and kokanee). In the case of large numbers of a given fish species captured, a random sub-sample will be selected for the ageing analysis. Analysis of two ageing structures is a useful verification process. Technique used for otolith ageing analysis will depend on the expected age of the fish (i.e., older lake whitefish may require more specialized analysis).

August has been identified as a favourable time of year to survey as the occurrence of maximum pool level, good weather, medium length nights, and thermal stratification of the reservoir optimize sampling (Sebastian 2003).

2.3.3 Task 3: Data Entry and Analysis

All data will be entered into a Microsoft Access database. Trawl data will be linked geographically with acoustic data such that catch composition data will be applied to the acoustic data from the same transect and layer where possible. Where no trawl data is available for acoustic sampling units then extrapolation will be necessary based on information such as the closest possible catch data, either from the same depth layer within the region, or the mean of that layer within the remainder of the study area.

Analyses will include but are not limited to providing estimates of:

- Summary of environmental data (e.g., vertical temperature profiles)
- Summary statistics of catch including morphometric data (e.g., length and age frequency distributions) and length-at-age of sportfish species
- Spatial distribution of fish (i.e., fish/ha vertically and horizontally)
- Density (fish/ha) of individual species and size (abundance, biomass) of total fish population with a measure of precision

Analyses are described in Sebastian et al. (2000, 2003). Accuracy of the abundance/biomass estimates will be dependent on accuracy of area estimates. Reservoir area at depth will be determined via bathymetric maps (available through WLL Bathymetric Mapping).

2.3.4 Task 5: Reporting

A report will be compiled which will include:

- a) an executive summary of the project;
- b) field methods, including a description of equipment and sampling conditions, map of sampling sites, and photographs;
- c) compilation of biological and environmental data collected, presented in tabular and graphical form;
- d) description of results as well as the analytical methods, known biases, and assumptions used;
- e) an assessment of the findings as they relate to the management questions and hypotheses;
- f) any recommendations towards improving future fish indexing.

A report will be provided in hard-copy and as Microsoft Word and Adobe Acrobat (*.pdf) format. The required maps and figures will be 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 Management Study Results

The key result of the study will be an index of the fish population in the Peace Arm in terms of population abundance, age, growth, and spatial distribution. If a spill occurs, then the information will be used primarily in combination with the WAC Bennett Dam Entrainment study and other programs within the Peace Spill Protocol to assess the relative impact of a spill on the fish population in Williston Reservoir due to entrainment. If, together, the results of the WLL Fish Index and WAC Bennett Dam Entrainment study, indicate that the relative impact of fish loss in the reservoir due to entrainment is large then a review of spill strategies will assist in identifying mitigation measures. Additionally, a large relative impact occurs this may discount the feasibility of flood pulse events of certain magnitudes.

2.5 Schedule

This study is a one-time event and is scheduled to occur in the month of August of Year 1.

2.6 Budget

The estimated overall cost for the study is \$110,613. Based on the Peace WUP, the study is a one-time event during the 10-year study period. Table 21-1 summarizes the budget estimated in 2007 dollars.

Table 21-1: Estimated budget for the Williston Fish Index

Sub-total		\$103,280
Inflation	2%	\$2,066
Contingency	5%	\$5,267
Total		\$110,613

2.7 References

Barrett, D.T., and T.G. Halsey. 1985. Fisheries resources and fisheries potential of Williston Reservoir and its tributary streams. Vol.1 Fisheries resources and fisheries potential of Williston Reservoir. Fisheries Tech. Circular 68, Ministry of Environment.

BC Hydro. 2003. Consultative Committee Report: Peace River Water Use Plan. Prepared by the Peace River water use plan consultative committee.

Blackman, B.G. 1992. Fisheries resources of Williston Reservoir twenty years after impoundment. B.C. Environment Fisheries Branch and B.C. Hydro Environmental Resources.

Johnson R.L. and I. Yesaki. 1989. Hydroacoustic surveys of Williston Reservoir (June, September, and October, 1988). Peace/Williston Fish and Wildlife Compensation Program, Report No. 57. 35pp plus appendices.

Pillipow, R.A. and A.R. Langston. 2002. Williston Reservoir fish assessments 2000, pelagic netting summary. Peace/Williston Fish and Willife Compensation Program, Report No. 261. 12pp plus appendices.

Resources Inventory Committee. 1997. Fish collection methods and standards. Version 4. <http://ilmbwww.gov.bc.ca/risc/pubs/aquatic/index.htm>

Sebastian, D.C., G. Scholten, L. Brescia. 2000. Arrow Reservoir fish summary.

Sebastian, D.C., G.H. Scholten and P.E. Woodruff. 2003. Williston Reservoir fish assessment: results of hydroacoustic, trawl and gill net surveys in August 2000. Peace/Williston Fish and Wildlife Compensation Program Report N. 274. 34pp. plus appendices.

Stockner, J.G. and A.R. Langston. 2000. The limnology of Williston Reservoir: results from the 1999 monitoring program. Peace/Williston Fish and Wildlife Compensation Program Report No. 214. 19p. plus appendices.