

Peace River Water Use Plan

Monitoring Program Terms of Reference

- **GMSMON-15 Reservoir Wetland Habitat**

July 30, 2008

Terms of Reference for the Peace River Water Use Plan Monitoring Program: Reservoir Wetland Habitat

1.0 MONITORING RATIONALE

1.1 Background

The annual reservoir cycling in Williston Reservoir creates a drawdown zone of approximately 450 km² that is unproductive in both the inundated state as aquatic habitat and drawdown state as terrestrial habitat (BC Hydro 2003). The drawdown shoreline is characterized by expansive flats of mud, sand and large woody debris. Pools and backwater areas that remain as reservoir water recedes vary in their capacity to support fish and wildlife. Little vegetation exists in the drawdown zone even after extended periods of non-inundation (e.g., 3-8 years). Consequently, poor habitat exists for fish and most terrestrial wildlife and may also pose increased predation risk to animals traversing the drawdown zone for access to the wetted edge.

The Peace Water Use Plan Committee (hereafter known as the Committee) recognized that the largely unproductive drawdown zone on Williston Reservoir contributes to low fishery productivity, a lack of riparian and wildlife habitat, and potentially increased predation risk for wildlife. To address this issue, the Committee recommended the Riparian and Wetland Habitat management plan to improve foreshore habitat for fisheries, wildlife, and riparian areas. A wetlands inventory and trial wetlands enhancement project will be implemented as part of this management plan. The Reservoir Wetland Habitat monitoring program, described as part of these terms of reference, will assess the effectiveness of wetland enhancement in meeting the objectives of the management plan. Potential ancillary benefits of this management plan are dust and erosion control; increased vegetation will reduce the severity of dust storms and erosion of banks caused by wave action and debris scour.

If wetland enhancement is deemed successful by this monitoring program, additional sites may be enhanced in the future. Results of this monitoring program will also be used to evaluate the extent of the benefits to the Williston Tributary Access management plan in the event that trial tributary sites and trial wetland sites are adjacent.

1.2 Management Questions

The key management questions are:

- 1) Are the enhanced (or newly created) wetlands used by fish?
- 2) Are the enhanced (or newly created) wetlands used by waterfowl and other wildlife?

- 3) Is there a change in the abundance, diversity, and extent of vegetation in the enhancement area?
- 4) Is the area and quality of fish and wildlife habitat created by the wetland enhancement maintained over time?

The monitoring program will primarily focus on the effectiveness of wetland enhancement to improve fish and wildlife habitat as well as maintain this habitat over the life of the project. The Peace WUP Committee Report did not explicitly identify the specific fish or wildlife benefits expected from the enhancement. To provide some indication of wildlife response to the wetland enhancement, this terms of reference identifies waterfowl and amphibians as the target species groups for the monitoring program. Monitoring of amphibians and birds will also provide an opportunity to improve our knowledge of these species groups as little data is presently available about them in Williston Reservoir. Reconnaissance surveys for amphibians were completed in 1998 and 1999 to document the presence and distribution of amphibian species suspected to reside in the watersheds (Hengeveld 1999, 2000). Detected during these surveys were western toads, wood frogs, Columbian spotted frogs, striped chorus frogs, and long-toed salamanders.

Once enhancement sites have been selected by the Wetland Trials implementation project, different target species groups may be deemed more suitable than those defined in this terms of reference. In this event, modifications to this monitoring program will be considered.

1.3 Detailed Hypotheses about the Ecological Impacts

The primary hypotheses¹ to be tested are:

- H₁: Fish species composition and density in wetlands changes following enhancement;
- H₂: The density, diversity, and spatial extent of riparian and aquatic vegetation changes following enhancement;
- H₃: The species composition and density of waterfowl changes following enhancement;
- H₄: Amphibian abundance and diversity in the wetland changes following wetland enhancement.

Hypotheses will require refinement following selection and design of wetland by the Wetland Inventory and Trial Wetlands implementation project. Monitoring will be specific to the type of wetland created/enhanced. Enhancement of wetlands will be based on site-specific conditions and could range from improving existing or relic wetlands to the creation of a new wetland. In either case, the main interest of this monitoring project is to determine if the enhancement creates and maintains habitat that, ultimately, is suitable and utilized by fish and wildlife.

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

1.4 Key Water Use Decision Affected

Information from this monitoring program, in combination with other programs within the Riparian and Wetland Habitat Enhancement and Williston Tributary Access management plans will be used to inform future decisions on reservoir operating elevations, and in particular limiting drawdown magnitude. Any future decisions on limiting drawdown of the reservoir would have implications for reservoir fish, dust, wildlife, and power generation.

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 hypotheses outlined in Section 1.3.

The study area will encompass those wetlands selected for enhancement as part of Trial Wetlands implementation project. Commencement of monitoring is conditional on the timing and outcome of the site selection procedure within the Trial Wetlands implementation project. If pre-existing wetlands are selected for enhancement then monitoring would begin as soon as possible to obtain pre-enhancement data; however, if wetlands are to be created at a site with no pre-existing wetlands then monitoring will begin following construction. The study area will also include the monitoring of two suitable control sites, if available.

The scope of the monitoring program, outlined within the Committee Report, includes monitoring primary productivity. However, the information gained would be of little value in assessing the overall effectiveness of wetland enhancement in improving habitat for fisheries, wildlife, and riparian areas. Furthermore, intensive sampling would likely be required as the community of primary producers can be highly variable from year to year due to environmental conditions.

Beginning in Year 1, monitoring will occur annually over the 10-year study period of the Riparian and Wetland Habitat management plan. Data collection, data analyses, and reports will also be done annually over the study period and a final study report will be produced in Year 10 that summarizes the results of the entire monitoring program and the conclusions that can be drawn pertaining to the management questions and hypotheses.

2.2 Approach

The approach to this monitoring program includes:

- i) Annual measurement of fish species composition, density and, habitat;
- ii) Annual measurement of vegetation density, diversity and spatial extent;
- iii) Annual measurement of waterfowl and amphibian density.

The components of this monitoring program will assess the effectiveness of the wetland enhancement to improve fish and wildlife habitat in the study area as well as maintain that habitat over the life of the project.

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 Williston Tributary Access and the Riparian and Wetland Habitat Enhancement management plans.

In particular, coordination with the Wetland Inventory and Trial Wetlands implementation projects will be necessary to determine study locations as well as construction timing of the enhancement, and ongoing maintenance activities. Aerial photos and digital elevation model (DEM) will be available through BC Hydro or by contacting the project coordinator for the Williston Reservoir Aerial Photos and DEM implementation project. Aerial photos may also be available from WLL Debris Trends monitoring program.

Cost efficiencies will be sought out among the various monitoring components of this program and other programs in the Williston Reservoir Management Plans to reduce project costs of working in this remote location.

2.3.2 Task 2: Site Selection

Enhancement sites will be pre-selected as part of the Trial Wetlands implementation project. If pre-existing wetlands are selected for enhancement then the utility of control sites will be assessed. The decision to use control sites will be based on availability of wetlands for monitoring (Wetland Inventory project) and the suitability of control sites given the nature of the enhancement project. In the event that control sites are deemed beneficial, the project coordinator would select the sites in consultation with the BC Hydro Study Lead. If wetlands are to be created at a site with no pre-existing wetlands then control sites would not be necessary and monitoring of enhancement sites will begin following construction.

2.3.3 Task 3: Field Sampling Program

At each site visit, the effects of reservoir drawdown/inundation will be noted and photos will be taken from permanent photo-monitoring points to provide a photographic record of site-specific conditions. Permanent photo-monitoring points specific to each aspect of the field monitoring program will be required. Weekly reservoir level will also be tracked over time.

Field Sampling Program: Fish

Field methods and data requirements for this task are referenced to Resource Inventory Committee (RIC 2001). Field data forms will be prepared in advance to capture all relevant information.

A survey will be conducted to provide an estimate of relative abundance of fish in the wetland area. Study sites will be surveyed on at least two site visits. Fish capture will occur when the reservoir is at or near low pool. Fish will be enumerated and species, fork length, and weight will be recorded. Methods (e.g., minnow traps, gill net) for the survey will be specific to site conditions but should be consistent for each location. Sampling should occur randomly within representative habitat types (e.g., area of wetland vegetation and area of open water). Large and small fish should be targeted. The sample size and location of sampling within the study sites is at the discretion of the researcher and subject to the available budget; however, a clear rationale of these decisions will be required. 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
- Crew and skill level
- Capture method and equipment specifications
- Effort

Physical measurements of the study area will be taken to determine sampling conditions. Data will be analyzed and stored for future reference. Parameters to be measured include but are not limited to:

- Water temperature
- Water depth
- Water clarity
- Water quality (e.g., alkalinity, ph, hardness)
- Water retention time

Field Sampling Program: Vegetation

Field methods and data requirements for this task are referenced to Mackenzie and Moran (2004) and U.S. EPA (2002). Field data forms will be prepared in advance to capture all relevant information. A standard sampling window (e.g., July) will be established to ensure that representative results are obtained at each site and that valid comparisons can be made between years. Sampling methodology (e.g., Braun-Blanquet method, transect sampling quadrat sampling), sample size and location of sampling within the study sites is at the discretion of the researcher and subject to the available budget; however, a clear rationale of these decisions will be required. Information to be collected includes but is not limited to:

- Vegetation characteristics by layer (species, densities and heights, per cent cover)

- Dominant emergent and submergent aquatic plant (visual estimate of percent of the wetland surface area covered by emergent and submergent vegetation)

The nature of the enhancement will influence what type of data is collected. The collection of additional data on wetland characteristics such as soil texture, watertable depth, hydrodynamic index, pH, absolute soil moisture, and nutrient regime and humus form will be identified by the proponent once Trial Wetlands project has reached the site selection and project design phase.

Using aerial photos taken in Years 1, 3, 5, 6, and 10 as part of the Williston Reservoir Aerial Photos and DEM implementation project and the Williston Debris Trends monitoring program, photographs will be interpreted to assess for changes in the spatial distribution and composition of vegetation over time. Photo interpretation for vegetation may be limited if photos are taken before the start of the growing season. Guidelines for photo interpretation are set out in RIC standards for VRI-Vegetation Resources Inventory (RIC 2002).

Unknown species should be collected and preserved for proper identification. In the event that rare plants (e.g., federally or provincially listed species) are found during the ground sampling, this data will be provided to the Conservation Data Center (CDC) by the contractor, using appropriate forms. Similarly, noxious weed species, if encountered, should be identified and weed sites should be entered into the Ministry of Forests and Range Invasive Alien Plant Program Application and forwarded to the BCH Hydro Vegetation Specialist. These sites should also be explicitly identified to determine if spread of these species is occurring over time.

Field Sampling Program: Wildlife

Wildlife inventories will be conducted for waterfowl and amphibians. Different/additional inventories may be proposed by the proponent once the Wetland Inventory and Trial Wetlands project has identified the location and design of trial sites. The inventories will be conducted concurrently and will correspond to the breeding period of both waterfowl and amphibians. Snow and soft roads early in the season will be a necessary consideration when determining survey timing.

Waterfowl inventories will be carried out during the months of May and June during the breeding season. Inventories will target two periods of the day (i) early morning to late morning periods and (ii) late afternoon to early evening as these are favourable periods for activity. Sites will be inventoried (three to four site visits). Methodology for surveying will follow guidelines set out by the Resources Inventory Standards Committee (RIC 1999). Methods (e.g., observation stations) for the survey may be specific to site conditions but should be consistent for each location. The sample size and location of sampling within the study sites is at the discretion of the researcher and subject to the available budget; however, a clear rationale of these decisions will be provided. The inventory will provide an estimate of relative abundance (or absolute abundance if area of wetland is known) by determining the number of breeding pairs per km² sampled. Any other wildlife observations will be noted.

An inventory of amphibian species in the wetlands will be conducted using standard procedures (RIC 1998a). Breeding period for amphibians in the Williston watershed is thought to be from late April to the end of June (Hengeveld 2000). The exact period will vary depending on geographic location, elevation, and weather conditions.

If appropriate, this monitor will also conform to the inventory methods identified in RIC (1998b) for pond-breeding amphibians. The inventory information to be collected at each habitat site will follow that described in RIC (1998a). The required habitat attributes include but are not limited to:

- Location: geographic coordinates, Broad Ecosystem Unit, ecosection, biogeoclimatic subzones
- Site information: elevation, slope, aspect, and mesoslope position
- Topography: surface topography code
- Structural stage: structural stage code
- Basic vegetation: dominant/indicator plant species and per cent cover for each layer
- Simple CWD: course woody debris volume and volume by decay class
- Surface substrate: surface substrate composition

The survey crew is to use standard habitat attribute definitions and codes and is encouraged to use RIC (1998a) standard forms for data recording.

Though the minimum data requirements for this monitor is to establish Presence/Not Detected status of amphibians in the study area, the survey crew are encouraged to adopt an animal sampling strategy that allows measures of relative abundance to be made. This would maximize the information content of the survey, allowing the results of the monitor to be used as a reference for future trend analyses. This would be particularly important should any of the animals observed in the area be a species of SARA concern. The minimum data requirements of all observations, in addition to the habitat attributes listed above are species, sex, developmental stage, and approximate size. If applicable, survey sites will be marked and georeferenced. Permanent photo-monitoring points will also be established to provide a photographic record of site-specific conditions.

Handling of all observed animals should be kept to a minimum. Additionally, nets, boots and containers should be washed and any bits of vegetation removed before going to another site to prevent transfer of diseases

2.3.4 Task 4: Data Entry and Analysis

The proponent will develop a Microsoft Access database to enter, check and store all data collected during the monitoring program. Data analysis will focus on the metrics for fish, vegetation, and wildlife and the observed changes over time. In the event that the enhancement occurs on pre-existing wetland, analysis of the monitoring program would be based on a before-after impact design. However, if the enhancement is the creation of a new wetland then the analysis will track the colonization of these trial habitats over time. The type of statistical analysis used to test for trends will depend largely on the nature of the data, and can include simple non-parametric correlation tests as well as more complex time series analyses.

Estimates for relative abundance will be based on a metric such as #fish/fish net⁻¹ night⁻¹ for each species for a given habitat type. Standard life history

summaries will also be provided which will include length-frequency distribution, length-weight relationships.

Vegetation metrics (e.g., U.S. EPA 2002) that are useful in one class of wetland (e.g., emergent) are not necessarily transferable to other classes. Thus appropriate measures for analysis will be developed by the proponent once wetland sites have been identified by the Trial Wetlands implementation project. However, metrics will provide a description of species richness, community structure, and spatial distribution over time. Air photo analysis in Years 1, 3, 5, 6, and 10 will simply consist of polygon delineation of vegetation communities, which would include descriptive summaries regarding changes in composition and spatial extent over time.

Wildlife analyses will be dependent on the exact type of monitoring implemented for a given wetland. However, wetland monitoring will include an estimate of bird usage such as #breeding pairs/area or other suitable metric. Analysis of amphibian data will depend on whether it is possible to collect an index of abundance or if the data will be presence/not detected data.

2.3.5 Task 5: Reporting

Project reporting will consist of a series of annual data reports with a larger summary mid-project report and a final report at the conclusion of the monitoring program. The annual data report will document the methodologies (including map of sites and photodocumentation), findings of the year and will include a discussion on how the year's data compare with that collected in previous years. Included in this discussion will be the results of all pertinent hypothesis testing and recommendations for improving the monitoring program.

A comprehensive mid-project and final year project report will be prepared that collates all of the data and includes:

- a) An executive summary of the project;
- b) Re-iterates the objective and scope of the monitor;
- c) Presents the methods of data collection (including map of sites and photodocumentation);
- d) Describes the compiled data set and presents the results of all analyses, and
- e) Discussion of the consequences of these results as they pertain to future wetland enhancement projects;
- f) Recommendations for future monitoring (if any) needed.

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 results of the monitoring program will provide support in the decision-making process to enhance or create additional wetland to mitigate for poor fish and wildlife productivity in the drawdown zone of Williston Reservoir. If fish, vegetation, and

wildlife benefits are incurred as a result of wetland enhancement, then enhancement of additional wetland areas will be considered for Years 6-10 of the study period.

2.5 Schedule

Monitoring is scheduled to begin in Year 1 and will be repeated annually over the 10-year study period. The survey will be conducted between May and June (Table 15-1).

Table 15-1: Schedule for the components of the Reservoir Wetland Habitat Monitoring Program

Monitoring Component	Implementation Period
Fish survey	May - June
Vegetation survey	June
Wildlife survey	May - June

2.6 Budget

The estimated total cost for the monitoring program over the 10-year study period is \$823,498. Table 15-2 summarizes the budget by labour and expenses estimated in 2007 dollars. As there are a number of uncertainties associated with this monitoring program due to the unknown nature of the enhancement, the annual budget costs assume:

- two enhancement sites (no control sites)
- two site visits to complete the fishery component, one site visit to complete the vegetation survey, three site visits to complete the wildlife inventories
- boat required only for the fish survey component
- equipment includes fish capture gear, camera, satellite phone, gps, weigh scale, water quality multi-meter, binoculars
- sites are road accessible

Cost will increase with the monitoring of more sites. Monitoring sites will increase if control sites are selected in Year 1 or if additional sites are selected for enhancement in Year 6.

Table 15-2: Estimated costs for the Reservoir Wetland Habitat monitoring program

Sub-total		\$675,500
Inflation	2%	\$108,783
Contingency	5%	\$39,214
Total		\$823,498

2.7 References

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