SLIPP
Shuswap Lake
Integrated
Planning Process

Working together to sustain our watershed

SLIPP Water Quality Monitoring Plan 2011 - 2014

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Introduction and Background

Plan Purpose

The purpose of this document is to provide an overview of the planned water quality monitoring activities for the first three years under SLIPP funding. Water quality monitoring results will be reported to the public on an annual basis. These results will provide information to support water quality protection in decision making and planning.

Background

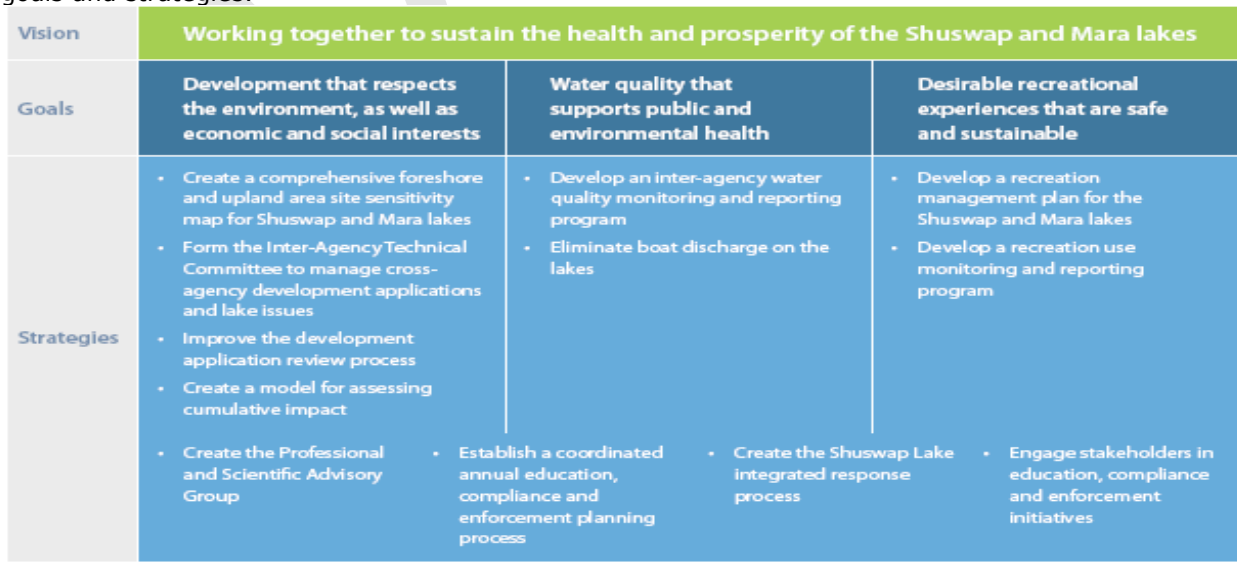
The Shuswap Lake Integrated Planning Process was initiated in the fall of 2006 to coordinate land and water use planning in the Shuswap watershed through increased coordination between public agencies, First Nations and other stakeholders. The SLIPP process brings key stakeholders together to sustain the health and prosperity of the Shuswap watershed. The three guiding goals of the SLIPP process are:

1) Development that respects the environment, as well as economic and social interests
2) Water quality that supports public and environmental health
3) Desirable recreational experiences that are safe and sustainable

A key component of the SLIPP process is increased coordination among public agencies and First Nations responsible for the health and prosperity of the Shuswap watershed. The agency and First Nations stakeholders directly involved in SLIPP are shown below.

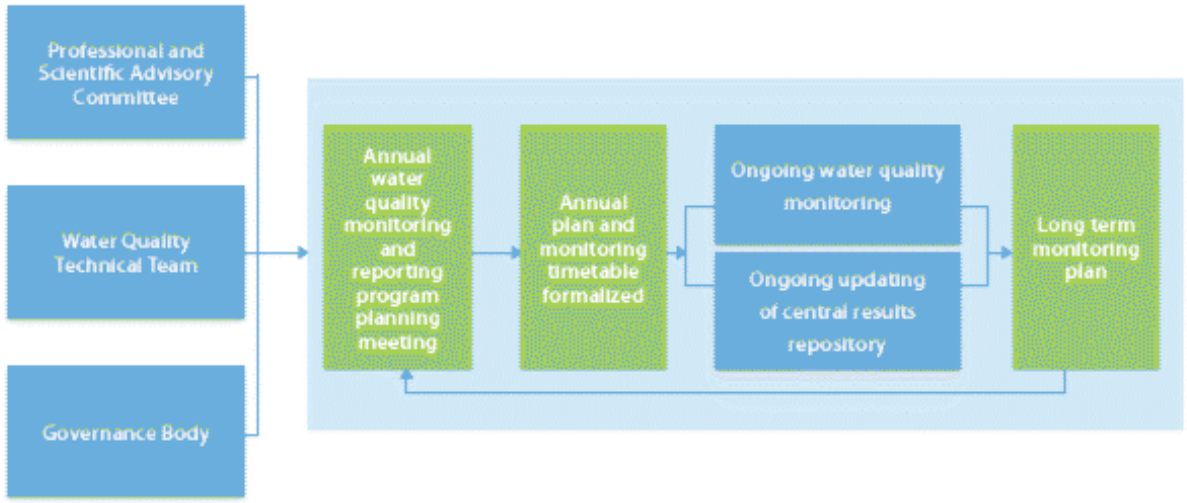
City of Salmon Arm
Columbia-Shuswap Regional District
District of Sicamous
Fisheries and Oceans Canada
Fraser Basin Council
Interior Health Authority
Ministry of Agriculture
Ministry of Environment
Ministry of Forests and Range
Ministry of Natural Resource Operations
Ministry of Community, Sports and Cultural Development
Regional District of North Okanagan
Royal Canadian Mounted Police
Shuswap Nation Tribal Council
Thompson-Nicola Regional District
Transport Canada

To work towards the SLIPP goals, public consultations and strategic planning sessions were conducted in 2007 and 2008. Identified were four cross-cutting strategies, which support the achievement of all three SLIPP goals, and eight goal-specific strategies, which each support the achievement of a specific SLIPP goal. The SLIPP Strategic Plan diagram below explains the linkages among the SLIPP vision, goals and strategies.



SLIPP Water Quality and Waste Management Strategy: Develop an Inter-Agency Water Quality Monitoring and Reporting Program

The SLIPP Strategic Plan recommends that an inter-agency program be established to prioritize, manage and coordinate water quality monitoring and reporting on Shuswap and Mara lakes and the foreshore. As demonstrated in the visual below, the program involves the development of a long-term plan and an annual process for setting monitoring priorities and allocating the resources of SLIPP participating agencies. Multiple agencies have historically and are currently monitoring various water quality dimensions, including lake, ground water and water clarity. While a degree of coordination already exists, public agencies have recognized that a more insightful and comprehensive picture of water quality, as it relates to public and environmental health, will be achieved through enhanced integration of their existing information, activities and resources. Stewardship groups and the business community will be engaged to leverage their resources, knowledge and monitoring efforts. The multi-year plan for the monitoring program has already been developed (2010) and identifies key areas of focus that will be tracked over time to identify long-term trends and issues. Annual monitoring priorities and actions, captured in an annual monitoring plan (this document), will be agreed to by the participating agencies based on previous years' data and emerging trends. As monitoring data is collected, it will be stored in a central data repository, along with historical data that is available to all participating agencies and the public, in an accessible and summarized form. A State-of-the-Lakes report will be developed annually. The image below provides a visual representation of the inter-agency Water Quality Monitoring and Reporting Program.



SLIPP Long Term Water Quality Monitoring Plan

A five year visionary plan was developed by Northwest Hydraulics Consultants Ltd. (Integrated Water Quality Monitoring Plan for the Shuswap Lakes, Nov. 07, 2010) to serve as a guiding framework for the development of annual water quality monitoring plans by SLIPP partners. The long term plan includes background on lake water quality, including a discussion of previous and current monitoring programs, trends in water quality, main concerns and emerging threats to water quality. The plan also discusses possible nutrient sources and loadings and proposes a framework for monitoring the lakes and tributaries in the Shuswap watershed over a 5 year period. The program is designed to monitor the known and emerging threats to drinking water quality and ecosystem health in the Shuswap and Mara lakes and surrounding tributaries. The plan states that the best defense for preventing further water quality degradation is a detailed assessment and analysis of the nutrients and contaminants being discharged, followed by concrete action plans to reduce or eliminate nutrients and contaminant loading as required.

The Plan has been endorsed by the SLIPP Steering Committee and is available on-line: **www.slippbc.com**

SLIPP Water Quality Monitoring Partners

SLIPP Partner	Role
City of Salmon Arm	• Local governments are responsible for management of solid and liquid waste systems, municipal water supply and floodplains. They also undertake local water conservation programs, with some undertaking their own watershed and water supply planning.
Columbia Shuswap Regional District	• Local governments are responsible for management of solid and liquid waste systems, municipal water supply and floodplains. They also undertake local water conservation programs, with some undertaking their own watershed and water supply planning.
District of Sicamous	• Local governments are responsible for management of solid and liquid waste systems, municipal water supply and floodplains. They also undertake local water conservation programs, with some undertaking their own watershed and water supply planning.
Fisheries and Oceans Canada	• Administers Fisheries Act, which protects fish habitat that rely on water.
Interior Health Authority	• Mandate to protect human health from drinking and recreational water hazards under the Drinking Water Protection Act and Public Health Act.
Ministry of Agriculture	• Support improvements in the efficiency of water use by the agriculture sector. • Provide programs and activities to identify and address critical agricultural environmental issues and adoption of best management practices.
Ministry of Environment	• Protects, manages and enhances the province's natural environment and ensures environmental sustainability. This includes protecting water by monitoring, regulating discharge of pollutants, and promoting behavioural change and environmental stewardship amongst other levels of government, companies, and members of the public.
Ministry of Natural Resource Operations	• Delivers integrated land management services for BC and holds the legislative authority for provincial permitting and licensing activities • Conducts groundwater sampling in the Shuswap watershed.
Regional District of North Okanagan	• Local governments are responsible for management of solid and liquid waste systems, municipal water supply and floodplains. They also undertake local water conservation programs, with some undertaking their own watershed and water supply planning.
Thompson-Nicola Regional District	• Local governments are responsible for management of solid and liquid waste systems, municipal water supply and floodplains. They also undertake local water conservation programs, with some undertaking their own watershed and water supply planning.

Annual Water Quality Monitoring Plans: 2011 - 2014

Monitoring Objectives

The monitoring program will support the protection of the long term drinking water quality and ecosystem health in Shuswap Area Lakes.

To achieve this objective, the program must 1) consider existing concerns by the public and member agencies and 2) identify current water quality problems and whether water quality changes over time and space exist and where the sources for these problems and changes lie.

These considerations will help prioritize management activities to protect lake water quality and ecosystem health.

Overview

This detailed annual monitoring plan was developed collaboratively by SLIPP partners on the Water Quality and Waste Management Technical Team, with support from scientific experts (Dr. John Stockner (Limnologist, Ecol-Logic Ltd.), Dr. Ken Ashley (Northwest Hydrolics, Consultants Ltd.), and Dr. Ken Hall (Northwest Hydrolics, Consultants Ltd.). It is aligned with the monitoring framework proposed in the long term water quality monitoring plan (described on page 3) and builds upon the water quality programs conducted by SLIPP agencies prior to SLIPP initiation.

The Plan also includes mandated or proposed monitoring activities by SLIPP partners and aims to make data of these sampling projects available, if relevant to the plan's objective.

The plan contains monitoring activities in the entire Shuswap watershed under the following four categories.

1. **Deep Station Monitoring** – Overall lake health; how productive is the lake?
2. **Near Shore and littoral Monitoring** – Local water quality for specific users; local effects from discharges, seepages and runoff; early warning for water quality changes.
3. **Water Quality Effects of Specific Activities** – Activities/Landuses/Wateruses.
4. **Watershed and Tributary Monitoring** – Identify sources of nutrients and/or contaminants of concern.

Table 1 (pages 12-13) provides an overview of the monitoring efforts planned under each category by year. Rationale for each monitoring component and monitoring details is provided below.

Table 2 (pages 14-19) includes a summary of proposed monitoring activities by SLIPP partners for 2011.

Monitoring results will be reported out on an annual basis in a State-of-the-Lakes report.

Deep Station Monitoring

Rationale
Past deep station water quality monitoring programs conducted by SLIPP partners have established a baseline of general lake water quality for each arm of the Shuswap Lake and Mara Lake. However, it is anticipated that the water quality in Shuswap and Mara Lakes will likely be influenced by nutrient release from the extraordinary salmon returns last year and the large number of decaying salmon carcasses along the lake and its tributaries as well as feeding juveniles. To identify the extent of the effects, intensive deep station monitoring is recommended at key sites in lake arms affected by the salmon returns as well as Little Shuswap Lake.

Intensive monitoring should also continue at sites within the boundary of the 2008 and 2010 Ochromonas algae bloom. At these sites, water samples will be analysed for additional components of the foodweb, such as pico-plankton, which play an important role in lake productivity and the forming of the Ochromonas blooms.

Deep station sampling in Mable and Sugar Lakes should also be continued.

We recommend conducting a primary productivity study in Shuswap Lake in 2011. Primary productivity is the process by which organisms make their own food from inorganic sources. The majority of primary producers are terrestrial plants and microbial life, such as algae. These organisms can use inorganic substances (such as carbon, phosphorus and nitrogen) and solar energy to carry out metabolic processes and build cellular material. This biological material provides essential food to higher organisms, thus primary productivity influences the entire biological activity of a lake. The method planned for Shuswap Lake uses a labelled tracer to quantify assimilated carbon, in this case ^{14}C (a heavy carbon atom). The method is a very sensitive measure for lake productivity.

To get an idea of overall lake water quality of Shuswap and Adams Lakes, the outflow of Adams Lake, as well as the South Thompson River water quality will be monitored for similar parameters These sites will be added to the Tributary Monitoring Program (described below).

Monitoring Details

a) *Sample sites:*
   - Key sites to determine influence from decaying salmon and sites close to the origin of the 2008, 2010 Ochromonas algae blooms: 7 sites (site locations are described in Table 2). In addition, continue spring and fall overturn sampling at Mable and Sugar Lakes.

b) *Sample frequency:*
   - Monthly May to October, weekly April to June, twice per winter. In Sugar and Mable Lake sampling will continue in spring and fall.
   - ^{14}C uptake – primary productivity: 2 sites twice/yr, potentially more frequent, if done by DFO.

c) *Parameters:*
   - Water temperature and dissolved Oxygen profiles.
   - Water clarity
   - Water chemistry
   - Nutrients
   - Chlorophyll a
   - Phytoplankton numbers, biomass and taxonomy
   - Zooplankton biomass (settled volume)
   - Carbon-14 uptake – sensitive measure of primary productivity

Near Shore littoral Monitoring

Rationale
Near shore areas are generally more sensitive to seasonal and annual changes in water quality due to their shallow depth, proximity to upland point and non-point sources and often restricted flushing rates. At the same time many water uses, such as swimming and drinking water withdrawal, occur near shore. Based on the above, near shore water quality provides an early warning for general water

quality changes, help identify suitability for water users and assist in finding sources for nutrient and contaminant inputs.

A fluorometer study in the 1980s, that located the presence of septic system seepage indicators such as laundry detergent whiteners, guided seepage and shallow lakeshore sampling programs in the 1990s and 2000s. Concentrations of nutrients and indicators for septic contamination were found to be quite high in most seepages. However, the water quality in the sampled shallow areas downstream of these seepages did not seem significantly affected by them in the Main Arm of Shuswap Lake. On the other hand, the shallow site in Salmon Arm near Christmas Island had significantly different water quality compared to the rest of the lake.

In order to confirm that the sampled sites represent those most affected by sewage seepage, a 2nd fluorometer study was conducted in 2010. The results of this study have been analysed and were used to guide additional water sampling along the shoreline of Shuswap Lake in 2011. Areas identified by the regional districts and Interior Health Authority (IHA) as those likely affected by septic seepage or those with sensitive recreational and drinking water use were also considered for final site selection.

While the grab sampling project provides snap shots of a water quality condition on a specific sampling date at selected locations, the growth of attached algae is an indicator of consistent nutrient availability. For that reason, an attached algae program has been launched by MoE in partnership with the Shuswap Water Action Team Society and the Swansea Point Community Association in 2010 and will continue in 2011. This program uses artificial substrate hung at 1m below the water surface at test and control sites. Algae biomass and species composition will be influenced by the availability of nutrients, such as carbon, nitrogen and phosphorus, and thus provide an integrative measure of latter.

In 1987 a lake wide Secchi Disk study was lead by the Columbia Shuswap Regional District and conducted by a large number of volunteers. A Secchi Disk is a simple measure of water clarity. Water clarity was measured at 135 sites, each 100m off shore in Shuswap Main Arm, Salmon Arm, Sicamous Arm and Mara Lake. Since water clarity is influenced by floating organism concentrations (including algae), it provides a rough measure of algae growth and nutrient availability. Shuswap Water Action Team and Swansea Point Community Association volunteers repeated this program in 2009 and 2010 at the same sites. It provides an effective tool to determine water quality trends in local areas throughout the lake. The Integrated Monitoring Plan by Northwest Hydraulics recommends extending this tool to the Little Shuswap, Mable and Adams Lakes. Since this requires the recruitment of a large number of volunteers and a volunteer organizer living in the area, it is suggested to start consultation and gauging of interest among First Nations and community groups in 2011 and commence the actual program not before 2012.

The Columbia Shuswap Regional District in cooperation with the Ministry of Natural Resource Management also conduct Groundwater sampling in combination with foreshore sampling to determine septic system seepages in critical areas (for locations, see Table 2).

Water purveyors regularly collect lake water samples at water intakes and local governments as well as BC Parks have beach samples analysed for E.coli on a weekly basis.

Sample sites should also be selected to determine effects from storm sewer discharges, where most applicable. Alternatively, a storm sewer effects model would be useful to determine potential effects.

Monitoring Details

a) *Sample sites:*
   - Grab sampling: Shallow sites that show indication of septic seepage (based on fluorometer measurements) and locations identified by SLIPP partners as sites of interest (to users or as sites receiving point or non-point discharges, e.g. downstream of storm sewers); up to 20 sites.
   - Attached algae: Similar selection criteria than above, but also include sites of concern by residents and SLIPP partners; up to 20 sites (10 visual, 10 analysed).
   - Secchi Disk: Select sites of concern and those for which volunteers are available on a weekly or bi-weekly basis; site # is flexible. All sites should be 100m off shore. The more the better.

b) *Sample frequency:*
- Grab sampling: Monthly throughout the summer or tailored to the specific uses or discharges.
- Attached algae: Install artificial substrate in May and after this every six weeks until October; retrieve after three, six and nine weeks of installation. Visual evaluation every three weeks.
- Secchi Disk: Measure weekly (if possible; otherwise bi-weekly) May to October.
- Groundwater sampling: 1-2 times/year
- Drinking water sampling: 1/year up to weekly, depending on parameter.
- Beach Sampling: weekly during beach season.

c) *Parameters:*
- Grab sampling:
  - Nutrients
  - Fecal indicators
  - Indicators of septic leakage
- Attached algae:
  - Formal Visual comparison – using a New Zealand Method
  - Chlorophyll a concentrations
  - Some species composition
- Secchi Disk:
  - Secchi Depth
- Groundwater sampling:
  - Water level
  - General chemistry
  - Nutrients
  - Metals
  - Fecal indicators
  - Organic compounds.
- Drinking Water Sampling:
  - Fecal indicators
  - General Chemistry
  - Metals
  - Organic compounds as needed.
- Beach Sampling:
  - Fecal indicators

Water Quality Effects of Specific Activities

Rationale
Based on findings of fluorometer study, near shore, seepage and groundwater sampling and the geology of some developed near shore areas (e.g. fractured rock), leakage from private septic systems, particularly drywells has been determined as one source of nutrients and sewage related contaminants into Shuswap Lake.

To deal with the issue, septic systems have been mapped and a survey of property owners about their system's maintenance has been conducted by the CSRD in Area C. Groundwater monitoring has been conducted in Area C and F. The CSRD is planning to implement a similar project for Area E of their Regional District and we hope additional SLIPP partners can implement these initiatives in their jurisdictions where applicable. The project is described under the section "Near Shore Monitoring". The results of such surveys can provide information to determine areas of higher risk. Where specific systems are identified as potentially problematic, dye test can be applied as needed and shallow sampling can commence as per the near shore monitoring program.

The City of Salmon Arm and the District of Sicamous fund and/or conduct monitoring programs to determine effects of the treated sewage discharges to the Salmon Arm and infiltration basins, respectively.

In an effort to determine whether there is a need to extend the community sewer system, the City of Salmon Arm will assess the effects of onsite sewage systems on Canoe Creek water quality.
One of the Goals under SLIPP is a "water quality that supports public and environmental health". The second strategy under this goal is to eliminate discharges from boats. A number of studies have been undertaken to identify the effect of boat discharges into the lake in general and into specific areas of the lake. Results have shown that effects exist; however, they can vary significantly between years. In order to ensure the range of the variation is captured effectively, it is recommended to repeat the MoE 2009 receiving water sampling program. The results of this project would also reflect effects of mitigation measures by houseboat companies on the water quality. These include but are not limited to removal of washing machines and plumbing of the kitchen sink into the blackwater holding tank.

A characterization of typical boat greywater quality and discharge / day and boat distribution as well as the determination and summary of loadings from permitted and estimates of non-permitted discharges will be added to a lake wide loading model that also covers loadings from large tributaries. The outcome of the model will be helpful in determining nutrient and source management priorities.

Effects of other activities, such as various land uses, will be monitored in more detail under the Watershed Monitoring category.

Monitoring Details

a) Sample sites:

- Sewage Treatment Plant Discharges: Salmon Arm - At discharge, near field and far field plus control site; Sicamous – Groundwater wells around infiltration basin.
- Canoe Creek: Program is being developed.
- Repeat of 2009 MoE Greywater Study: 6 test sites each at beaches highly frequented by boats – Nielson Beach, Hungry Cove, and Marble Point plus three control beaches.
- Greywater characterization: Collect samples of boat greywater from collection tanks (at least 10 tanks). Work with the houseboat companies to determine tanked greywater volume for each tested tank as well as number people and days producing this amount.
- Loading information: Retrieve discharge information of permitted discharges (or those under plans) from Environmental Protection Division, MoE. Apply peer reviewed and tested coefficients (e.g. from EPA) and loading calculations to determine non-point source loadings, identify loadings from tributaries from the tributary sampling project (described below).

b)Sample frequency:

- Sewage Treatment Plant Discharges: Salmon Arm – 6-8 times/year; Sicamous – quarterly.
- Canoe Creek: Program is being developed.
- Repeat of 2009 MoE Greywater Study: 5x weekly during high boating season plus 5x weekly outside of boat season.
- Greywater characterization: Sample as greywater tank filling is available.
- Loading information: Use results of various sampling programs.

c)Parameters:

- Sewage Treatment Plant Discharges:
  - Water temperature
  - Nutrients
  - Water clarity
  - Water chemistry
  - Chlorophyll a
- Canoe Creek: Program is being developed.
- Repeat of 2009 MoE Greywater Study:
  - E.coli
  - Fecal coliforms
  - Greywater tracers (pot. endocrine disruptors)
- Greywater characterization:
  - Nutrients,
  - greywater tracers (pot. endocrine disruptors),
  - E.coli,
  - Fecal coliforms
- Loading information:
  - Nutrients
  - Contaminants that may exceed health or environmental thresholds

Watershed and Tributary Monitoring

Rationale

In order to manage access nutrients and/or contaminants in lakes, it is important to identify where the most significant loadings originate from. Direct discharges or seepages into the lakes are only some sources for these loadings. A vast amount of chemical and physical constituents are carried into the lakes via tributaries that capture all runoff within the watershed. Runoff from some land use activities in the watershed can contribute significant amounts of nutrients and/or contaminants that are often washed into the lake via a tributary. For that reason, it is important to determine the loadings of critical constituents from these streams into the lake. This information will be added to a lakewide loading model, which will help focus future water quality protection activities on the most significant sources.

Once a tributary has been determined as a major contributor of problematic nutrients or contaminants, water quality monitoring (as proposed here for the second to third year) of specific stream sections within this tributary should commence to identify the actual source within the tributary. This work may include source identification tools as needed and available. In order to determine best sample sites and stream sections that most likely receive higher loadings, MoE's land use map will be finalized for the entire Shuswap Lake Watershed. Other information, such as live stock numbers by area and farming type will also be utilized.

Monitoring of specific stream sections within the Lower Shuswap River will commence in 2011 at four sites in the Lower Shuswap River by the Lower Shuswap Stewardship Society funded through the Nord Okanagan Regional District under the Shuswap River Watershed Sustainability Plan. At the same time, the Ministry of Environment conducts similar sampling programs on various tributaries into the Lower Shuswap River.

Monitoring Details

a)Sample sites:

- Tributary loading: Near mouth of Salmon River, Shuswap River, Eagle River, Hummingbird Creek, Sicamous Creek, Anstey River, Seymour River, Scotch Creek, Albas Creek. Continuation of White Creek, Tappen Creek, Canoe Creek, Newsome Creek.
- Sampling within selected tributaries: Tributaries and sites selected based on outcome of first two years.

b)Sample frequency:

- Biweekly year round. Weekly during freshet.

c)Parameters:

- Nutrients (incl. DOC, TOC)
- General Ions
- Metals
- Bromide, Chloride, Sulphate
- Turbidity
- Conductivity
- pH
- Hardness
- E.coli
- Fecal coliforms

Next Steps:

Annual water quality planning and implementation meetings are proposed annually, or more frequently, as required.

The details concerning the number of sample sites, locations, parameters and agencies conducting these tests have been shared among the Water Quality Technical Committee Members and sampling coordination in order to avoid duplication and ensure an efficient monitoring program is under way.