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**Nova Scotia**

# Automated Water Quality Monitoring Program

May 2007

NOVA SCOTIA
Environment and Labour

**Nova Scotia's**
**Automated Surface Water Quality Monitoring Network**

**Data Analysis and Interpretation**


Prepared by

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for

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Water and Wastewater Branch

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## EXECUTIVE SUMMARY

This report describes the water quality of Kelley River (Cumberland County), North East Margaree River (Inverness/Victoria County), Pockwock Lake (Halifax/Hants County) and Shelburne River (Queens/Shelburne/Digby County) watersheds based on hourly real time data generated by the Nova Scotia Automated Water Quality Monitoring Program between 2002 and 2005.

This report presents individual watershed water quality assessments which utilize a series of tables and plots which have been generated using validated hourly data and daily, monthly and annual data resulting from statistical analyses. Water quality parameters examined include temperature, turbidity, conductivity, dissolved oxygen, and pH.

This report also contains:

- products of a detailed land use investigation,
- reference documentation used in the design, deployment and operation/maintenance/calibration of network instrumentation,
- monitoring program QA/QC documentation, and
- grab sample water quality data.

The dominant land use category in each of the four watersheds is forest, comprising between 61 and 88 percent of individual total watershed areas. The second most abundant feature is a combination of water and wetland areas (8-23 percent).

As expected, water temperature was observed to vary with air temperature. Although minimum water temperatures were similar between monitoring stations, maximums and number of hours exceeding permissible limits for salmon and trout species were not. For the operational years 2003-2005, Pockwock Lake on average had 1000 hours per year when recorded water temperatures were above the 21$^{o}$C limit. For the North East Margaree River the average number of hours per year was approximately 25; Shelburne River 1460 hours; and Kelley River, 440 hours.

As expected, elevated turbidity levels for the three river systems (North East Margaree, Shelburne, and Kelley) occurred at a higher frequency and magnitude than for the single lake location (Pockwock Lake). For Pockwock Lake, hourly turbidity values were typically less than 5 NTU. On one occasion only during the entire 4 years of record were hourly measurements observed to rise for a short period of time above this limit when levels were observed to peak at 36 NTU. Lake dampening effects were absent in the flowing systems which experienced several episodes of consecutive hourly readings greater than 10 NTU, for which event peaks reached as high as 160 NTU (Kelley River 2005). North East Margaree River experienced several episodes in which turbidity levels were maintained in the range of 10 to 100 NTU. Shelburne River experienced less frequent events of 10 NTU or greater, three of which peaked at between 70 and 106 NTU.

For three of the four monitoring stations. water conductivity is reflective of dilute water with average annual values for Pockwock Lake, Shelburne River, and Kelley River of 39, 33, and 26 uS/cm, respectively. Very little deviation from these means was observed to occur. For the North East Margaree River, much higher values were recorded, ranging from 161 – 172 uS/cm. Surficial geology, and not road de-icing activities, was considered to be the major reason for the elevated levels, relative to the other three sites.

Water conductivity in Pockwock Lake, Shelburne River and Kelley River is reflective of dilute waters with mean annual ranges of 38 - 40, 32 - 35, and 26 (2005 only) uS/cm, respectively. Conductivity levels were observed to remain fairly constant on a daily basis throughout the period of record with only minor shifts outside annual mean ranges. North East Margaree River mean annual conductivity was much higher, ranging from 161 – 172 uS/cm which indicates a much greater dissolved solids content. With the exception of Pockwock Lake, the effects of precipitation and snowmelt runoff, assumed to contain low concentrations of dissolved solids, were observed for the river systems and were inversely related to quantity of flow. During higher flow periods, conductivity levels were lower compared to low flow periods when the effects of groundwater seepage, assumed to contain higher concentrations of dissolved solids, played a more significant role.

Well-oxygenated water was the norm at all four sites. At no time did dissolved oxygen levels fall below the 5.0 mg/L guideline established for the protection of aquatic life. An inverse annual trend to that of water temperature was observed at all sites, explainable by the fact that the solubility of oxygen in water decreases as water temperature rises.

Although not examined on an individual basis for this review, the observed spatial variation in water quality is assumed to be a reflection of differences in relative impacts of precipitation, geology, land use and forest composition, percent of water/wetland areas, and human influence. For example, the watersheds of Pockwock Lake, Shelburne River and Kelley River contain surface water/wetland areas that make up more than 10 percent of the total area in each watershed with an annual pH of 5.3, 4.4, and 5.5, respectively. It is likely that these watersheds possess a surficial geology with low buffering capacity. The low pH of Shelburne River is punctuated by high water colour (102-226 True Colour Units), a trait of water containing elevated levels of organic carbon. Sphagnum bogs are known to be major sources of colour and organic acid. Contrary to this, the North East Margaree River has an annual mean pH of 7.2, a sign of a greater abundance of carbonate minerals in the watershed. Water/wetland areas are limited to 8 percent of the total watershed area.

The report concludes that the water quality monitoring network provides valuable information that is essential when attempting to examine trends. The data generated by the network should also be of value when comparing trends in other provinces for these parameters.

The report recommends that efforts be initiated to improve the program's ability to generate more complete hourly datasets. At the present time, efficacy varies between parameters and was observed in 2005 to range from 47 to 92 percent coverage. More frequent field visits were suggested.

**ACKNOWLEDGEMENTS**

A considerable amount of time and effort went into the design and implementation of the automated water quality monitoring program associated with this study. The lead investigator responsible for the program was Mr. Darrell Taylor of the Nova Scotia Department of Environment & Labour (NSEL).

Mr. Alan Tattrie of NSEL was responsible for all field operations, including data collection, maintenance and operation of instrumentation, and QA/QC. Environment Canada (EC) contributed data retrieval services to the program and were important in integrating the water quality equipment with existing hydrometric equipment at the co-located sites. The description of the procedure used to download water quality data from field instrumentation used in the report was provided by Mr. Guy Leger of the Water Survey of Canada.

Raw real time data used in the report was compiled by Mr. Alan Tattrie (NSEL).

Ms. Nerissa Mulligan of NSEL generated program and monitoring station background text sections for the report. Figure 1 in the Program Background section was generated by Mr. Charlie Williams of NSEL.

Photographs used in the report were provided by Mr. Denis Parent and Mr. Todd Smith of EC and Mr. Alan Tattrie of NSEL.

# 1.0 PROGRAM BACKGROUND

The Nova Scotia Automated Surface Water Quality Monitoring Network (Figure 1) consists of a series of stations located throughout the province where automated equipment monitor water quality in support of water management decisions. It is part of a long term comprehensive water resource monitoring program for the province.

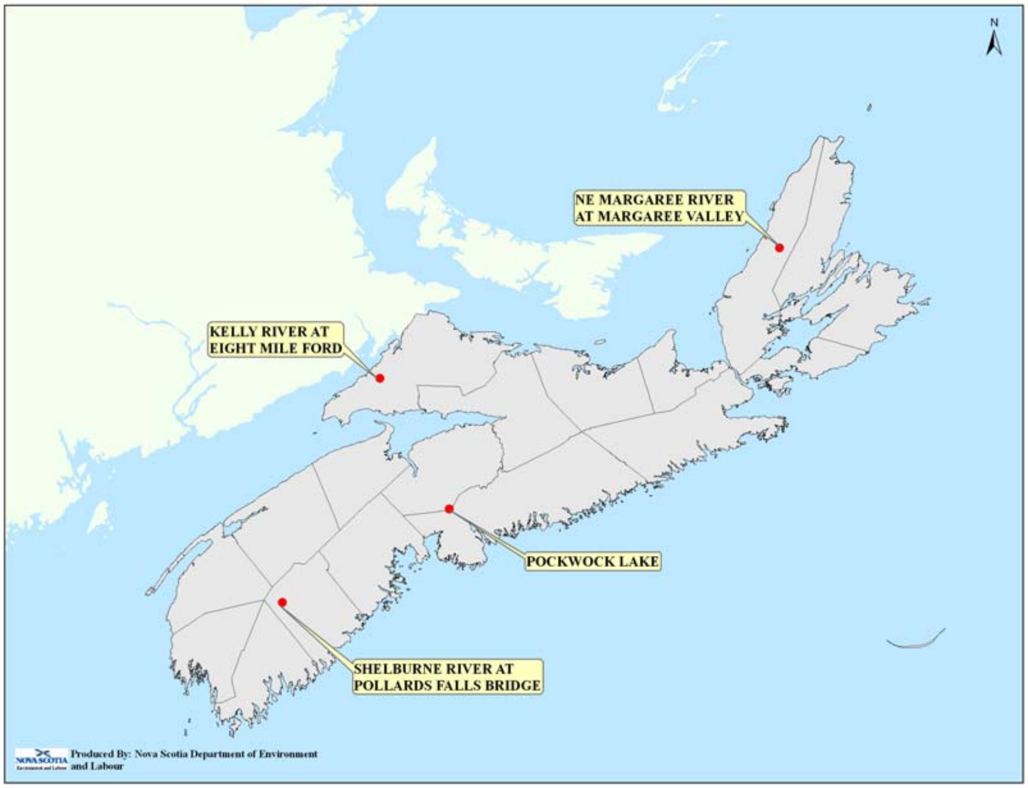


Figure 1.0-1. Nova Scotia Automated Surface Water Quality Monitoring Network station locations.

This program is intended to determine baseline water quality in lakes and streams throughout the province, and assess impacts on both a local and regional scale, as part of water resource management activities. Long term trends in water quality are measured in both relatively pristine watersheds as well as more impacted sites. Monitoring stations include areas of provincial significance such as Heritage River sites, Provincial Parks and Sanctuaries and Municipal Drinking Water Supplies. Monitoring stations are typically co-located with hydrometric (stream flow) monitoring stations to allow 1) program delivery efficiencies, 2) capabilities for real-time reporting, and 3) calculations of loadings of contaminants or other water quality constituents.

Site locations have been selected based on meeting one or more of the following criteria:

- Heritage River status or nomination
- Protected Area status (provincial /federal park, sanctuary, or public drinking water supply watershed)
- hydrometric station
- geographical coverage
- important fish habitat (eg salmon)
- largely unimpacted site
- Water Quality Index potential
- historical long term water quality dataset.

In addition to contributing to provincial water resource management activities, this program supports both the Canadian Heritage River Program and the national Canadian Environmental Sustainability Indicators (CESI) reporting initiative.

Automated equipment was first introduced at Pockwock Lake in 1999 as a pilot program, then expanded to the Shelburne River, North East Margaree River, and Kelley River stations in 2000, 2001, and 2004, respectively.

## 2.0 PARAMETERS

Five water quality characteristics were and continue to be monitored through this program. They are:

***Water Temperature ($^{o}$C)***- a constituent of concern because it affects fish and fish habitat.

Water temperature varies on a diurnal (during the day), seasonal and annual basis and even within the water column itself. Water temperature is known to affect a number of fish characteristics including feeding rates and metabolism, migration, spawning, incubation, and emergence. Tolerance to temperature varies among fish species and life stage. Higher water temperatures can result in an increase in the incidence of disease. A maximum permissible limit for salmon and trout is 20-21$^{o}$C (Alabaster and Lloyd 1982).

***Specific conductance (conductivity)(uS/cm)*** – refers to the ability of a substance to conduct electric current and is an indirect indicator of dissolved minerals, acids, and metals in the water. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity.

The conductivity of natural fresh waters varies greatly and may range from less than 20 uS/cm in dilute waters to over several hundred or more in waters influenced by limestone or salt deposits. Road-salting activity is one example of a human influence on conductivity levels in surface and groundwater resources.

***Turbidity (NTU)*** - an indicator of water transparency, is caused by the presence of suspended matter.

The major source of suspended matter is watershed soil transported to surface waters through the process of erosion. A general description of matter contributing to turbidity includes clay, silt, finely divided organic and inorganic matter and plankton and other microscopic organisms. Turbidity is measured in nephelometric turbidity units (NTU). The Canadian Council of Ministers of the Environment (CCME) lists limits of 1 NTU entering a water distribution system for drinking water and 50 NTU for recreational uses. A maximum limit of 5 NTU is permitted if it can be demonstrated that the efficacy of disinfection is not compromised. An aesthetic objective of 5 NTU at the point of consumption has been set.

***pH (pH Units)*** – the logarithm of the reciprocal of the concentration of free hydrogen ions. The pH scale ranges from 0 – 14, 7 being neutral. Values below 7 indicate increasing levels of acidity; above 7 indicate increasing levels of alkalinity.

Water quality guidelines established for recreational uses and the protection of aquatic life recommends a pH range of 5.0 – 9.0. Values below pH 5.0, for example, are harmful to the eggs and fry of salmonids. For drinking water, a range of 6.5 – 8.5 is recommended mainly for reasons of corrosion and encrustation of piped system components and the disinfection effectiveness of chlorination.

***Dissolved Oxygen (mg/L)*** **–** varies seasonally and geographically and is in part the result of variations in temperature, turbulence, atmospheric pressure, photosynthetic activity and organic decomposition.

Adequate levels of dissolved oxygen are essential for a healthy aquatic ecosystem. The minimum tolerable concentration is known to vary among aquatic species and life stage. Concentrations at or above 5.0 mg/L will provide safe conditions for these organisms in the aquatic ecosystem.

# 3.0 METHODS

## 3.1 STATION SET-UP

Supporting infrastructure and design specifications employed for each of the automated water quality monitoring stations in the network adhered to guidelines and standards established by the U.S. Geological Survey and the manufacturers of data gathering equipment and instrumentation, Hydrolab® and Campbell Scientific (Canada) Corporation. Cover pages and Table of Contents for pertinent documents are contained in Appendix I. Nova Scotia Department of Environment & Labour (NSEL) Water and Wastewater Branch can be contacted by telephone at (902) 424-2553 or electronically via the NSEL Water Line at delwater@gov.ns.ca for information on how to obtain a complete version of these documents.

## 3.2 STATION IDENTIFICATION

Each station, whether stream site or lake, has been located based on geographic location. As part of a unique identification system used by Environment Canada for its stream gauging network, an assigned locator code accompanies each of the three stream sites. This code is unique in that it applies specifically to a given station. The code is usually assigned when a station is first established and is retained for that station indefinitely. Station locator information for the NSEL network is presented in Table 1.

Table 3.2-1. Automated Surface Water Quality Network Monitoring Station Locator Information.

| Station Name | Description | EC Station Code* | Geographic Location Longitude Latitude |
|---|---|---|---|
| Kelley River | Mill Creek @ 8-Mile Foord | 01DL001 | 64° 27' 05"W 45° 35' 10"N |
| North East Margaree River | @ Margaree Valley | 01FB001 | 60° 58' 36"W 46° 22' 10"N |
| Pockwock Lake | @ Pumphouse | na | 63° 50' 43"W 44° 46' 56"N |
| Shelburne River | @ Pollard's Fall Bridge | 01ED013 | 65° 14' 32"W 44° 12' 59"N |

*Environment Canada Hydrometric Network Station Code; na: not applicable

## 3.3 DATA COLLECTION, MANAGEMENT AND STATISTICAL REVIEW

Field instrumentation at each of the automated monitoring sites included Hydrolab® datasondes equipped with temperature, pH, conductivity, dissolved oxygen, and turbidity sensors that gathered information which were subsequently stored on a datalogger. These data are downloaded at regular intervals and in turn verified by NSEL staff. A detailed description of these procedures is contained in Appendix II.

Under the Terms of Reference of this report, CWRS staff applied professional judgement to further scrutinize the verified datasets. Data were deleted and recorded (see Data Omission section, Appendix II). Following this review, the datasets were deemed to be of high quality and suitable for release by NSEL.

Statistics were computed from these final datasets of hourly data for each site and expressed in a series of tables and/or plots as hourly, monthly, seasonal and annual minimum/maximum/mean/standard deviation values for each year on record for each station for each measured quantity. Results of the analyses are presented in this report with each station summary.

In addition to the above, individual exceedence tables have been generated using validated hourly datasets that are based on guidelines published by the Canadian Council of the Ministers of the Environment (CCME) for the Protection of Freshwater Aquatic Life, Drinking Water, and Recreational Use. The more sensitive water temperature criteria published by Alabaster and Lloyd (1982) for salmon and trout have been adopted for this exercise instead of that published by the CCME for drinking water. The CCME limit is an aesthetic objective that is considered to have little bearing on this review.

## 3.4 SUPPLEMENTAL CLIMATE INFORMATION

For each station and period of record, precipitation and air temperature data from The Green Lane™, Environment Canada’s (EC) National Climate Data and Information Archive, has been combined with information generated through the automated water quality (WQ) monitoring program. This information is considered an added benefit when attempting to interpret the water quality data. The archive is accessible at http://climate.weatheroffice.ec.gc.ca/Welcome_e.html. Climate stations used for each of the automated WQ sites are listed in Table 2. Sites were chosen based on proximity to the target watershed and completeness of record.

Table 3.4-1. Supplemental climate information sources.

| Real Time Station Name | EC Climate Station | EC ID | Geographic Location Longitude Latitude |
|---|---|---|---|
| Kelley River | Nappan CDA | 8203700 | 64° 15' W 45° 46' N |
| North East Margaree River | Cheticamp CS | 8200827 | 60° 57' W 46° 39' N |
| Pockwock Lake | Pockwock Lake | 8204453 | 63° 49' W 44° 46' N |
| Shelburne River | Kejimkjik 1 | 8202592 | 65° 12' W 44° 25' N |

## 3.5 LAND USE INFORMATION

A generalized land use classification was developed for this review. Using forest cover maps obtained from the Nova Scotia Department of Natural Resources (NSDNR) in digital format, each watershed was sub-divided into the following categories: agriculture, barren, cleared, forest, urban, and wetland/water. This information is presented in tabular and map form that is contained in each of the station summaries. As well a detailed breakdown of land use and forest type is contained in Appendix IV. As with the supplemental climate data, inclusion of the land use information provide a valuable detailed description of watershed features that are essential when attempting to understand observed changes in water quality.

## 3.6 GRAB SAMPLE WATER QUALITY

In addition to the automated measurements, periodic water samples are collected manually from each of the automated monitoring sites and analyzed for common water quality parameters. These data are not only used for instrument calibration, but to more fully characterize water quality. These data are available to calculate loads and yields in support of water management activities. For the purpose of this report the grab sample data were limited to QA/QC use only.

These data are presented in Appendix III.

## 3.7 QA/QC

Monitoring stations were established and instrumentation calibrated according to standard methods published by the United States Geological Survey (USGS) and Hydrolab™ as reported by Campbell Scientific Canada Corporation (CSCC). The size of these documents prohibits their inclusion in this report. For reference, document Title pages and Table of Contents are provided in Appendix I. A slightly modified version of the USGS data rating system was adopted for this monitoring program (see Table II-1). For instrument calibration, Hydrolab™ sensors were calibrated during regular field visits using a portable hand held water quality meter that had been calibrated using commercially available liquid standards. During the early phases of the program, both grab sample results from laboratory analyses and liquid standards were used. Refer to Appendix V for details.

Raw real time data undergoes a series of verification steps prior to it being considered suitable for release by NSEL. The first step in the procedure is to examine and reject any data that are considered faulty due to probe and/or logger malfunction or probe interference due to submerged debris. Data are also screened from the dataset if they are found to exceed maximum allowable limits based on a slightly modified version of those published by the USGS (Appendix II, Table II-2). For this report, individual data sets provided by NSEL have undergone further scrutiny by CWRS staff prior to carrying out statistical analysis and based on professional judgement, some additional data were deleted.

Station descriptions, field maintenance and operational procedures, and data verification procedures are compiled in annual reports. This information can be found in Appendix II.

# 4.0 AUTOMATED WATER QUALITY MONITORING STATION SUMMARY

## 4.1 POCKWOCK LAKE
## 2002-2005

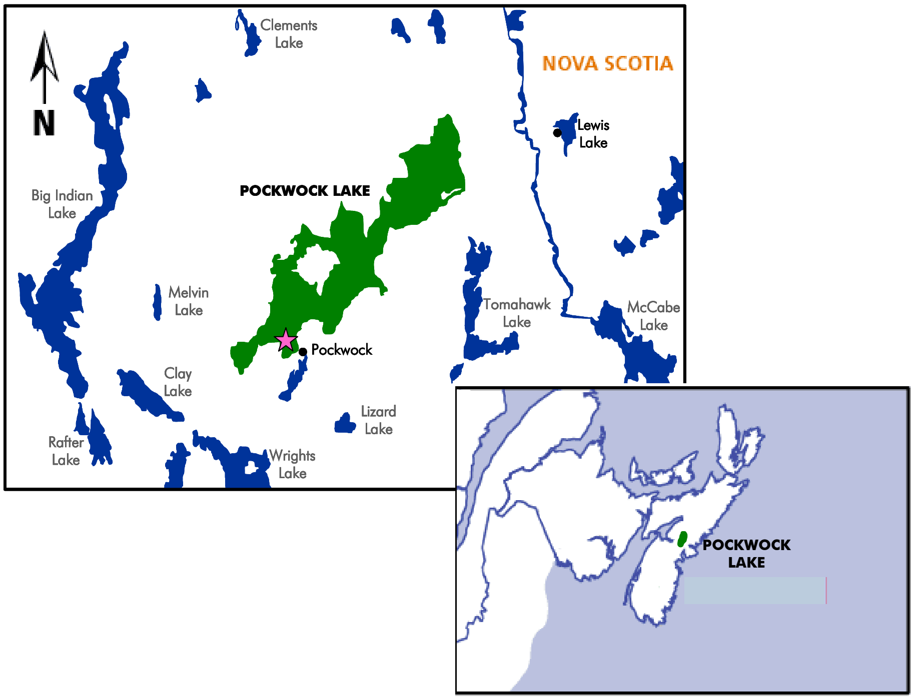


Figure 4.1-1. Location of Pockwock Lake.

### 4.1.1 Background Information

*4.1.1.1 Location of Station*

The geographic location, in longitude and latitude, of the Automated Network Station on Pockwock Lake is 63°50’43” W, 44° 46’56”N and is denoted in Figure 4-1 by a star.

*4.1.1.2 Geographic Setting*

Pockwock Lake is located on the border between Halifax and Hants Counties and is the drinking water supply for Halifax, Bedford, Sackville, Timberlea, Fall River and Waverley. The watershed is 56.61 $km^2$, is protected by provincial designation and is jointly managed by the Halifax Regional Water Commission (HRWC) and the Nova Scotia Department of Natural Resources.

*4.1.1.3 Geology and Geomorphology*

The bedrock geology in the Pockwock watershed is made up of two main rock types. Pockwock Lake represents the contact between the South Mountain Batholith (SMB), granitic rocks, which dominate the central and western regions of Nova Scotia and the Goldenville Formation of the Meguma Group, found in the southern mainland of the province.

The surficial geology of the area developed as a result of the numerous glaciations. The southern portion of the Pockwock watershed is characterized by the presence of several till units with varying textures, compositions, age and places of origin. In areas north of Pockwock Lake, less till was deposited by retreating glaciers and as a result, exposed granite bedrock structures are frequently visible. Tills on the west side of the lake are derived from the underlying granites and tills on the eastern side of the lake are derived from the underlying Goldenville Formation.

The dominant landform in the watershed is the undulating to moderately rolling plain with a thin mantle of stony till and peat bogs.

*4.1.1.4 Forest Cover and Land Use*

The watershed is under forest management by HRWC and contract to Elmsdale Lumber Ltd., with goals of water quality protection and sustainable forestry. About 61% of the land within the watershed is forested, 13% is clear-cut, and 23% of it is covered by water and/or wetlands. 2.7 % of the watershed is considered as urban land use.

*4.1.1.5 Climate*

Normal (1971-2000) precipitation in the Pockwock Lake watershed, as recorded at the Environment Canada Climate Station at Pockwock Lake is 1529 mm, comprised of 1335 mm of rainfall and 190 cm of snowfall. The mean annual temperature is 6.4$^{o}$C with a mean monthly high of 18.4$^{o}$C in July and a low of –5.9$^{o}$C in January.

Figure 4.1-2. Aerial view of Pockwock Lake.

*4.1.1.6 Wildlife and Habitat*

The Pockwock Lake watershed provides habitat for many species of plants and animals, including deer, beaver, and muskrat. Such wildlife species are important to water use in this context, due to the potential for fecal contamination and the lake water use as a drinking water supply. Treatment technologies are employed which address such issues prior to final water use.

*4.1.1.7 Human Settlement and Industrial Development*

The name Pockwock comes from the Mi’kmaq word Paakwaak, meaning “must stop here”. Early European settlement occurred slowly in the area, with a recent increase in residential development during the late 1990s and early in the following decade. Industrial development in the watershed is restricted and includes only limited forestry overseen by the HRWC. This watershed became a protected drinking water supply area as designated under the Environment Act in 1994.

## 4.1.2 Land Use and Forest Type Summary Information

### *4.1.2.1 Land Use*

| Land Type | Area km$^2$ | % of Total Area |
|---|---|---|
| Agriculture | 0.00 | 0.0 |
| Barren | 0.3 | 0.6 |
| Clearcut | 7.0 | 12.9 |
| Forested | 32.7 | 60.6 |
| Urban | 1.5 | 2.7 |
| Wetland/Water | 12.5 | 23.1 |
| Total | 54.0 | 100.0 |

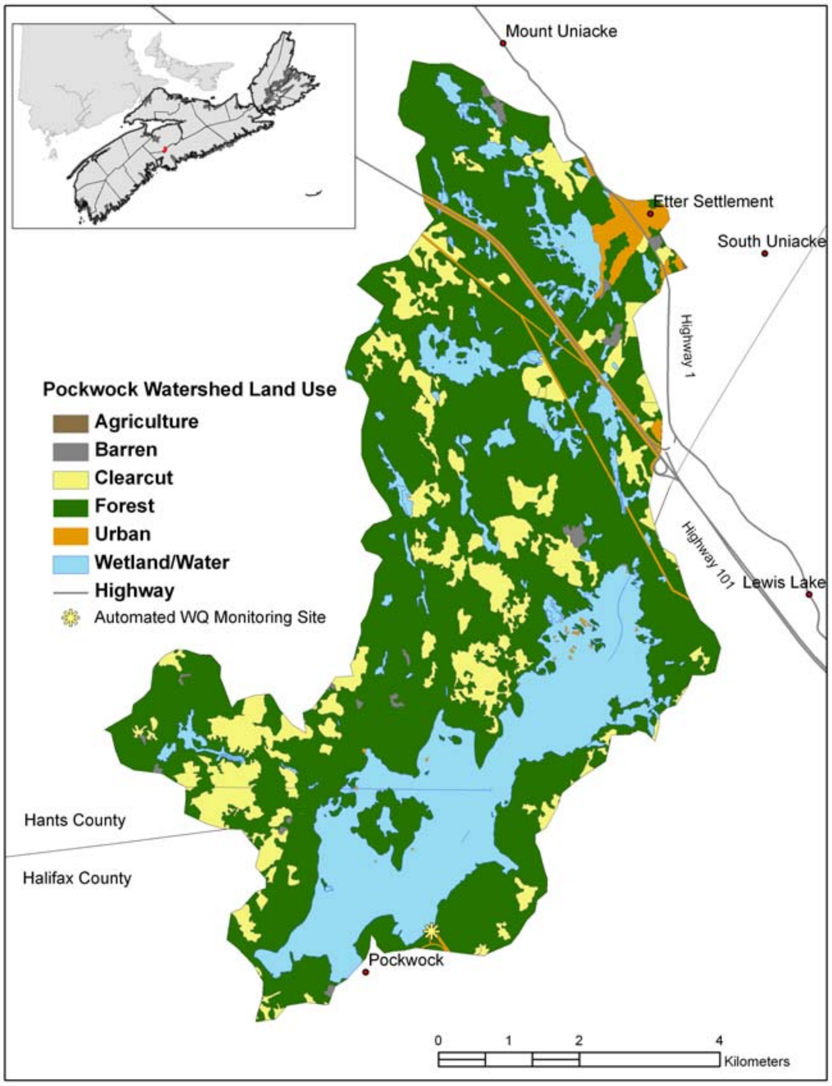


Figure 4.1-3. Land use mapping of Pockwock Lake Watershed.

### *4.1.2.2 Forest Type*

| Forest Type | Area km$^2$ | % of Total Area |
|---|---|---|
| Forested | 32.7 | 100.0 |
| Hardwood | 1.6 | 4.9 |
| Mixed Wood | 5.3 | 16.2 |
| Softwood | 25.8 | 78.9 |
| Unknown | 0.0 | 0.0 |

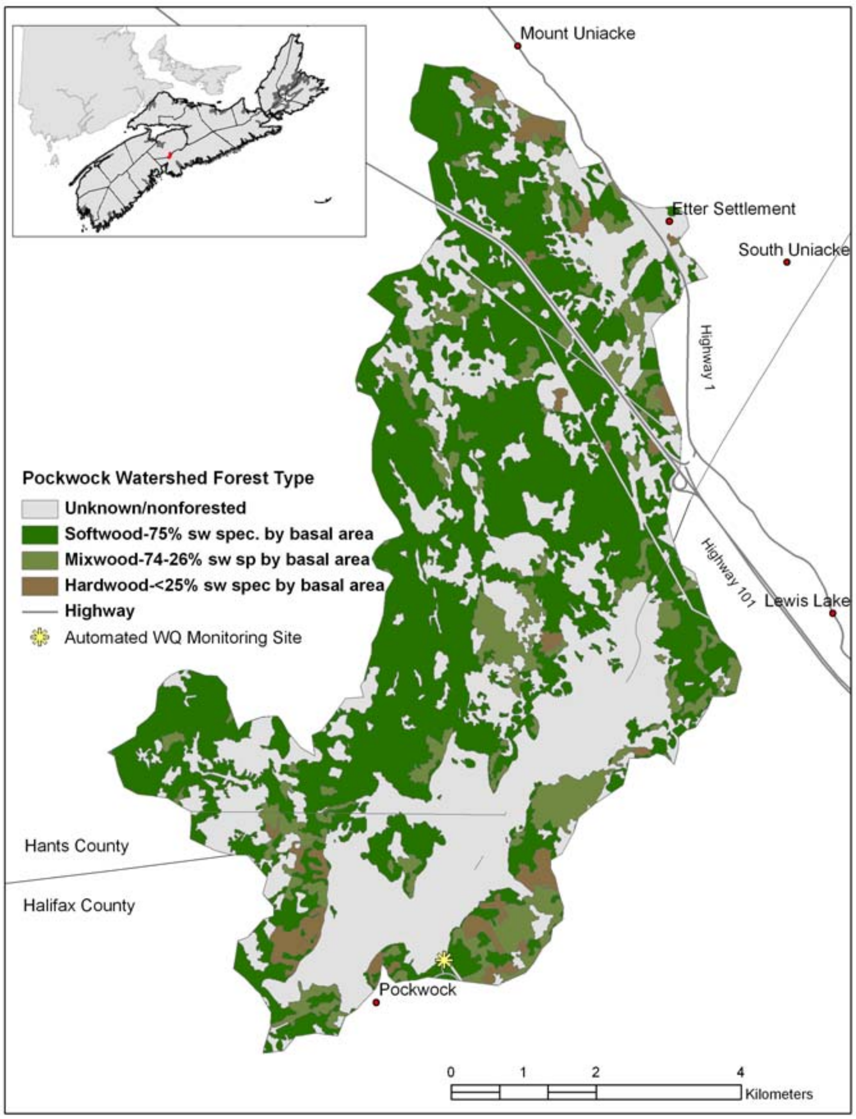


Figure 4.1-4. Forest type mapping of Pockwock Lake Watershed.

### 4.1.3 Water Quality Summary Information

Table 4.1-1. Hourly statistics of minimum, maximum, mean, and standard deviation and exceedences as per established water quality guidelines for hourly real time data for Pockwock Lake for the period 2002 –2005.

| Parameter | Year | Min | Max | Mean | SD | CWQ Guideline | | | Readings[5] | # of Exceedences | | | Exceedences As % of Readings | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWAL[1] | DW[1] | REC[1] | | | | | | | |
| | | | | | | | | | | | | | | | |
| Temperature, °C | 2002 | 9.4 | 24.5 | 18.2 | 3.6 | 20-21[2] | | | 2132 | 494 | | | 23 | | |
| | 2003 | 0.8 | 23.3 | 10.8 | 7.6 | | | | 7922 | 1072 | | | 14 | | |
| | 2004 | 0.3 | 23.3 | 9.9 | 7.4 | | | | 8158 | 867 | | | 11 | | |
| | 2005 | 6.4 | 23.3 | 16.4 | 4.8 | | | | 4102 | 1022 | | | 25 | | |
| | | | | | | | | | | | | | | | |
| Turbidity, NTU | | | | | | | | | | DW <1[3] | DW ≤5[4] | REC | DW <1[3] | DW ≤5[4] | REC |
| | 2002 | - | - | - | - | | <1[3], ≤5[4] | ≤50 | - | - | - | - | - | - | - |
| | 2003 | 0.0 | 1.8 | 0.3 | 0.3 | | | | 5383 | 38 | 0 | 0 | 1 | 51 | 52 |
| | 2004 | 0.0 | 7.6 | 1.2 | 0.8 | | | | 4817 | 2468 | 1 | 0 | 0 | 0 | 1 |
| | 2005 | 0.0 | 35.9 | 1.0 | 1.5 | | | | 4102 | 2130 | 41 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | | | |
| Conductivity, uS/cm | 2002 | 38.8 | 40.2 | 39.4 | 0.7 | | | | | | | | | | |
| | 2003 | 34.7 | 39.8 | 37.7 | 1.4 | | | | | | | | | | |
| | 2004 | 35.7 | 43.4 | 39.9 | 1.7 | | | | | | | | | | |
| | 2005 | 35.5 | 42.4 | 37.9 | 1.2 | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Dissolved Oxygen, mg/L | 2002 | 6.6 | 10.7 | 8.7 | 0.7 | ≥5.0 | | | 2128 | 0 | | | 0 | | |
| | 2003 | 7.6 | 14.2 | 10.8 | 2.2 | | | | 7922 | 0 | | | 0 | | |
| | 2004 | 7.7 | 13.4 | 10.8 | 1.9 | | | | 8155 | 0 | | | 0 | | |
| | 2005 | 7.5 | 10.9 | 8.8 | 0.8 | | | | 4102 | 0 | | | 0 | | |
| | | | | | | | | | | | | | | | |
| pH, Units | | | | | | | | | | FWAL | DW | REC | FWAL | DW | REC |
| | 2002 | 5.3 | 5.5 | 5.4 | 0.0 | 6.5-9.0 | 6.5-8.5 | 6.5-9.5 | 2131 | 2131 | 2131 | 2131 | 100 | 100 | 100 |
| | 2003 | 4.9 | 5.8 | 5.3 | 0.2 | | | | 7921 | 7921 | 7921 | 7921 | 100 | 100 | 100 |
| | 2004 | 4.9 | 5.6 | 5.3 | 0.1 | | | | 8157 | 8157 | 8157 | 8157 | 100 | 100 | 100 |
| | 2005 | 4.8 | 5.4 | 5.1 | 0.1 | | | | 4100 | 4100 | 4100 | 4100 | 100 | 100 | 100 |

[1] FWAL: Freshwater Aquatic Life; DW: Drinking Water; REC: Recreational Uses.
[2] Upper permissible limit for salmon and trout (Alabaster and Lloyd. 1982). CCME DW guideline deemed to be inappropriate.
[3] Maximum Acceptable Concentration for water entering a distribution system.
[4] Aesthetic Objective. 5NTU may be permitted if demonstrated that the disinfection method is not compromised.
[5] The number of hourly readings possible in each of the years 2002, 2003 and 2005 is 8760. For 2004 the number is 8784. The number recorded in the table refers to the actual number of approved measurements.

*4.1.3.1 Temperature*

Figure 4.1-5. Water temperature from August 2002 through December 2005 for the Pockwock Lake using hourly values. Gaps in the plot indicate missing data.

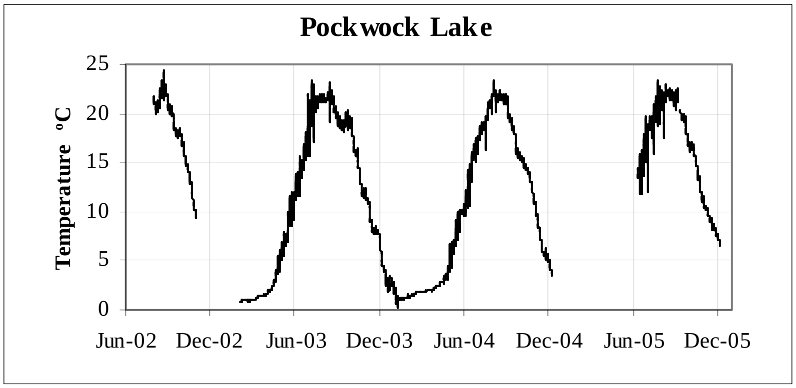


Figure 4.1-6. Water temperature from August 2002 through December 2005 for the Pockwock Lake using daily mean values. Gaps in the plot indicate missing data.

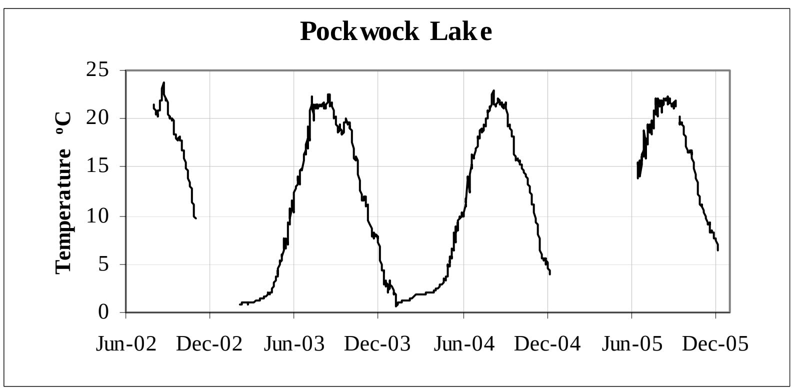

Figure 4.1-7. Air and water temperature from August 2002 through December 2005 for Pockwock Lake using monthly mean values. Gaps in the plot indicate missing data.

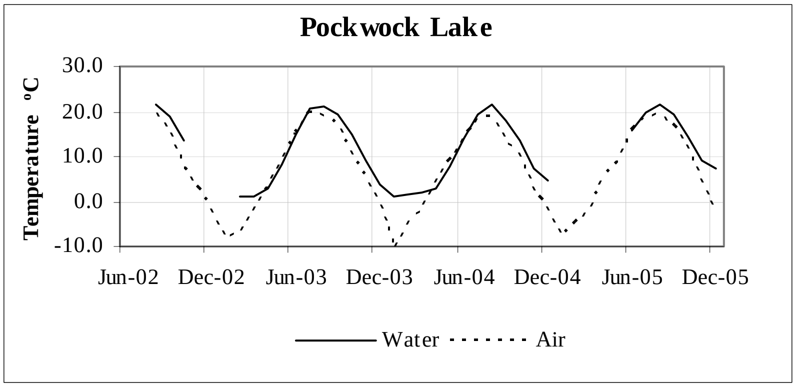


Table 4.1-2. Mean monthly water temperature for Pockwock Lake during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | °C | ------------- | ----- |
| August | 2002 | 21.7 | 20.4 | 23.8 | 1.0 |
| September | 2002 | 18.8 | 16.9 | 20.5 | 1.1 |
| October | 2002 | 13.7 | 9.7 | 16.9 | 2.2 |
| November | 2002 | | | | |
| December | 2002 | | | | |
| January | 2003 | | | | |
| February | 2003 | 0.9 | 0.8 | 1.0 | 0.0 |
| March | 2003 | 1.3 | 1.0 | 1.6 | 0.2 |
| April | 2003 | 2.9 | 1.7 | 5.3 | 1.0 |
| May | 2003 | 8.2 | 5.2 | 11.6 | 2.1 |
| June | 2003 | 14.8 | 11.7 | 18.0 | 1.7 |
| July | 2003 | 20.9 | 17.8 | 22.3 | 1.0 |
| August | 2003 | 21.2 | 19.6 | 22.6 | 0.7 |
| September | 2003 | 19.1 | 18.4 | 19.9 | 0.4 |
| October | 2003 | 14.7 | 11.7 | 19.1 | 2.4 |
| November | 2003 | 9.0 | 7.4 | 12.0 | 1.5 |
| December | 2003 | 3.7 | 2.1 | 7.3 | 1.4 |
| January | 2004 | 1.3 | 0.7 | 2.3 | 0.4 |
| February | 2004 | 1.6 | 1.3 | 1.8 | 0.2 |
| March | 2004 | 2.0 | 1.8 | 2.3 | 0.1 |
| April | 2004 | 3.1 | 2.4 | 4.9 | 0.6 |
| May | 2004 | 7.9 | 4.7 | 10.2 | 1.9 |
| June | 2004 | 13.8 | 9.8 | 16.9 | 2.4 |
| July | 2004 | 19.3 | 17.1 | 21.2 | 1.2 |

Table 4.1-2, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | °C | ------------- | ----- |
| August | 2004 | 21.7 | 21.1 | 22.9 | 0.4 |
| September | 2004 | 18.1 | 15.5 | 21.6 | 1.9 |
| October | 2004 | 13.7 | 11.1 | 15.6 | 1.4 |
| November | 2004 | 7.2 | 5.0 | 10.9 | 1.9 |
| December | 2004 | 4.5 | 3.9 | 5.0 | 0.4 |
| January | 2005 | | | | |
| February | 2005 | | | | |
| March | 2005 | | | | |
| April | 2005 | | | | |
| May | 2005 | | | | |
| June | 2005 | 15.6 | 13.9 | 18.8 | 1.2 |
| July | 2005 | 19.6 | 15.9 | 22.2 | 1.5 |
| August | 2005 | 21.7 | 20.7 | 22.2 | 0.4 |
| September | 2005 | 19.5 | 16.7 | 22.0 | 1.6 |
| October | 2005 | 14.4 | 11.0 | 16.8 | 2.1 |
| November | 2005 | 9.1 | 7.6 | 11.1 | 1.0 |
| December | 2005 | 7.1 | 6.5 | 7.6 | 0.5 |

Table 4.1-3. Mean seasonal water temperature for Pockwock Lake during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | °C | ------------- | ----- |
| Summer | 2002 | 21.7 | 20.4 | 23.8 | 1.0 |
| Fall | 2002 | 16.3 | 9.7 | 20.5 | 3.1 |
| Winter | 2003 | 0.9 | 0.8 | 1.0 | 0.0 |
| Spring | 2003 | 4.1 | 1.0 | 11.6 | 3.3 |
| Summer | 2003 | 19.0 | 11.7 | 22.6 | 3.2 |
| Fall | 2003 | 14.3 | 7.4 | 19.9 | 4.4 |
| Winter | 2004 | 2.2 | 0.7 | 7.3 | 1.4 |
| Spring | 2004 | 4.3 | 1.8 | 10.2 | 2.8 |
| Summer | 2004 | 18.3 | 9.8 | 22.9 | 3.6 |
| Fall | 2004 | 13.0 | 5.0 | 21.6 | 4.8 |
| Winter | 2005 | 4.5 | 3.9 | 5.0 | 0.4 |
| Spring | 2005 | | | | |
| Summer | 2005 | 19.5 | 13.9 | 22.2 | 2.5 |
| Fall | 2005 | 14.1 | 7.6 | 22.0 | 4.5 |

Table 4.1-4. Mean annual water temperature for Pockwock Lake during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ------------- | $^oC$ | ------------- | ----- |
| 2002 | 18.1 | 9.7 | 23.8 | 3.7 |
| 2003 | 10.8 | 0.8 | 22.6 | 7.6 |
| 2004 | 9.9 | 0.7 | 22.9 | 7.4 |
| 2005 | 16.4 | 6.5 | 22.2 | 4.8 |

Missing value implies insufficient data to compute the statistic.

### *4.1.3.2 Turbidity*

Figure 4.1-8. Turbidity levels from August 2002 to December 2005 for the Pockwock Lake based on hourly values. Gaps in the plot indicate missing data.

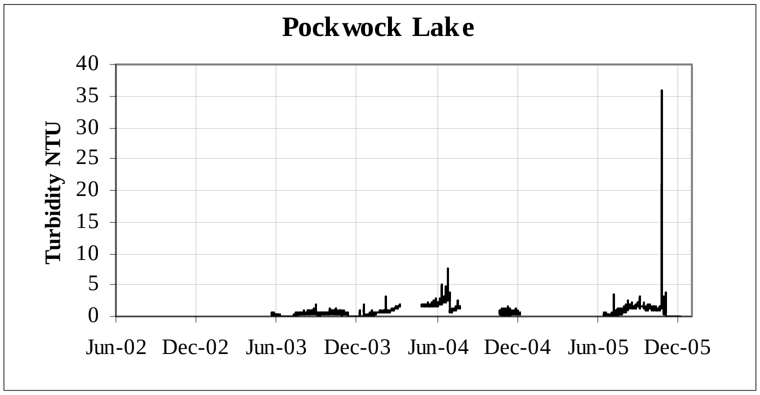


Figure 4.1-9. Turbidity levels from August 2002 to December 2005 for the Pockwock Lake based on daily mean values. Gaps in the plot indicate missing data.

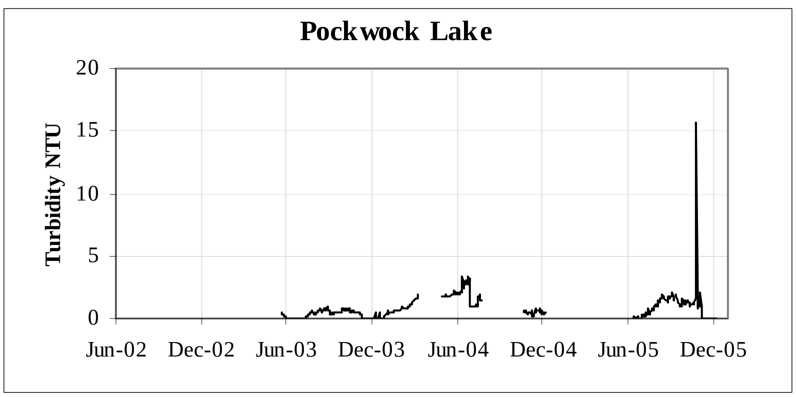

Figure 4.1-10. Turbidity levels from August 2002 to December 2005 for the Pockwock Lake based on monthly mean values. Gaps in the plot indicate missing data.

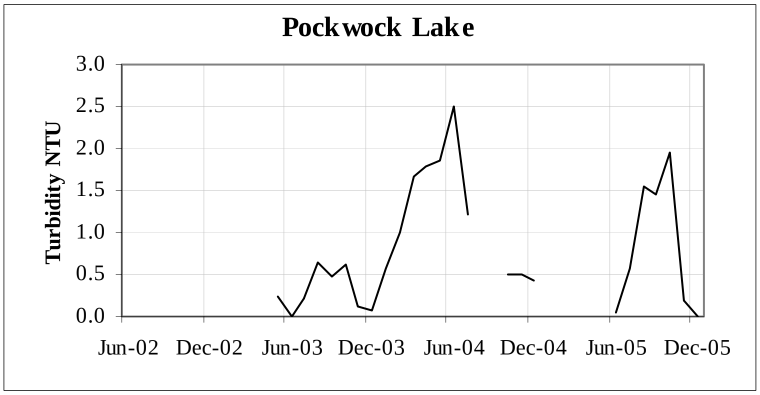


Table 4.1-5. Mean monthly turbidity for Pockwock Lake during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ NTU ------------ | | | ----- |
| August | 2002 | | | | |
| September | 2002 | | | | |
| October | 2002 | | | | |
| November | 2002 | | | | |
| December | 2002 | | | | |
| January | 2003 | | | | |
| February | 2003 | | | | |
| March | 2003 | | | | |
| April | 2003 | | | | |
| May | 2003 | 0.2 | 0.1 | 0.4 | 0.1 |
| June | 2003 | 0.0 | 0.0 | 0.1 | 0.0 |
| July | 2003 | 0.2 | 0.0 | 0.6 | 0.2 |
| August | 2003 | 0.7 | 0.4 | 1.0 | 0.1 |
| September | 2003 | 0.5 | 0.3 | 0.9 | 0.1 |
| October | 2003 | 0.6 | 0.5 | 0.8 | 0.1 |
| November | 2003 | 0.1 | 0.0 | 0.5 | 0.2 |
| December | 2003 | 0.1 | 0.0 | 0.5 | 0.1 |
| January | 2004 | 0.6 | 0.3 | 0.7 | 0.1 |
| February | 2004 | 1.0 | 0.7 | 1.5 | 0.2 |
| March | 2004 | 1.7 | 1.5 | 1.9 | 0.1 |
| April | 2004 | 1.8 | 1.8 | 1.8 | 0.0 |
| May | 2004 | 1.9 | 1.7 | 2.2 | 0.1 |
| June | 2004 | 2.5 | 0.9 | 3.4 | 0.6 |
| July | 2004 | 1.2 | 0.9 | 1.9 | 0.3 |

Table 4.1-5, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ NTU | | ------------ | ----- |
| August | 2004 | | | | |
| September | 2004 | | | | |
| October | 2004 | 0.5 | 0.3 | 0.6 | 0.1 |
| November | 2004 | 0.5 | 0.1 | 0.8 | 0.2 |
| December | 2004 | 0.4 | 0.4 | 0.5 | 0.0 |
| January | 2005 | | | | |
| February | 2005 | | | | |
| March | 2005 | | | | |
| April | 2005 | | | | |
| May | 2005 | | | | |
| June | 2005 | 0.1 | 0.0 | 0.2 | 0.1 |
| July | 2005 | 0.6 | 0.1 | 1.1 | 0.3 |
| August | 2005 | 1.6 | 1.0 | 1.9 | 0.2 |
| September | 2005 | 1.5 | 1.0 | 2.1 | 0.3 |
| October | 2005 | 2.0 | 0.8 | 15.7 | 2.7 |
| November | 2005 | 0.2 | 0.0 | 2.1 | 0.5 |
| December | 2005 | 0.0 | 0.0 | 0.0 | 0.0 |

Table 4.1-6. Mean seasonal turbidity for Pockwock Lake during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ NTU | | ------------ | ----- |
| Summer | 2002 | | | | |
| Fall | 2002 | | | | |
| Winter | 2003 | | | | |
| Spring | 2003 | 0.2 | 0.1 | 0.4 | 0.1 |
| Summer | 2003 | 0.3 | 0.0 | 1.0 | 0.3 |
| Fall | 2003 | 0.4 | 0.0 | 0.9 | 0.3 |
| Winter | 2004 | 0.5 | 0.0 | 1.5 | 0.4 |
| Spring | 2004 | 1.8 | 1.5 | 2.2 | 0.1 |
| Summer | 2004 | 2.0 | 0.9 | 3.4 | 0.8 |
| Fall | 2004 | 0.5 | 0.1 | 0.8 | 0.2 |
| Winter | 2005 | 0.4 | 0.4 | 0.5 | 0.0 |
| Spring | 2005 | | | | |
| Summer | 2005 | 0.8 | 0.0 | 1.9 | 0.7 |
| Fall | 2005 | 1.2 | 0.0 | 15.7 | 1.8 |

Table 4.1-7. Mean annual turbidity for Pockwock Lake during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ------------ NTU | | ------------ | ----- |
| 2002 | | | | |
| 2003 | 0.3 | 0.0 | 1.0 | 0.3 |
| 2004 | 1.2 | 0.1 | 3.4 | 0.8 |
| 2005 | 1.0 | 0.0 | 15.7 | 1.4 |

Missing value implies insufficient data to compute the statistic.

### *4.1.3.3 Conductivity*

Figure 4.1-11. Conductivity from August 2002 to December 2005 for the Pockwock Lake based on hourly values. Gaps in the plot indicate missing data.

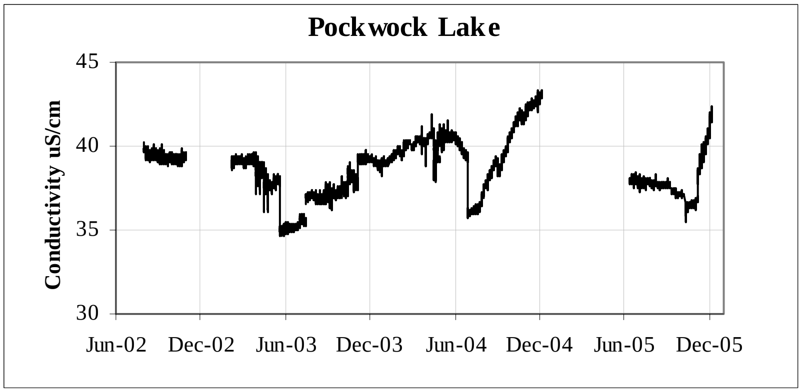


Figure 4.1-12. Conductivity from August 2002 to December 2005 for the Pockwock Lake based on daily mean values. Gaps in the plot indicate missing data.

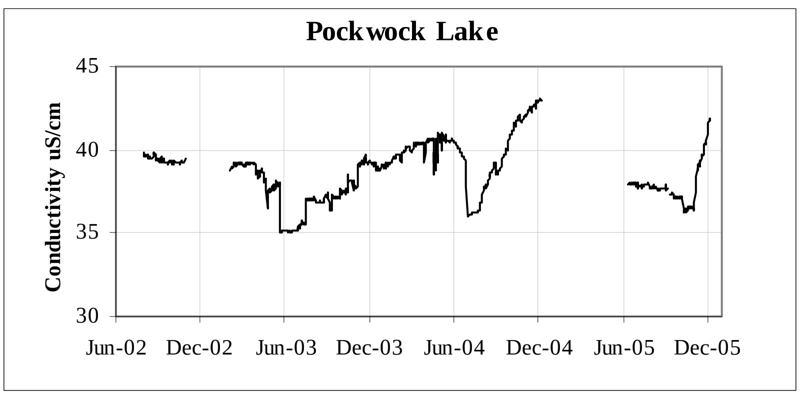

Figure 4.1-13. Conductivity from August 2002 to December 2005 for the Pockwock Lake based on monthly mean values. Gaps in the plot indicate missing data.

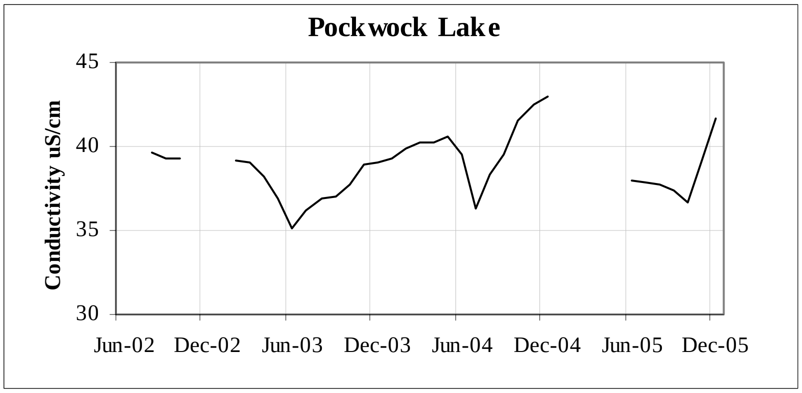


Table 4.1-8. Mean monthly conductivity for Pockwock Lake during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ---------- uS/cm | ---------- | | ----- |
| August | 2002 | 39.6 | 39.4 | 39.9 | 0.1 |
| September | 2002 | 39.3 | 39.1 | 39.6 | 0.1 |
| October | 2002 | 39.3 | 39.1 | 39.5 | 0.1 |
| November | 2002 | | | | |
| December | 2002 | | | | |
| January | 2003 | | | | |
| February | 2003 | 39.1 | 38.8 | 39.3 | 0.1 |
| March | 2003 | 39.1 | 38.5 | 39.2 | 0.1 |
| April | 2003 | 38.2 | 36.5 | 38.9 | 0.7 |
| May | 2003 | 36.9 | 35.0 | 38.1 | 1.3 |
| June | 2003 | 35.1 | 35.0 | 35.3 | 0.1 |
| July | 2003 | 36.2 | 35.3 | 37.1 | 0.8 |
| August | 2003 | 37.0 | 36.8 | 37.3 | 0.2 |
| September | 2003 | 37.1 | 36.4 | 37.7 | 0.3 |
| October | 2003 | 37.8 | 37.3 | 38.5 | 0.3 |
| November | 2003 | 39.0 | 37.7 | 39.7 | 0.6 |
| December | 2003 | 39.0 | 38.8 | 39.3 | 0.2 |
| January | 2004 | 39.3 | 38.9 | 39.7 | 0.3 |
| February | 2004 | 39.9 | 39.3 | 40.2 | 0.3 |
| March | 2004 | 40.2 | 39.3 | 40.4 | 0.2 |
| April | 2004 | 40.2 | 38.5 | 41.0 | 0.7 |
| May | 2004 | 40.6 | 40.0 | 41.0 | 0.2 |
| June | 2004 | 39.6 | 36.0 | 40.5 | 1.1 |
| July | 2004 | 36.3 | 36.0 | 37.1 | 0.3 |

Table 4.1-8, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ---------- uS/cm | | ---------- | ----- |
| August | 2004 | 38.3 | 37.3 | 39.2 | 0.6 |
| September | 2004 | 39.6 | 38.5 | 40.7 | 0.7 |
| October | 2004 | 41.6 | 40.9 | 42.1 | 0.3 |
| November | 2004 | 42.5 | 42.0 | 43.0 | 0.3 |
| December | 2004 | 43.0 | 43.0 | 43.1 | 0.1 |
| January | 2005 | | | | |
| February | 2005 | | | | |
| March | 2005 | | | | |
| April | 2005 | | | | |
| May | 2005 | | | | |
| June | 2005 | 37.9 | 37.8 | 38.0 | 0.1 |
| July | 2005 | 37.8 | 37.7 | 38.0 | 0.1 |
| August | 2005 | 37.7 | 37.6 | 37.9 | 0.1 |
| September | 2005 | 37.3 | 37.1 | 37.9 | 0.3 |
| October | 2005 | 36.6 | 36.2 | 37.2 | 0.3 |
| November | 2005 | 39.2 | 36.4 | 40.9 | 1.2 |
| December | 2005 | 41.6 | 41.3 | 41.9 | 0.2 |

Table 4.1-8. Mean seasonal conductivity for Pockwock Lake during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ---------- uS/cm | | ---------- | ----- |
| Summer | 2002 | 39.6 | 39.4 | 39.9 | 0.1 |
| Fall | 2002 | 39.3 | 39.1 | 39.6 | 0.1 |
| Winter | 2003 | 39.1 | 38.8 | 39.3 | 0.1 |
| Spring | 2003 | 38.0 | 35.0 | 39.2 | 1.2 |
| Summer | 2003 | 36.1 | 35.0 | 37.3 | 0.9 |
| Fall | 2003 | 37.9 | 36.4 | 39.7 | 0.9 |
| Winter | 2004 | 39.4 | 38.8 | 40.2 | 0.4 |
| Spring | 2004 | 40.4 | 38.5 | 41.0 | 0.5 |
| Summer | 2004 | 38.1 | 36.0 | 40.5 | 1.5 |
| Fall | 2004 | 41.2 | 38.5 | 43.0 | 1.3 |
| Winter | 2005 | 43.0 | 43.0 | 43.1 | 0.1 |
| Spring | 2005 | | | | |
| Summer | 2005 | 37.8 | 37.6 | 38.0 | 0.1 |
| Fall | 2005 | 37.7 | 36.2 | 40.9 | 1.3 |

Table 4.1-9. Mean annual conductivity for Pockwock Lake during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ---- | ---------- uS/cm ---------- | | | ------- |
| 2002 | 39.4 | 39.1 | 39.9 | 0.2 |
| 2003 | 37.7 | 35.0 | 39.7 | 1.4 |
| 2004 | 39.9 | 36.0 | 43.1 | 1.7 |
| 2005 | 37.9 | 36.2 | 41.9 | 1.2 |

Missing value implies insufficient data to compute the statistic.

### *4.1.3.4 Dissolved Oxygen*

Figure 4.1-15. Dissolved oxygen concentration from August 2002 to December 2005 for the Pockwock Lake based on <u>hourly values</u>. Gaps in the plot indicate missing data.

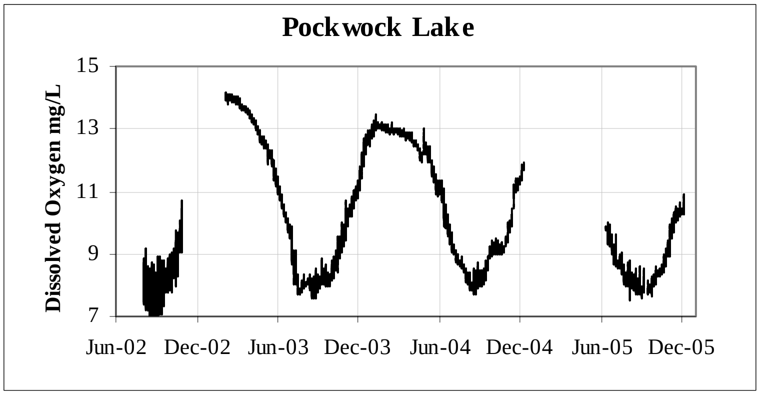


Figure 4.1-16. Dissolved oxygen concentration from August 2002 to December 2005 for the Pockwock Lake based on <u>daily mean values</u>. Gaps in the plot indicate missing data.

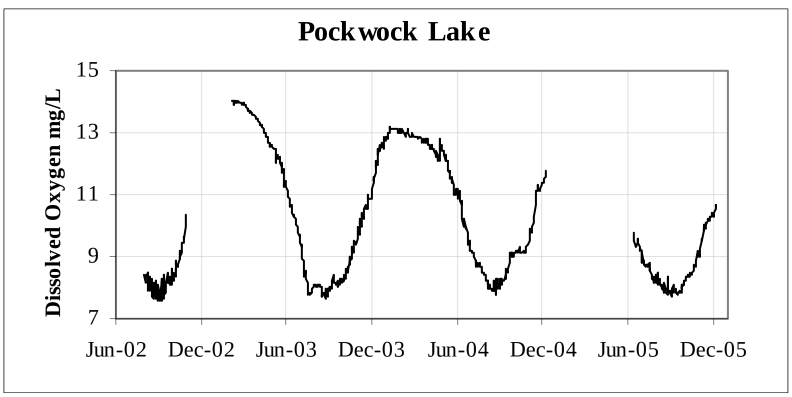

Figure 4.1.17. Dissolved oxygen concentration from August 2002 to December 2005 for Pockwock Lake based on monthly mean values. Gaps in the plot indicate missing data.

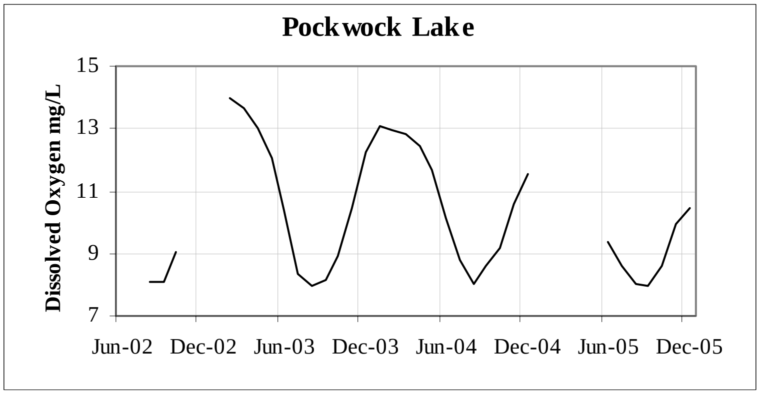


Table 4.1-10. Mean monthly dissolved oxygen concentrations for Pockwock Lake during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | mg/L | ------------ | ----- |
| August | 2002 | 8.1 | 7.6 | 8.5 | 0.3 |
| September | 2002 | 8.1 | 7.6 | 8.6 | 0.3 |
| October | 2002 | 9.1 | 8.3 | 10.4 | 0.6 |
| November | 2002 | | | | |
| December | 2002 | | | | |
| January | 2003 | | | | |
| February | 2003 | 14.0 | 13.9 | 14.1 | 0.0 |
| March | 2003 | 13.7 | 13.4 | 13.9 | 0.2 |
| April | 2003 | 13.0 | 12.6 | 13.4 | 0.3 |
| May | 2003 | 12.0 | 11.3 | 12.6 | 0.4 |
| June | 2003 | 10.4 | 9.7 | 11.3 | 0.5 |
| July | 2003 | 8.3 | 7.8 | 9.5 | 0.5 |
| August | 2003 | 7.9 | 7.7 | 8.1 | 0.1 |
| September | 2003 | 8.2 | 7.9 | 8.4 | 0.1 |
| October | 2003 | 8.9 | 8.2 | 9.6 | 0.4 |
| November | 2003 | 10.5 | 9.6 | 11.0 | 0.4 |
| December | 2003 | 12.2 | 11.0 | 12.9 | 0.5 |
| January | 2004 | 13.1 | 12.8 | 13.2 | 0.1 |
| February | 2004 | 13.0 | 12.9 | 13.1 | 0.1 |
| March | 2004 | 12.8 | 12.6 | 12.9 | 0.1 |
| April | 2004 | 12.4 | 12.1 | 12.8 | 0.2 |
| May | 2004 | 11.7 | 11.0 | 12.4 | 0.5 |
| June | 2004 | 10.1 | 9.2 | 11.1 | 0.6 |

Table 4.1-10, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | mg/L | ------------ | ----- |
| July | 2004 | 8.8 | 8.4 | 9.2 | 0.2 |
| August | 2004 | 8.1 | 7.8 | 8.3 | 0.1 |
| September | 2004 | 8.6 | 8.1 | 9.1 | 0.4 |
| October | 2004 | 9.2 | 9.1 | 9.4 | 0.1 |
| November | 2004 | 10.6 | 9.5 | 11.4 | 0.7 |
| December | 2004 | 11.6 | 11.4 | 11.8 | 0.1 |
| January | 2005 | | | | |
| February | 2005 | | | | |
| March | 2005 | | | | |
| April | 2005 | | | | |
| May | 2005 | | | | |
| June | 2005 | 9.4 | 8.8 | 9.8 | 0.2 |
| July | 2005 | 8.6 | 8.2 | 9.1 | 0.2 |
| August | 2005 | 8.0 | 7.8 | 8.5 | 0.2 |
| September | 2005 | 7.9 | 7.7 | 8.3 | 0.1 |
| October | 2005 | 8.6 | 8.2 | 9.2 | 0.3 |
| November | 2005 | 10.0 | 9.0 | 10.4 | 0.4 |
| December | 2005 | 10.5 | 10.3 | 10.7 | 0.1 |

Table 4.1-11. Mean seasonal dissolved oxygen concentrations for Pockwock Lake during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | mg/L | ------------ | ----- |
| Summer | 2002 | 8.1 | 7.6 | 8.5 | 0.3 |
| Fall | 2002 | 8.6 | 7.6 | 10.4 | 0.7 |
| Winter | 2003 | 14.0 | 13.9 | 14.1 | 0.0 |
| Spring | 2003 | 12.9 | 11.3 | 13.9 | 0.7 |
| Summer | 2003 | 8.9 | 7.7 | 11.3 | 1.1 |
| Fall | 2003 | 9.2 | 7.9 | 11.0 | 1.0 |
| Winter | 2004 | 12.7 | 11.0 | 13.2 | 0.5 |
| Spring | 2004 | 12.3 | 11.0 | 12.9 | 0.6 |
| Summer | 2004 | 9.0 | 7.8 | 11.1 | 0.9 |
| Fall | 2004 | 9.5 | 8.1 | 11.4 | 0.9 |

Table 4.1-11, continued

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | mg/L | ------------ | ----- |
| Winter | 2005 | 11.6 | 11.4 | 11.8 | 0.1 |
| Spring | 2005 | | | | |
| Summer | 2005 | 8.5 | 7.8 | 9.8 | 0.5 |
| Fall | 2005 | 8.9 | 7.7 | 10.4 | 0.9 |

Table 4.1-12. Mean annual dissolved oxygen concentrations for Pockwock Lake during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ------------ | mg/L | ------------ | ----- |
| 2002 | 8.4 | 7.6 | 10.4 | 0.6 |
| 2003 | 10.8 | 7.7 | 14.1 | 2.2 |
| 2004 | 10.8 | 7.8 | 13.2 | 1.9 |
| 2005 | 8.8 | 7.7 | 10.7 | 0.8 |

Missing value implies insufficient data to compute the statistic.

### *4.1.3.5 pH*

Figure 4.1-18. pH from August 2002 through December 2005 for the Pockwock Lake based on hourly values. Gaps in the plot indicate missing data.

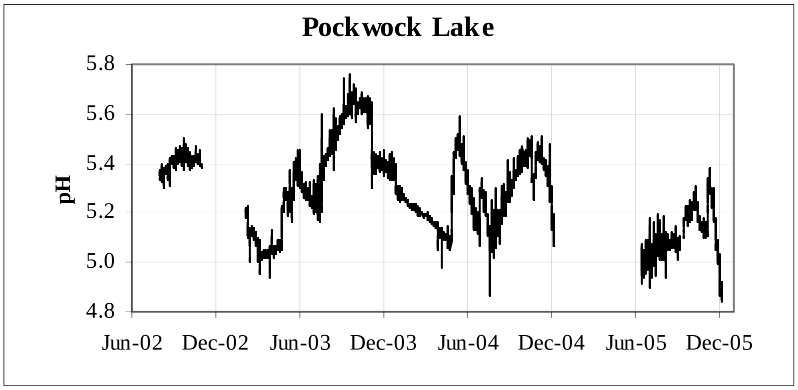


Figure 4.1-19. pH from August 2002 through December 2005 for the Pockwock Lake based on daily mean values. Gaps in the plot indicate missing data.

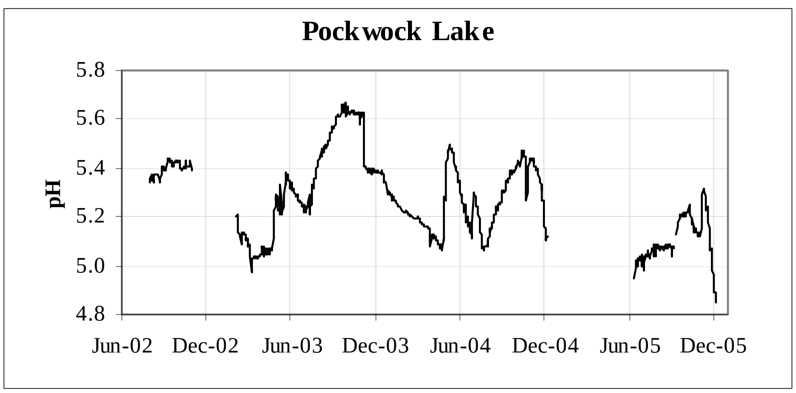

Figure 4.1-20. pH from August 2002 through December 2005 for the Pockwock Lake based on monthly mean values. Gaps in the plot indicate missing data.

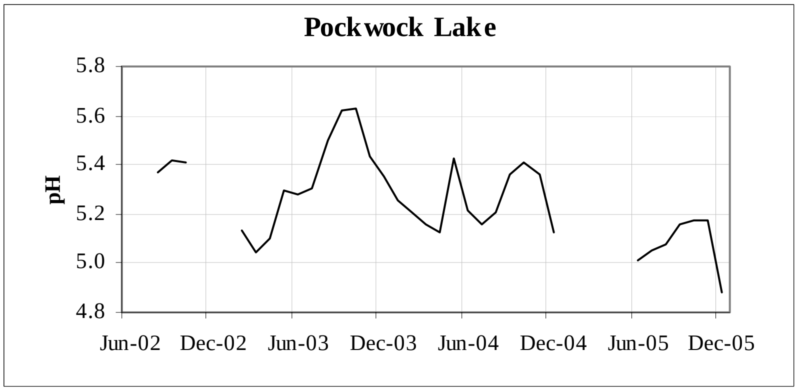


Table 4.1-13. Mean monthly pH for Pockwock Lake during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| August | 2002 | 5.37 | 5.34 | 5.41 | 0.02 |
| September | 2002 | 5.42 | 5.39 | 5.44 | 0.02 |
| October | 2002 | 5.41 | 5.39 | 5.43 | 0.01 |
| November | 2002 | | | | |
| December | 2002 | | | | |
| January | 2003 | | | | |
| February | 2003 | 5.13 | 5.08 | 5.21 | 0.04 |
| March | 2003 | 5.04 | 4.97 | 5.09 | 0.02 |
| April | 2003 | 5.10 | 5.04 | 5.28 | 0.08 |
| May | 2003 | 5.29 | 5.21 | 5.38 | 0.05 |
| June | 2003 | 5.28 | 5.22 | 5.34 | 0.03 |
| July | 2003 | 5.31 | 5.21 | 5.43 | 0.07 |
| August | 2003 | 5.50 | 5.44 | 5.57 | 0.04 |
| September | 2003 | 5.62 | 5.56 | 5.67 | 0.03 |
| October | 2003 | 5.63 | 5.58 | 5.65 | 0.01 |
| November | 2003 | 5.44 | 5.37 | 5.63 | 0.09 |
| December | 2003 | 5.36 | 5.29 | 5.39 | 0.03 |
| January | 2004 | 5.26 | 5.22 | 5.30 | 0.02 |
| February | 2004 | 5.21 | 5.19 | 5.23 | 0.01 |
| March | 2004 | 5.16 | 5.08 | 5.20 | 0.03 |
| April | 2004 | 5.12 | 5.06 | 5.30 | 0.06 |
| May | 2004 | 5.42 | 5.33 | 5.50 | 0.05 |
| June | 2004 | 5.21 | 5.11 | 5.32 | 0.06 |
| July | 2004 | 5.15 | 5.06 | 5.29 | 0.08 |

Table 4.1-13, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| August | 2004 | 5.21 | 5.11 | 5.28 | 0.05 |
| September | 2004 | 5.36 | 5.30 | 5.41 | 0.03 |
| October | 2004 | 5.41 | 5.27 | 5.47 | 0.05 |
| November | 2004 | 5.36 | 5.16 | 5.44 | 0.07 |
| December | 2004 | 5.13 | 5.10 | 5.15 | 0.02 |
| January | 2005 | | | | |
| February | 2005 | | | | |
| March | 2005 | | | | |
| April | 2005 | | | | |
| May | 2005 | | | | |
| June | 2005 | 5.01 | 4.95 | 5.05 | 0.02 |
| July | 2005 | 5.05 | 4.98 | 5.09 | 0.02 |
| August | 2005 | 5.08 | 5.06 | 5.09 | 0.01 |
| September | 2005 | 5.16 | 5.04 | 5.22 | 0.06 |
| October | 2005 | 5.18 | 5.12 | 5.25 | 0.04 |
| November | 2005 | 5.18 | 4.96 | 5.32 | 0.11 |
| December | 2005 | 4.88 | 4.85 | 4.91 | 0.02 |

Table 4.1-14. Mean seasonal pH for Pockwock Lake during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| Summer | 2002 | 5.37 | 5.34 | 5.41 | 0.02 |
| Fall | 2002 | 5.41 | 5.39 | 5.44 | 0.01 |
| Winter | 2003 | 5.13 | 5.08 | 5.21 | 0.04 |
| Spring | 2003 | 5.15 | 4.97 | 5.38 | 0.12 |
| Summer | 2003 | 5.36 | 5.21 | 5.57 | 0.11 |
| Fall | 2003 | 5.56 | 5.37 | 5.67 | 0.10 |
| Winter | 2004 | 5.27 | 5.19 | 5.39 | 0.07 |
| Spring | 2004 | 5.24 | 5.06 | 5.50 | 0.14 |
| Summer | 2004 | 5.19 | 5.06 | 5.32 | 0.07 |
| Fall | 2004 | 5.38 | 5.16 | 5.47 | 0.06 |
| Winter | 2005 | 5.13 | 5.10 | 5.15 | 0.02 |
| Spring | 2005 | | | | |
| Summer | 2005 | 5.05 | 4.95 | 5.09 | 0.03 |
| Fall | 2005 | 5.17 | 4.96 | 5.32 | 0.07 |

Table 4.1-14. Mean annual pH for Pockwock Lake during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ---- | ------- | ------- | ------- | ------- |
| 2002 | 5.40 | 5.34 | 5.44 | 0.03 |
| 2003 | 5.34 | 4.97 | 5.67 | 0.20 |
| 2004 | 5.26 | 5.06 | 5.50 | 0.12 |
| 2005 | 5.11 | 4.85 | 5.32 | 0.09 |

Missing value implies insufficient data to compute the statistic.

### 4.1.4 Overview of Pockwock Lake Water Quality

Water quality data for the period of record are typical of a predominantly forested watershed (61% of total area) with a significant surface water component (23% of total area) of which a large portion exists as lake area. Igneous bedrock dominates the watershed geology. Small areas of metamorphic bedrock are also present.

It should be noted that the water quality data gathered at this monitoring station represents conditions at a depth of approximately 5m.

Variation in water temperature follows a seasonal pattern very similar to that of air temperature. It is interesting to note that during the Fall cooling phase of the annual heat cycle a slight lag between air and water temperature exists. A simple explanation for this phenomenon is that the rate at which stored thermal energy in the lake is lost to the atmosphere is less than is necessary for the lake water to match decreasing air temperatures. Seasonal minimum and maximum mean water temperatures ranged from 0.9 and 4.5$^{o}$C for Winter (December to February) and 18.3 and 21.7$^{o}$C for Summer (June to August).

Turbidity values were relatively low for most of the period of record with less than 1 percent of all hourly measurements (2003-2005) greater than 5 NTU. Mean annual concentrations ranged between 0.3 and 1.2 NTU. There appears to be a repeating turbidity peak during the growing season that is most likely associated with algal growth, the magnitude of which is dependent on ambient conditions. Also of note for hourly turbidity measurements was an episode of elevated readings over a 24-hour period between October 25 and 26, 2005 that saw readings reach upwards of 36 NTU. On October 23, 25 mm of rainfall occurred which may have played a minor role in the increase, but because other rainfall events of similar and greater amounts triggered only minor turbidity responses, it is more likely that some other factor was the main cause.

Variation in conductivity levels in Pockwock Lake was minor during the period of record, fluctuating between a mean daily low of 35 uS/cm and a high of 43 uS/cm. No temporal trend was observed. Annual means remained steady at between 38 and 40 uS/cm.

Dissolved oxygen concentrations show a pattern that is essentially the inverse of temperature. Mean daily concentrations ranged between 7.6 and 14.1mg/L. Minimum dissolved oxygen concentrations occurred during the warmer months, typically July and August when water temperature peaks, while maximum concentrations occurred during the colder months of January and February. This annual trend was consistent throughout the 4-year period of record.

Pockwock Lake is slightly acidic with daily mean pH values ranging from 4.8 to 5.7. Between 2002 and 2005, annual mean pH varied between 5.4 and 5.1. Given the slightly acidic nature of the lake, acceptable ranges of values published by the CCME for

Drinking Water use and the Protection of Aquatic Life of 6.5 to 8.5 and 6.5 to 9.0, respectively, were exceeded for the entire monitoring period. The data suggests a downward pH trend may be occurring in the lake. Because of the length of data record, however, uncertainty exists as to whether this is indeed taking place. It is possible that what has been observed, particularly in 2005 when pH levels were reduced to near 4.8 in December, simply expands our understanding of normal variation in lake pH.

# 4.2 NORTH EAST MARGAREE RIVER 2002-2005

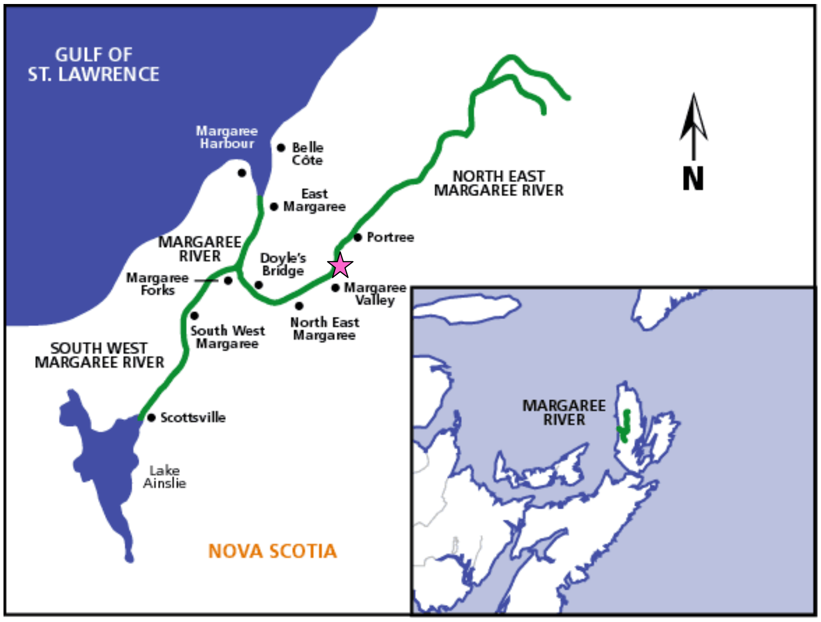


Figure 4.2-1. Location of North East Margaree River (map is courtesy of the Canadian Heritage Rivers System).

## 4.2.1 Background Information

### *4.2.1.1 Location of Station*

The geographic location, in longitude and latitude, of the Automated Network Station on the North East Margaree River is 60°58'36"W, 46°22'10"N and is denoted in Figure 4.2-1 by a star.

### *4.2.1.2 Geographical Setting*

The North East Margaree River is located on Cape Breton Island in the Margaree River watershed. Its drainage area is 368 $km^2$ and it flows through the Aspy Fault as a steep valley stream and then widens to join the South East Margaree River, which traces its headwaters to Lake Ainslie, at Margaree Forks and then flows north through a wide tidal estuary to empty into the Gulf of Saint Lawrence at Margaree Harbour.

### *4.2.1.3 Geology and Geomorphology*

The complex geology of Cape Breton is well displayed in the Margaree-Lake Ainslie system. As the North East Margaree flows along the Aspy Fault, it cuts through Precambrian, Cambrian, Ordovician and Silurian sedimentary and metamorphic rocks, visible as rhyolites and crystalline branded schists and gneisses in the upper reaches of the North East Margaree.

Classic examples of river erosion, ice erosion and deposition from the Wisconsin glaciation, including V-shaped valleys in the upper reaches and U-shaped valleys in the lower reaches dominate the landscape of the North East Margaree. The geomorphology of the system is made up of: braided channels of coarse sand and gravels; river terraces; point bars; cut banks; meanders; pools and riffles; natural levees; and finally river deltas in the broad tidal estuary where the Margaree enters the Gulf of St. Lawrence.

The dominant landform in the watershed is a gently to strongly rolling plateau, with boggy depressions.

*4.2.1.4 Forest Cover and Land Use*

The Margaree valley has the greatest proportion of forested floodplain of any river in Nova Scotia, including spruce-fir forests, mixed hardwoods and remnant stands of maple-elm climax forest. 88% of the land within the watershed is forested, 8% covered by wetlands, and less than 0.5 % characterized as urban land use.

Figure 4.2-2. NE Margaree River looking upstream (monitoring station is located just out of view on left side of photo).

*4.2.1.5 Climate*

Normal (1971-2000) precipitation in the North East Margaree River watershed, as recorded at the Environment Canada Climate Station at Cheticamp is 1391 mm, comprised of 1054 mm of rainfall and 338 cm of snowfall. The mean annual temperature is 6.2$^{o}$C with a mean monthly high of 18.3 $^{o}$C in July and a low of -6.7 $^{o}$C in February.

*4.2.1.6 Wildlife and Habitat*

Gravel bars in the upper reaches provide safe haven for spawning salmon, which return to spawn. Young salmon, gaspereau and sea (speckled) trout run heavy in the spring. The watershed also provides habitat to striped bass, bald eagles, osprey, ringnecked ducks, the rare Gaspé shrew, rock voles, pine martens, lynx, and moose.

Figure 4.2-3. North East Margaree River monitoring station.

*4.2.1.7 Human Settlement and Industrial Development*

The Mi'kmaq called the river "Weekuch". Early French settlers gave the river the name St. Marguerite in the 18th century. The 19th century saw many Scottish, English and Irish immigrants settle in the Margaree river valley to farm, fish and log. Industrial development in the watershed includes forestry, commercial and recreational fishing (e.g. salmon and gaspereau), and tourism. The river system is popular with outdoor enthusiasts for such activities as fishing, hiking and canoeing. The Margaree River system was nominated to the Canadian Heritage River System in 1991 and was designated a Canadian Heritage River in 1998.

## 4.2.2 Land Use and Forest Type Summary Information

### *4.2.2.1 Land Use*

| Land Type | Area km$^2$ | % of Total Area |
|---|---|---|
| Agriculture | 2.8 | 0.8 |
| Barren | 9.6 | 2.6 |
| Clearcut | 0.8 | 0.2 |
| Forested | 323.0 | 88.1 |
| Urban | 1.2 | 0.3 |
| Wetland/Water | 29.3 | 8.0 |
| Total | 366.7 | 100.0 |

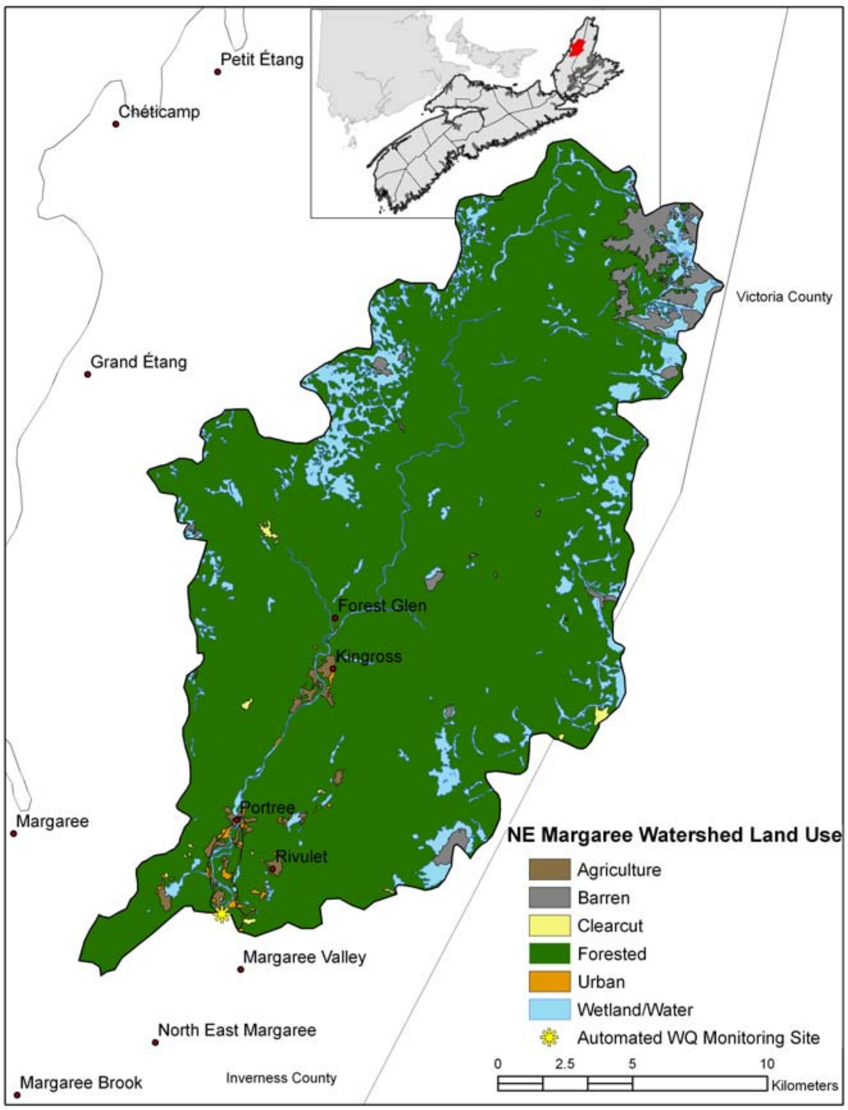


Figure 4.2-4. Land use mapping of North East Margaree River Watershed.

### *4.2.2.2* Forest Type

| Forest Type | Area km$^2$ | % of Total Area |
|---|---|---|
| Forested | 323.0 | 100.0 |
| Hardwood | 54.2 | 14.8 |
| Mixed Wood | 82.4 | 22.5 |
| Softwood | 167.6 | 45.7 |
| Unknown | 18.8 | 17.0 |

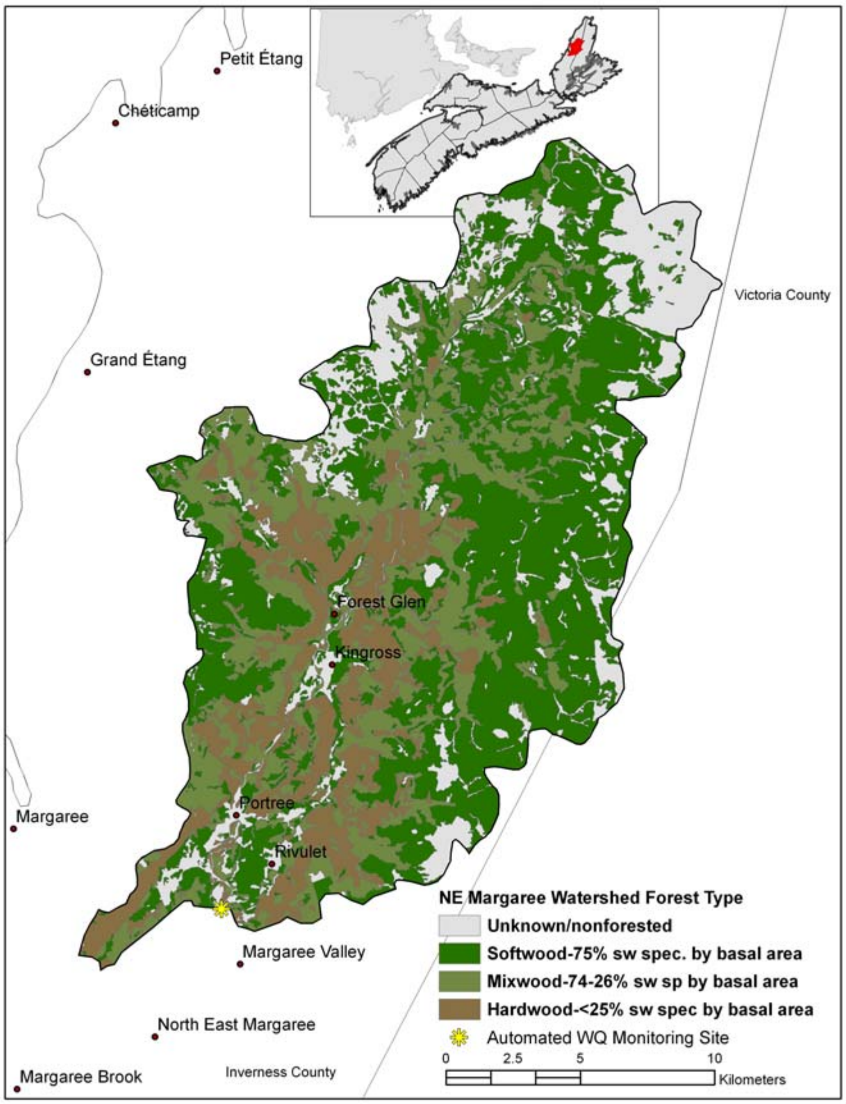


Figure 4.2-5. Forest type mapping of North East Margaree River Watershed.

### 4.2.3 Water Quality Summary Information

Table 4.2-1. Hourly statistics of minimum, maximum, mean, and standard deviation and exceedences as per established water quality guidelines for hourly real time data for North East Margaree River for the period 2002 –2005.

| Parameter | Year | Min | Max | Mean | SD | CWQ Guideline | | | Readings[5] | # of Exceedences | | | Exceedences As % of Readings | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWAL[1] | DW[1] | REC[1] | | | | | | | |
| | | | | | | | | | | | | | | | |
| Temperature, °C | 2002 | -0.3 | 23.3 | 9.8 | 6.3 | 20-21[2] | | | 4841 | 87 | | | 2 | | |
| | 2003 | -0.2 | 21.7 | 8.8 | 6.3 | | | | 6889 | 29 | | | <1 | | |
| | 2004 | -0.3 | 21.8 | 6.3 | 6.1 | | | | 8401 | 23 | | | <1 | | |
| | 2005 | -0.1 | 22.0 | 8.1 | 6.4 | | | | 8031 | 25 | | | <1 | | |
| | | | | | | | | | | | | | | | |
| Turbidity, NTU | | | | | | | | | | DW <1[3] | DW ≤5[4] | REC | DW <1[3] | DW ≤5[4] | REC |
| | 2002 | 0.0 | 10.6 | 1.0 | 1.4 | | <1[3], ≤5[4] | ≤50 | 654 | 239 | 2 | 0 | 36 | 0 | 0 |
| | 2003 | 0.0 | 96.4 | 1.8 | 5.6 | | | | 3986 | 1540 | 228 | 14 | 39 | 6 | <1 |
| | 2004 | 0.0 | 80.5 | 1.5 | 3.9 | | | | 7616 | 3240 | 365 | 0 | 42 | 5 | 0 |
| | 2005 | 0.0 | 57.4 | 0.8 | 3.9 | | | | 4841 | 590 | 163 | 5 | 12 | 3 | <1 |
| | | | | | | | | | | | | | | | |
| Conductivity, uS/cm | 2002 | 48.6 | 329.0 | 158.8 | 71.5 | | | | | | | | | | |
| | 2003 | 28.9 | 366.0 | 165.4 | 68.6 | | | | | | | | | | |
| | 2004 | 42.6 | 380.0 | 172.6 | 74.8 | | | | | | | | | | |
| | 2005 | 36.0 | 344.7 | 161.2 | 78.8 | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Dissolved Oxygen, mg/L | 2002 | 7.7 | 14.7 | 11.0 | 1.9 | ≥5.0 | | | 4841 | 0 | | | 0 | | |
| | 2003 | 7.4 | 15.8 | 11.3 | 2.4 | | | | 6001 | 0 | | | 0 | | |
| | 2004 | 7.0 | 15.5 | 12.3 | 2.2 | | | | 8361 | 0 | | | 0 | | |
| | 2005 | 6.7 | 15.1 | 11.3 | 2.3 | | | | 8028 | 0 | | | 0 | | |
| | | | | | | | | | | | | | | | |
| pH, Units | | | | | | | | | | FWAL | DW | REC | FWAL | DW | REC |
| | 2002 | 6.3 | 7.7 | 7.2 | 0.2 | 6.5-9.0 | 6.5-8.5 | 6.5-9.5 | 4841 | 40 | 40 | 40 | <1 | <1 | <1 |
| | 2003 | 6.2 | 8.2 | 7.1 | 0.2 | | | | 6885 | 32 | 32 | 32 | <1 | <1 | <1 |
| | 2004 | 6.4 | 8.0 | 7.2 | 0.2 | | | | 8401 | 11 | 11 | 11 | <1 | <1 | <1 |
| | 2005 | 6.2 | 8.0 | 7.2 | 0.3 | | | | 8031 | 94 | 94 | 94 | 3 | 3 | 3 |

[1] FWAL: Freshwater Aquatic Life; DW: Drinking Water; REC: Recreational Uses.
[2] Upper permissible limit for salmon and trout (Alabaster and Lloyd. 1982). CCME DW guideline deemed to be inappropriate.
[3] Maximum Acceptable Concentration for water entering a distribution system.
[4] Aesthetic Objective. 5NTU may be permitted if demonstrated that the disinfection method is not compromised.
[5] The number of hourly readings possible in each of the years 2002, 2003 and 2005 is 8760. For 2004 the number is 8784. The number recorded in the table refers to the actual number of approved measurements.

*.4.2.3.1 Temperature*

Figure 4.2-6. Water temperature from June 2002 through November 2005 for the NE Margaree River using hourly values. Gaps in the plot indicate missing data.

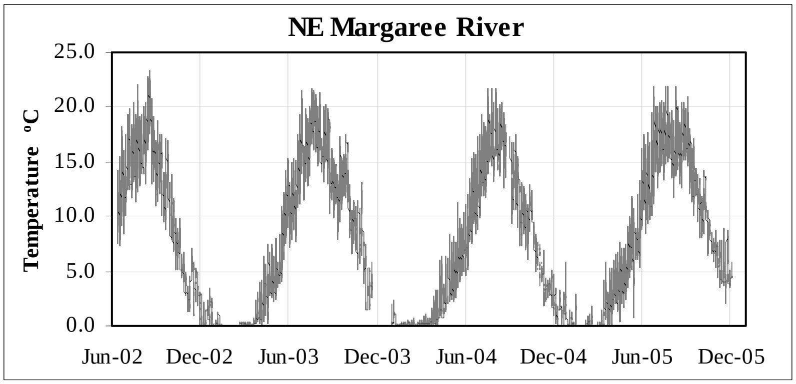


Figure 4.2-7. Water temperature from June 2002 through November 2005 for the NE Margaree River using daily mean values. Gaps in the plot indicate missing data.

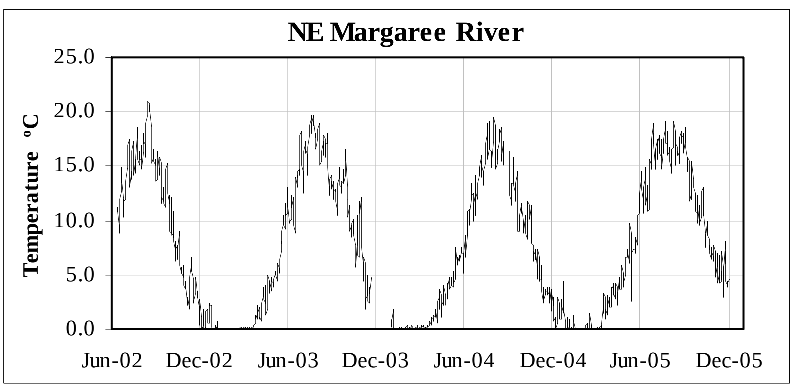

Figure 4.2-8. Air and water temperature from June 2002 through November 2005 for the NE Margaree River using monthly mean values. Gaps in the plot indicate missing data.

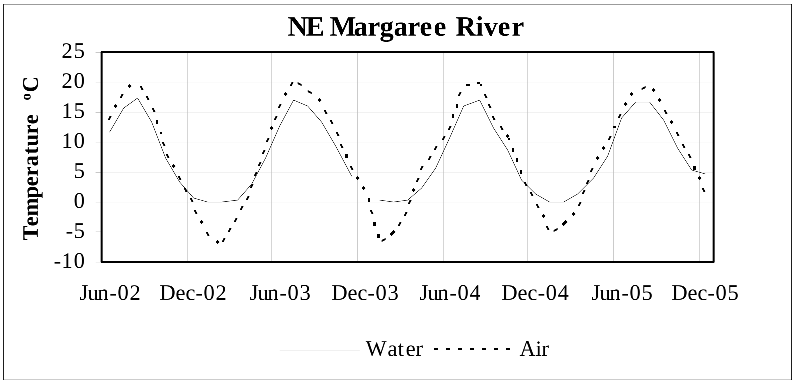


Table 4.2-2. Mean monthly water temperature for North East Margaree River during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | °C | ------------- | ----- |
| June | 2002 | 11.7 | 8.9 | 15.0 | 1.6 |
| July | 2002 | 15.6 | 13.1 | 18.5 | 1.3 |
| August | 2002 | 17.5 | 14.4 | 20.9 | 2.0 |
| September | 2002 | 13.4 | 9.0 | 16.3 | 1.8 |
| October | 2002 | 7.2 | 3.7 | 12.1 | 2.1 |
| November | 2002 | 3.4 | 0.4 | 6.6 | 1.5 |
| December | 2002 | 0.8 | -0.2 | 2.8 | 0.9 |
| January | 2003 | 0.1 | 0.0 | 0.7 | 0.2 |
| February | 2003 | 0.1 | 0.0 | 0.2 | 0.1 |
| March | 2003 | 0.4 | 0.0 | 2.2 | 0.5 |
| April | 2003 | 2.9 | 0.8 | 5.0 | 1.3 |
| May | 2003 | 7.3 | 3.8 | 12.6 | 2.7 |
| June | 2003 | 12.8 | 8.8 | 18.3 | 2.7 |
| July | 2003 | 17.1 | 12.4 | 19.8 | 1.9 |
| August | 2003 | 16.0 | 12.3 | 18.9 | 1.9 |
| September | 2003 | 13.2 | 10.4 | 16.6 | 1.4 |
| October | 2003 | 9.4 | 5.7 | 13.1 | 1.8 |
| November | 2003 | 4.3 | 1.8 | 7.6 | 1.7 |
| December | 2003 | | | | |
| January | 2004 | 0.2 | 0.0 | 1.8 | 0.4 |
| February | 2004 | 0.1 | 0.0 | 0.3 | 0.1 |
| March | 2004 | 0.5 | 0.1 | 1.2 | 0.3 |
| April | 2004 | 2.5 | 0.6 | 4.9 | 1.1 |

Table 4.2-2, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | °C | ------------- | ----- |
| May | 2004 | 5.7 | 3.6 | 7.6 | 1.3 |
| June | 2004 | 10.7 | 6.7 | 14.2 | 2.1 |
| July | 2004 | 15.9 | 13.3 | 19.0 | 1.6 |
| August | 2004 | 17.0 | 14.8 | 19.4 | 1.3 |
| September | 2004 | 12.2 | 9.0 | 16.4 | 2.0 |
| October | 2004 | 8.6 | 4.6 | 11.8 | 1.9 |
| November | 2004 | 3.8 | 1.6 | 7.3 | 1.3 |
| December | 2004 | 1.3 | -0.2 | 4.4 | 1.1 |
| January | 2005 | 0.1 | -0.1 | 1.4 | 0.4 |
| February | 2005 | 0.1 | -0.1 | 1.4 | 0.3 |
| March | 2005 | 1.2 | -0.1 | 3.4 | 1.2 |
| April | 2005 | 4.0 | 2.1 | 6.0 | 0.8 |
| May | 2005 | 7.8 | 2.6 | 11.5 | 2.0 |
| June | 2005 | 13.9 | 10.6 | 19.0 | 2.3 |
| July | 2005 | 16.8 | 14.6 | 19.1 | 1.1 |
| August | 2005 | 16.7 | 14.4 | 19.1 | 1.2 |
| September | 2005 | 13.6 | 9.7 | 18.6 | 2.2 |
| October | 2005 | 8.9 | 6.3 | 13.1 | 1.8 |
| November | 2005 | 5.3 | 2.9 | 8.1 | 1.3 |
| December | 2005 | 4.7 | 4.7 | 4.7 | |

Table 4.2-3. Mean seasonal water temperature for North East Margaree River during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | °C | ------------- | ----- |
| Summer | 2002 | 15.4 | 8.9 | 20.9 | 2.8 |
| Fall | 2002 | 8.0 | 0.4 | 16.3 | 4.5 |
| Winter | 2003 | 0.5 | -0.2 | 2.8 | 0.8 |
| Spring | 2003 | 3.5 | 0.0 | 12.6 | 3.3 |
| Summer | 2003 | 15.3 | 8.8 | 19.8 | 2.8 |
| Fall | 2003 | 9.6 | 1.8 | 16.6 | 3.8 |
| Winter | 2004 | 0.2 | 0.0 | 1.8 | 0.3 |
| Spring | 2004 | 2.9 | 0.1 | 7.6 | 2.4 |
| Summer | 2004 | 14.4 | 6.7 | 19.4 | 3.2 |
| Fall | 2004 | 8.2 | 1.6 | 16.4 | 3.9 |

Table 4.2-3, continued

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | $^{o}C$ | ------------- | ----- |
| Winter | 2005 | 0.5 | -0.2 | 4.4 | 0.9 |
| Spring | 2005 | 4.3 | -0.1 | 11.5 | 3.0 |
| Summer | 2005 | 15.8 | 10.6 | 19.1 | 2.1 |
| Fall | 2005 | 9.2 | 2.9 | 18.6 | 3.8 |

Table 4.2-4. Mean annual water temperature for North East Margaree River during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ------------- | $^{o}C$ | ------------- | ----- |
| 2002 | 9.9 | -0.2 | 20.9 | 6.2 |
| 2003 | 8.7 | 0.0 | 19.8 | 6.2 |
| 2004 | 6.4 | -0.2 | 19.4 | 6.0 |
| 2005 | 8.1 | -0.1 | 19.1 | 6.3 |

Missing value implies insufficient data to compute the statistic.

### *4.2.3.2 Turbidity*

Figure 4.2-9. Turbidity levels from June 2002 to November 2005 for the NE Margaree River based on hourly values. Gaps in the plot indicate missing data.

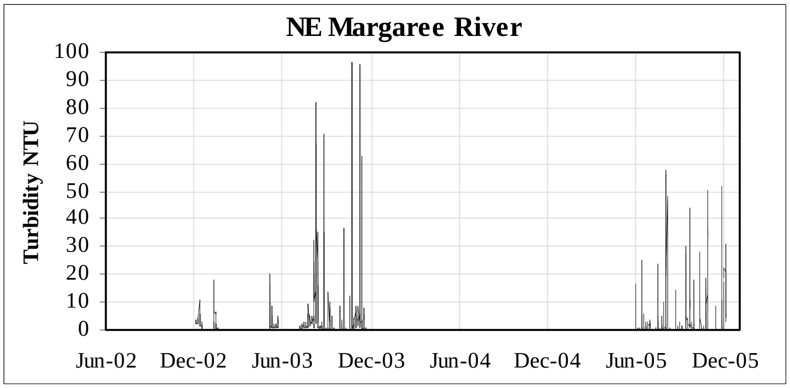


Figure 4.2-10. Turbidity levels from June 2002 to November 2005 for the NE Margaree River based on daily mean values. Gaps in the plot indicate missing data.

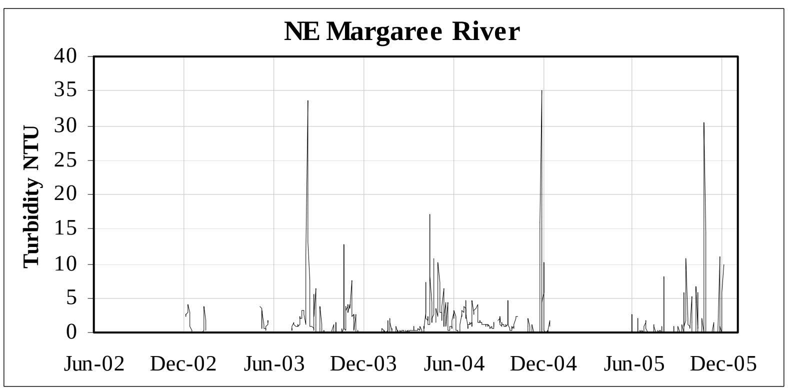

Figure 4.2-11. Turbidity levels and stream stage from June 2002 to November 2005 for the NE Margaree River based on monthly mean values. Gaps in the plot indicate missing data.

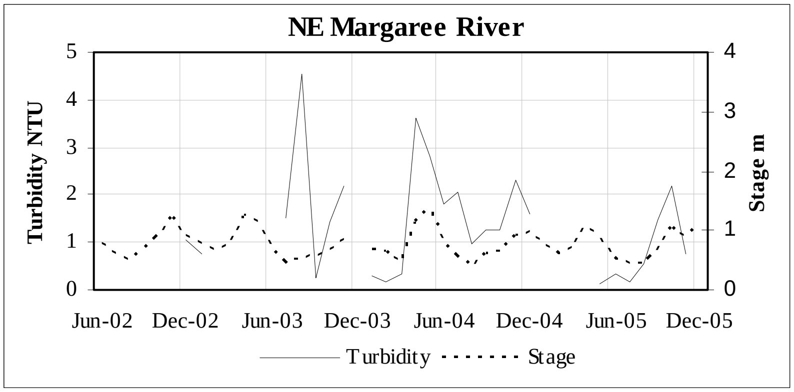


Table 4.2-5 Mean monthly turbidity for North East Margaree River during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | NTU | ------------ | ----- |
| December | 2002 | 1.0 | 0.0 | 4.0 | 1.4 |
| January | 2003 | 0.8 | 0.0 | 3.8 | 1.2 |
| February | 2003 | | | | |
| March | 2003 | | | | |
| April | 2003 | | | | |
| May | 2003 | 1.3 | 0.4 | 3.7 | 1.1 |
| June | 2003 | | | | |
| July | 2003 | 1.5 | 0.2 | 3.3 | 0.9 |
| August | 2003 | 4.5 | 0.0 | 33.6 | 7.1 |
| September | 2003 | 0.3 | 0.0 | 3.8 | 0.7 |
| October | 2003 | 1.4 | 0.0 | 12.8 | 2.8 |
| November | 2003 | 2.2 | 0.0 | 7.6 | 2.0 |
| December | 2003 | | | | |
| January | 2004 | 0.3 | 0.0 | 1.9 | 0.5 |
| February | 2004 | 0.2 | 0.0 | 0.8 | 0.2 |
| March | 2004 | 0.3 | 0.0 | 1.0 | 0.2 |
| April | 2004 | 3.6 | 0.4 | 17.1 | 3.8 |
| May | 2004 | 2.8 | 0.2 | 10.0 | 2.7 |
| June | 2004 | 1.8 | 0.0 | 4.7 | 1.4 |
| July | 2004 | 2.1 | 0.9 | 4.6 | 1.1 |
| August | 2004 | 1.0 | 0.6 | 1.6 | 0.2 |
| September | 2004 | 1.2 | 0.4 | 4.5 | 0.9 |
| October | 2004 | 1.3 | 0.0 | 2.4 | 1.0 |

Table 4.2-5, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | NTU | ------------ | ----- |
| November | 2004 | 2.3 | 0.0 | 35.2 | 6.9 |
| December | 2004 | 1.6 | 0.0 | 10.2 | 3.2 |
| January | 2005 | | | | |
| February | 2005 | | | | |
| March | 2005 | | | | |
| April | 2005 | | | | |
| May | 2005 | 0.1 | 0.0 | 2.5 | 0.6 |
| June | 2005 | 0.3 | 0.0 | 2.0 | 0.5 |
| July | 2005 | 0.2 | 0.0 | 1.0 | 0.3 |
| August | 2005 | 0.6 | 0.0 | 8.2 | 2.0 |
| September | 2005 | 1.5 | 0.0 | 10.7 | 2.2 |
| October | 2005 | 2.2 | 0.0 | 30.4 | 6.0 |
| November | 2005 | 0.8 | 0.0 | 11.1 | 2.3 |
| December | 2005 | | | | |

Table 4.2-6 Mean seasonal turbidity for North East Margaree River during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}

Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | NTU | ------------ | ----- |
| Winter | 2003 | 0.9 | 0.0 | 4.0 | 1.3 |
| Spring | 2003 | 1.3 | 0.4 | 3.7 | 1.1 |
| Summer | 2003 | 3.2 | 0.0 | 33.6 | 5.5 |
| Fall | 2003 | 1.2 | 0.0 | 12.8 | 2.2 |
| Winter | 2004 | 0.2 | 0.0 | 1.9 | 0.4 |
| Spring | 2004 | 2.2 | 0.0 | 17.1 | 3.0 |
| Summer | 2004 | 1.7 | 0.0 | 4.7 | 1.1 |
| Fall | 2004 | 1.7 | 0.0 | 35.2 | 4.4 |
| Winter | 2005 | 1.6 | 0.0 | 10.2 | 3.2 |
| Spring | 2005 | 0.1 | 0.0 | 2.5 | 0.6 |
| Summer | 2005 | 0.3 | 0.0 | 8.2 | 1.2 |
| Fall | 2005 | 1.5 | 0.0 | 30.4 | 4.0 |

Table 4.2-7 Mean seasonal turbidity for North East Margaree River during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ------------ | NTU | ------------ | ----- |
| 2002 | 1.0 | 0.0 | 4.0 | 1.4 |
| 2003 | 1.8 | 0.0 | 33.6 | 3.6 |
| 2004 | 1.6 | 0.0 | 35.2 | 2.8 |
| 2005 | 0.9 | 0.0 | 30.4 | 2.9 |

Missing value implies insufficient data to compute the statistic.

### *4.2.3.3 Conductivity*

Figure 4.2-12. Conductivity from June 2002 to November 2005 for the NE Margaree River based on <u>hourly values</u>. Gaps in the plot indicate missing data.

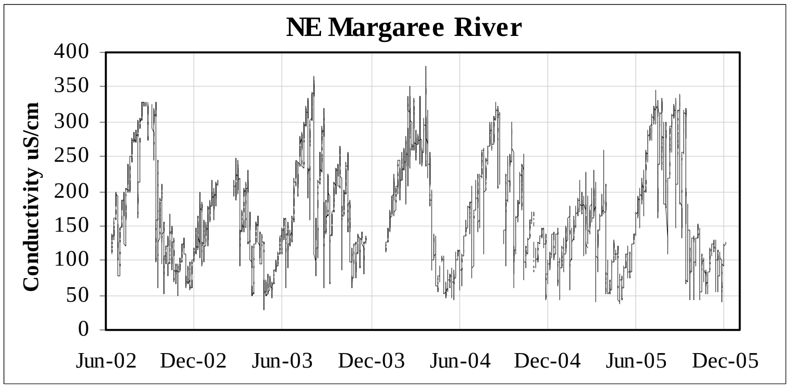


Figure 4.2-13. Conductivity from June 2002 to November 2005 for the NE Margaree River based on <u>daily mean values</u>. Gaps in the plot indicate missing data.

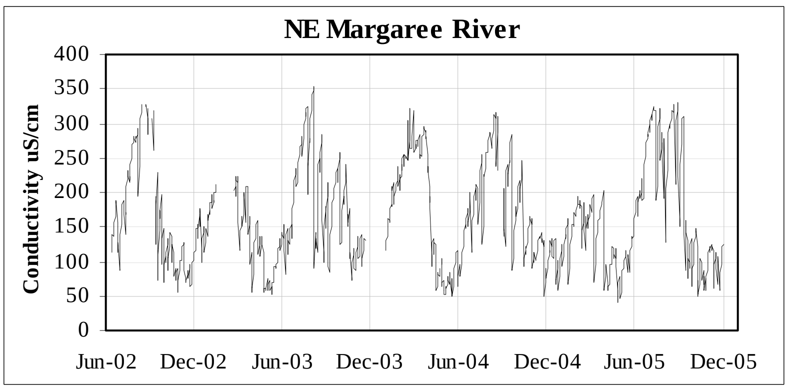

Figure 4.2-14. Conductivity and stream stage from June 2002 to November 2005 for the NE Margaree River based on monthly mean values. Gaps in the plot indicate missing data.

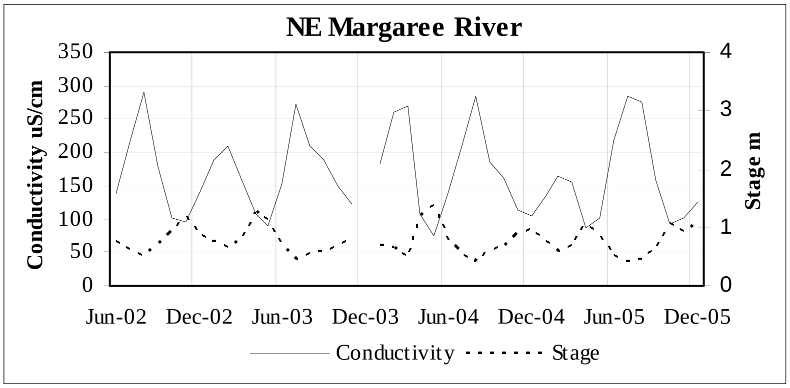


Table 4.2-8. Mean monthly conductivity for North East Margaree River during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----------uS/cm---------- | | | ----- |
| June | 2002 | 139.0 | 88.4 | 189.3 | 26.9 |
| July | 2002 | 214.5 | 138.6 | 282.3 | 44.6 |
| August | 2002 | 289.5 | 194.9 | 326.9 | 36.8 |
| September | 2002 | 179.7 | 70.8 | 318.2 | 77.9 |
| October | 2002 | 102.7 | 56.4 | 142.0 | 22.7 |
| November | 2002 | 94.2 | 62.5 | 128.2 | 18.7 |
| December | 2002 | 141.3 | 99.9 | 176.5 | 19.9 |
| January | 2003 | 188.5 | 166.8 | 212.0 | 12.6 |
| February | 2003 | 208.4 | 193.6 | 224.3 | 11.2 |
| March | 2003 | 159.3 | 54.3 | 222.7 | 39.7 |
| April | 2003 | 107.4 | 54.3 | 158.8 | 36.1 |
| May | 2003 | 89.4 | 50.8 | 133.8 | 24.7 |
| June | 2003 | 153.6 | 82.4 | 235.2 | 38.8 |
| July | 2003 | 270.9 | 196.2 | 324.3 | 36.2 |
| August | 2003 | 209.3 | 90.1 | 353.6 | 82.3 |
| September | 2003 | 189.1 | 82.7 | 257.0 | 47.7 |
| October | 2003 | 150.1 | 72.2 | 240.7 | 51.5 |
| November | 2003 | 121.3 | 92.9 | 139.0 | 13.3 |
| December | 2003 | | | | |
| January | 2004 | 183.6 | 116.0 | 239.0 | 34.3 |
| February | 2004 | 260.8 | 219.3 | 321.4 | 26.3 |
| March | 2004 | 268.1 | 230.4 | 296.5 | 18.7 |
| April | 2004 | 106.7 | 57.7 | 209.3 | 41.6 |
| May | 2004 | 75.9 | 50.3 | 114.8 | 19.8 |

Table 4.2-8, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----------uS/cm---------- | | | ----- |
| June | 2004 | 137.0 | 78.7 | 199.4 | 35.7 |
| July | 2004 | 208.1 | 125.8 | 270.0 | 36.6 |
| August | 2004 | 284.3 | 230.9 | 316.5 | 22.7 |
| September | 2004 | 184.2 | 88.0 | 284.8 | 58.0 |
| October | 2004 | 161.7 | 92.2 | 245.9 | 45.7 |
| November | 2004 | 112.3 | 49.8 | 142.7 | 22.8 |
| December | 2004 | 106.0 | 57.7 | 134.3 | 20.6 |
| January | 2005 | 135.1 | 65.3 | 172.7 | 26.8 |
| February | 2005 | 165.6 | 116.5 | 195.0 | 21.4 |
| March | 2005 | 154.7 | 58.8 | 202.4 | 40.8 |
| April | 2005 | 87.3 | 42.0 | 122.5 | 22.4 |
| May | 2005 | 103.0 | 46.0 | 157.4 | 26.9 |
| June | 2005 | 217.7 | 163.6 | 287.9 | 41.2 |
| July | 2005 | 283.4 | 187.9 | 324.3 | 39.5 |
| August | 2005 | 274.0 | 128.6 | 330.7 | 55.1 |
| September | 2005 | 158.8 | 62.6 | 311.5 | 79.7 |
| October | 2005 | 92.0 | 49.2 | 148.6 | 28.3 |
| November | 2005 | 100.5 | 59.0 | 125.3 | 20.9 |
| December | 2005 | 125.7 | 125.7 | 125.7 | |

Table 4.2-9. Mean seasonal conductivity for North East Margaree River during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}

Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----------uS/cm---------- | | | ----- |
| Summer | 2002 | 217.5 | 88.4 | 326.9 | 68.4 |
| Fall | 2002 | 122.1 | 56.4 | 318.2 | 58.3 |
| Winter | 2003 | 164.0 | 99.9 | 224.3 | 32.0 |
| Spring | 2003 | 118.8 | 50.8 | 222.7 | 45.1 |
| Summer | 2003 | 211.9 | 82.4 | 353.6 | 73.8 |
| Fall | 2003 | 157.4 | 72.2 | 257.0 | 50.8 |
| Winter | 2004 | 220.9 | 116.0 | 321.4 | 49.4 |
| Spring | 2004 | 151.7 | 50.3 | 296.5 | 90.2 |
| Summer | 2004 | 203.6 | 78.7 | 316.5 | 66.9 |
| Fall | 2004 | 152.8 | 49.8 | 284.8 | 53.4 |
| Winter | 2005 | 134.5 | 57.7 | 195.0 | 33.3 |
| Spring | 2005 | 115.3 | 42.0 | 202.4 | 42.3 |
| Summer | 2005 | 258.8 | 128.6 | 330.7 | 53.8 |
| Fall | 2005 | 116.8 | 49.2 | 311.5 | 57.8 |

Table 4.2-10. Mean seasonal conductivity for North East Margaree River during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ----------uS/cm---------- | | | ----- |
| 2002 | 161.6 | 56.4 | 326.9 | 73.1 |
| 2003 | 165.4 | 50.8 | 353.6 | 67.7 |
| 2004 | 171.9 | 49.8 | 321.4 | 74.0 |
| 2005 | 161.2 | 42.0 | 330.7 | 78.0 |

Missing value implies insufficient data to compute the statistic.

### *4.2.3.4 Dissolved Oxygen*

Figure 4.2-15. Dissolved oxygen concentration from June 2002 to November 2005 for the NE Margaree River based on hourly values. Gaps in the plot indicate missing data.

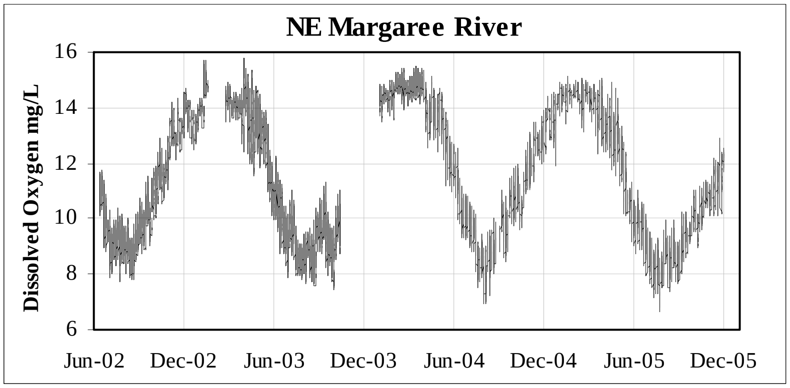


Figure 4.2-16. Dissolved oxygen concentration from June 2002 to November 2005 for the NE Margaree River based on daily mean values. Gaps in the plot indicate missing data.

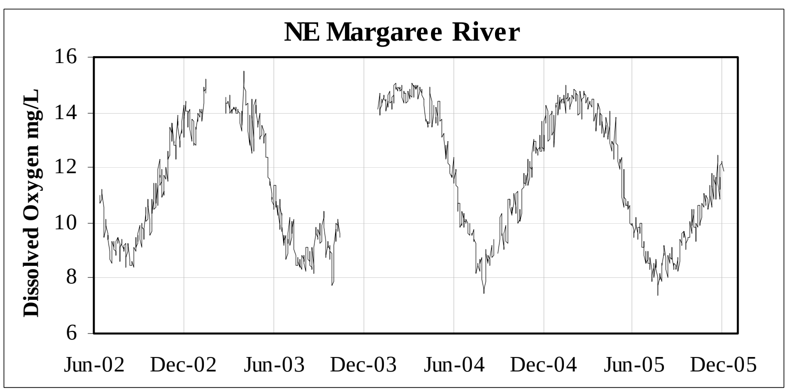

Figure 4.2-17. Dissolved oxygen concentration and stream stage from June 2002 to November 2005 for the NE Margaree River based on monthly mean values. Gaps in the plot indicate missing data.

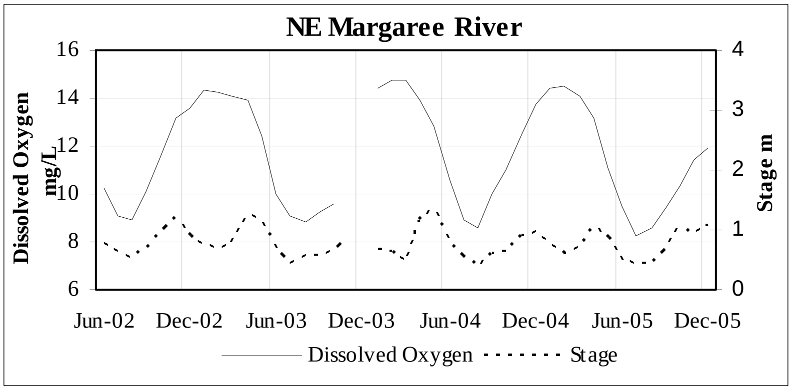


Table 4.2-11. Mean monthly dissolved oxygen for North East Margaree River during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | | ------------ mg/L ------------ | | ----- |
| June | 2002 | 10.2 | 9.4 | 11.3 | 0.6 |
| July | 2002 | 9.1 | 8.6 | 9.5 | 0.3 |
| August | 2002 | 8.9 | 8.4 | 9.6 | 0.4 |
| September | 2002 | 10.1 | 9.1 | 11.4 | 0.5 |
| October | 2002 | 11.5 | 10.5 | 12.6 | 0.5 |
| November | 2002 | 13.2 | 12.3 | 14.3 | 0.5 |
| December | 2002 | 13.6 | 12.8 | 14.4 | 0.4 |
| January | 2003 | 14.4 | 13.7 | 15.2 | 0.5 |
| February | 2003 | 14.3 | 14.0 | 14.5 | 0.2 |
| March | 2003 | 14.1 | 13.3 | 15.2 | 0.3 |
| April | 2003 | 13.9 | 12.5 | 15.5 | 0.8 |
| May | 2003 | 12.4 | 10.6 | 13.9 | 1.0 |
| June | 2003 | 10.0 | 8.7 | 11.4 | 0.8 |
| July | 2003 | 9.1 | 8.4 | 10.2 | 0.6 |
| August | 2003 | 8.9 | 8.2 | 9.9 | 0.5 |
| September | 2003 | 9.3 | 7.8 | 10.4 | 0.7 |
| October | 2003 | 9.6 | 8.8 | 10.1 | 0.4 |
| November | 2003 | | | | |
| December | 2003 | | | | |
| January | 2004 | 14.4 | 13.9 | 14.8 | 0.2 |
| February | 2004 | 14.8 | 14.3 | 15.1 | 0.2 |
| March | 2004 | 14.8 | 14.5 | 15.0 | 0.2 |
| April | 2004 | 13.9 | 13.5 | 14.9 | 0.4 |

Table 4.2-11, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ---------- mg/L ---------- | | | ----- |
| May | 2004 | 12.8 | 11.6 | 14.4 | 0.9 |
| June | 2004 | 10.6 | 9.8 | 12.0 | 0.7 |
| July | 2004 | 9.0 | 7.6 | 10.0 | 0.6 |
| August | 2004 | 8.6 | 7.4 | 9.4 | 0.5 |
| September | 2004 | 10.0 | 8.9 | 10.9 | 0.6 |
| October | 2004 | 11.0 | 10.0 | 12.3 | 0.6 |
| November | 2004 | 12.5 | 11.4 | 13.7 | 0.5 |
| December | 2004 | 13.8 | 12.6 | 14.6 | 0.5 |
| January | 2005 | 14.4 | 13.9 | 15.0 | 0.2 |
| February | 2005 | 14.5 | 13.7 | 14.8 | 0.3 |
| March | 2005 | 14.1 | 13.3 | 14.5 | 0.4 |
| April | 2005 | 13.2 | 12.3 | 14.1 | 0.4 |
| May | 2005 | 11.1 | 9.9 | 12.6 | 0.9 |
| June | 2005 | 9.5 | 8.5 | 10.2 | 0.5 |
| July | 2005 | 8.3 | 7.4 | 9.0 | 0.4 |
| August | 2005 | 8.6 | 8.0 | 9.2 | 0.3 |
| September | 2005 | 9.4 | 8.2 | 10.5 | 0.5 |
| October | 2005 | 10.4 | 9.3 | 11.0 | 0.4 |
| November | 2005 | 11.5 | 10.5 | 12.4 | 0.6 |
| December | 2005 | 11.9 | 11.9 | 11.9 | |

Table 4.2-12. Mean seasonal dissolved oxygen for North East Margaree River during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}

Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ mg/L ------------ | | | ----- |
| Summer | 2002 | 9.3 | 8.4 | 11.3 | 0.7 |
| Fall | 2002 | 11.6 | 9.1 | 14.3 | 1.4 |
| Winter | 2003 | 13.9 | 12.8 | 15.2 | 0.6 |
| Spring | 2003 | 13.5 | 10.6 | 15.5 | 1.1 |
| Summer | 2003 | 9.3 | 8.2 | 11.4 | 0.8 |
| Fall | 2003 | 9.4 | 7.8 | 10.4 | 0.6 |
| Winter | 2004 | 14.6 | 13.9 | 15.1 | 0.3 |
| Spring | 2004 | 13.8 | 11.6 | 15.0 | 1.0 |
| Summer | 2004 | 9.4 | 7.4 | 12.0 | 1.1 |
| Fall | 2004 | 11.2 | 8.9 | 13.7 | 1.2 |

Table 4.2-12, continued

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ mg/L | | ------------ | ----- |
| Winter | 2005 | 14.2 | 12.6 | 15.0 | 0.5 |
| Spring | 2005 | 12.8 | 9.9 | 14.5 | 1.4 |
| Summer | 2005 | 8.8 | 7.4 | 10.2 | 0.7 |
| Fall | 2005 | 10.4 | 8.2 | 12.4 | 1.0 |

Table 4.2-13. Mean annual dissolved oxygen for North East Margaree River during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ------------ mg $L^{-1}$ | | ------------ | ----- |
| 2002 | 11.0 | 8.4 | 14.4 | 1.8 |
| 2003 | 11.3 | 7.8 | 15.5 | 2.3 |
| 2004 | 12.2 | 7.4 | 15.1 | 2.2 |
| 2005 | 11.3 | 7.4 | 15.0 | 2.3 |

Missing value implies insufficient data to compute the statistic.

### *4.2.3.5 pH*

Figure 4.2-18. pH from June 2002 to November 2005 for the NE Margaree River based on hourly values. Gaps in the plot indicate missing data.

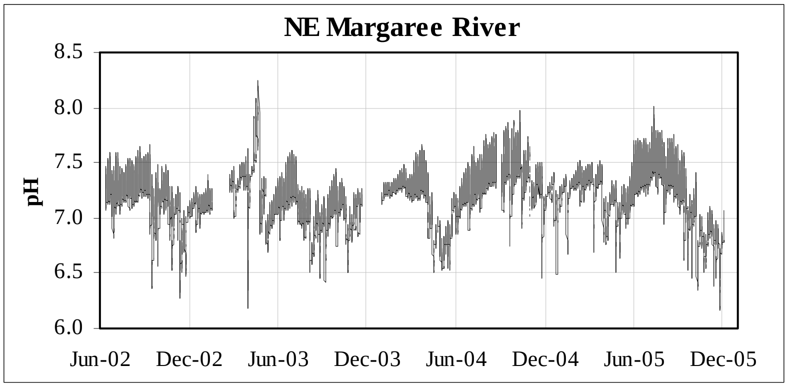


Figure 4.2-19. pH from June 2002 to November 2005 for the NE Margaree River based on daily mean values. Gaps in the plot indicate missing data.

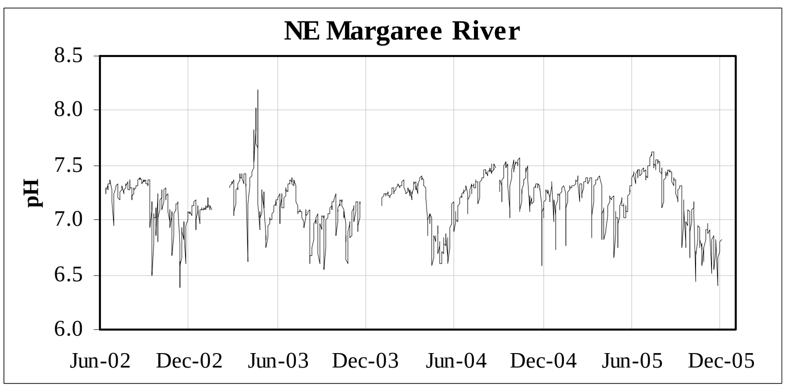

Figure 4.2-20. pH and stream stage from June 2002 to November 2005 for the NE Margaree River based on monthly mean values. Gaps in the plot indicate missing data.

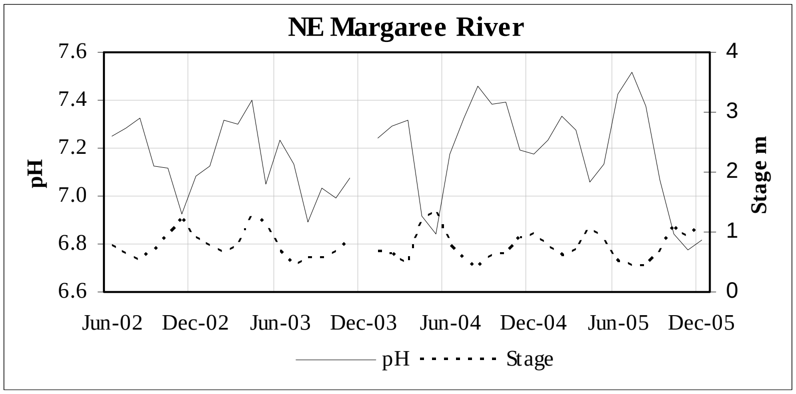


Table 4.2-14. Mean monthly pH for North East Margaree River during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| June | 2002 | 7.25 | 6.95 | 7.37 | 0.10 |
| July | 2002 | 7.29 | 7.19 | 7.35 | 0.04 |
| August | 2002 | 7.32 | 7.18 | 7.38 | 0.05 |
| September | 2002 | 7.13 | 6.50 | 7.37 | 0.23 |
| October | 2002 | 7.12 | 6.67 | 7.30 | 0.15 |
| November | 2002 | 6.93 | 6.39 | 7.16 | 0.21 |
| December | 2002 | 7.08 | 6.92 | 7.19 | 0.06 |
| January | 2003 | 7.13 | 7.09 | 7.21 | 0.03 |
| February | 2003 | 7.32 | 7.29 | 7.35 | 0.02 |
| March | 2003 | 7.30 | 6.62 | 7.43 | 0.16 |
| April | 2003 | 7.40 | 6.75 | 8.19 | 0.36 |
| May | 2003 | 7.05 | 6.74 | 7.27 | 0.13 |
| June | 2003 | 7.23 | 6.96 | 7.38 | 0.10 |
| July | 2003 | 7.13 | 6.93 | 7.37 | 0.14 |
| August | 2003 | 6.89 | 6.61 | 7.09 | 0.16 |
| September | 2003 | 7.03 | 6.54 | 7.24 | 0.16 |
| October | 2003 | 6.99 | 6.60 | 7.18 | 0.17 |
| November | 2003 | 7.08 | 6.90 | 7.17 | 0.08 |
| December | 2003 | | | | |
| January | 2004 | 7.24 | 7.14 | 7.29 | 0.03 |
| February | 2004 | 7.29 | 7.23 | 7.36 | 0.04 |
| March | 2004 | 7.32 | 7.19 | 7.40 | 0.05 |
| April | 2004 | 6.92 | 6.58 | 7.28 | 0.19 |

Table 4.2-14, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| May | 2004 | 6.84 | 6.60 | 7.16 | 0.18 |
| June | 2004 | 7.17 | 6.98 | 7.32 | 0.10 |
| July | 2004 | 7.32 | 7.15 | 7.44 | 0.06 |
| August | 2004 | 7.46 | 7.41 | 7.51 | 0.03 |
| September | 2004 | 7.38 | 7.02 | 7.55 | 0.14 |
| October | 2004 | 7.39 | 7.07 | 7.57 | 0.14 |
| November | 2004 | 7.19 | 6.59 | 7.33 | 0.15 |
| December | 2004 | 7.18 | 6.73 | 7.35 | 0.13 |
| January | 2005 | 7.24 | 6.77 | 7.32 | 0.12 |
| February | 2005 | 7.33 | 7.17 | 7.40 | 0.05 |
| March | 2005 | 7.28 | 6.83 | 7.40 | 0.17 |
| April | 2005 | 7.06 | 6.65 | 7.23 | 0.14 |
| May | 2005 | 7.13 | 6.75 | 7.32 | 0.13 |
| June | 2005 | 7.42 | 7.33 | 7.47 | 0.04 |
| July | 2005 | 7.51 | 7.38 | 7.63 | 0.06 |
| August | 2005 | 7.38 | 7.12 | 7.47 | 0.09 |
| September | 2005 | 7.07 | 6.66 | 7.32 | 0.19 |
| October | 2005 | 6.84 | 6.43 | 7.16 | 0.19 |
| November | 2005 | 6.77 | 6.40 | 6.97 | 0.15 |
| December | 2005 | 6.82 | 6.82 | 6.82 | |

Table 4.2-15. Mean seasonal pH for North East Margaree River during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| Summer | 2002 | 7.29 | 6.95 | 7.38 | 0.07 |
| Fall | 2002 | 7.06 | 6.39 | 7.37 | 0.21 |
| Winter | 2003 | 7.13 | 6.92 | 7.35 | 0.09 |
| Spring | 2003 | 7.25 | 6.62 | 8.19 | 0.28 |
| Summer | 2003 | 7.08 | 6.61 | 7.38 | 0.20 |
| Fall | 2003 | 7.03 | 6.54 | 7.24 | 0.15 |
| Winter | 2004 | 7.27 | 7.14 | 7.36 | 0.05 |
| Spring | 2004 | 7.03 | 6.58 | 7.40 | 0.26 |
| Summer | 2004 | 7.31 | 6.98 | 7.51 | 0.13 |
| Fall | 2004 | 7.32 | 6.59 | 7.57 | 0.17 |

Table 4.2-15, continued

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| Winter | 2005 | 7.25 | 6.73 | 7.40 | 0.12 |
| Spring | 2005 | 7.16 | 6.65 | 7.40 | 0.17 |
| Summer | 2005 | 7.44 | 7.12 | 7.63 | 0.09 |
| Fall | 2005 | 6.90 | 6.40 | 7.32 | 0.22 |

Table 4.2-16. Mean annual pH for North East Margaree River during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- |
| 2002 | 7.16 | 6.39 | 7.38 | 0.19 |
| 2003 | 7.13 | 6.54 | 8.19 | 0.23 |
| 2004 | 7.22 | 6.58 | 7.57 | 0.21 |
| 2005 | 7.18 | 6.40 | 7.63 | 0.26 |

Missing value implies insufficient data to compute the statistic.

### 4.2.4 Overview of North East Margaree River Water Quality

Water quality data for the period of record are fairly typical of a predominantly forested watershed (88% of total area) located on a combination of areas of sedimentary and metamorphic bedrock.

Variation in water temperature follows a seasonal pattern very similar to that of air temperature, which is to be expected of a shallow flowing river. Seasonal minimum and maximum mean water temperatures ranged from 0.2 and 0.5$^{o}$C for Winter (December to February) and 14.4 and 15.8$^{o}$C for Summer (June to August).

Turbidity values are relatively low for most of the period of record, although there are periods when values were relatively higher for short periods of time. The time of year when peak values were more often observed was during periods of increased flows occurring in the Fall. Environmental conditions (soil moisture, evapotransporation rates, etc.) are such that more of the rainfall landing on the terrestrial escosystem at this time of year is available as runoff, therefore increasing runoff velocities and erosion potential.

Conductivity appears to follow a pattern that is inverse to stage. This is reasonable assuming that increased stage is the result of precipitation events and/or snowmelt that are diluting the concentration of ions in the river and lowering conductivity. Conductivity levels were observed to peak at between 257 and 353 uS/cm during the low flow months of July and August and bottom out at between 42 and 58 uS/cm during the typically higher flow months of October/November and April/May. It appears that the potential effect on water conductivity due to increased chloride content due to road-de-icing activities is negligible.

Dissolved oxygen concentrations show a pattern that is essentially the inverse of temperature, which is also typical of shallow surface waters with low biological productivity since the solubility of oxygen in water decreases as water temperature rises. At no time during the period of record did concentrations dip below 7.4 mg/L, remaining well above a CCME published threshold for the protection of aquatic life of 5.0 mg/L.

Based on the period of record, the North East Margaree River appears to be relatively well buffered in that pH values are relatively high compared to most surface waters in the province, which is certainly related to the bedrock and soils in the watershed. Less than 1 percent of all pH measurements fell outside the ranges of values published by the CCME for Drinking Water use and the Protection of Aquatic Life of 6.5 to 8.5 and 6.5 to 9.0, respectively. pH appears to have a weak inverse relationship to flow in that during periods of increased flow, pH levels are depressed.

# 4.3 SHELBURNE RIVER
# 2002-2005

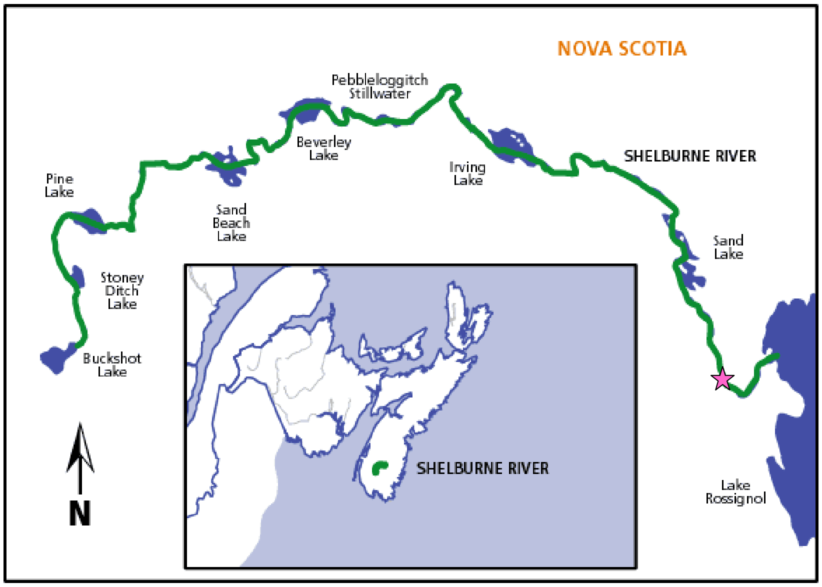


Figure 4.3-1. Location of Shelburne River (map courtesy of Canadian Heritage Rivers System).

## 4.3.1 Background Information

### *4.3.1.1 Location of Station*

The geographic location, in longitude and latitude, of the Automated Network Station on the Shelburne River is 65°14'32" W, 44° 12'59"N and is denoted in Figure 4.3-1 by a star.

### *4.3.1.2 Geographical Setting*

The Shelburne River begins at Buckshot Lake in the Tobeatic Wilderness Area and empties into Lake Rossignol. It is 53 km long, its drainage area is 277.4 km$^2$ and it flows through many shallow, rocky lakes and rapids as well as wetlands and undisturbed forests. 5% of the watershed lies within Kejimkujik National Park.

### *4.3.1.3 Geology and Geomorphology*

For the upper two-thirds of its length, the Shelburne flows over plutonic granites and granitoids, which lie under a large portion of southwestern Nova Scotia. It is covered by a thin layer of loose, stony, granite till. The lower portion of the river, east of Irving Lake, flows over more easily erodable quartzites and slates.

The dominant landscape features of the Shelburne have resulted from exposed underlying bedrock and glacial action. Exceptional examples of erratics, eskers, and outwash plains are characteristic of the Shelburne River. Drainage is poor, with peat bogs forming in the shallow depressions.

The dominant landform in the watershed is the undulating to moderately rolling plain with a thin mantle of stony till and peat bogs.

*4.3.1.4 Forest Cover and Land Use*

The river corridor is heavily forested and has some of the last old-growth stands of white pine, red spruce and hemlock in Nova Scotia, while the barren land surrounding it consists primarily of heath vegetation and bogs. About 75% of the watershed is Provincial Crown Land in wilderness condition. 75% of the land within the watershed is forested, 18% of it is covered by a combination of wetlands and water, and less than 0.5 % characterized as urban land use.

*4.3.1.5 Climate*

Normal (1971-2000) precipitation in the Shelburne River watershed, as recorded at the Environment Canada Climate Station in Kejimkujik National Park, is 1399 mm, comprised of 1154 mm of rainfall and 244 cm of snowfall. The mean annual temperature is 6.3$^{o}$C with a mean monthly high of 18.4$^{o}$C in July and a low of -6.1$^{o}$C in January.

Figure 4.3-2. Shelburne River Automated Water Quality Monitoring Station.

*4.3.1.6 Wildlife and Habitat*

The area supports large black bear and moose populations and other species which prefer remote areas. There are numerous wetlands in the watershed which provide habitat for nesting ducks, beaver, otter and muskrat.

*4.3.1.7 Human Settlement and Industrial Development*

Centuries ago, the Shelburne was used by the Mi’kmaq as a travel route as part of an important web of lakes and rivers. European settlers followed these Mi’kmaq canoe routes to hunt, fish, trap and explore. Industrial development in the watershed includes a limited amount of forestry, recreational fishing (e.g. salmon and brook trout), and tourism. The undisturbed riverbanks make the entire river corridor a popular wilderness canoeing destination. The undisturbed barrens and eskers also provide scenic views for hikers. The Shelburne River system was designated a Canadian Heritage River in 1997.

## 4.3.2 Land Use and Forest Type Summary Information

### *4.3.2.1 Land Use*

| Land Type | Area km$^2$ | % of Total Area |
|---|---|---|
| Barren | 15.9 | 5.9 |
| Clearcut | 1.0 | 0.4 |
| Forested | 202.3 | 75.4 |
| Urban | 0.7 | 0.3 |
| Wetland/Water | 48.4 | 18.0 |
| Total | 268.3 | 100.0 |

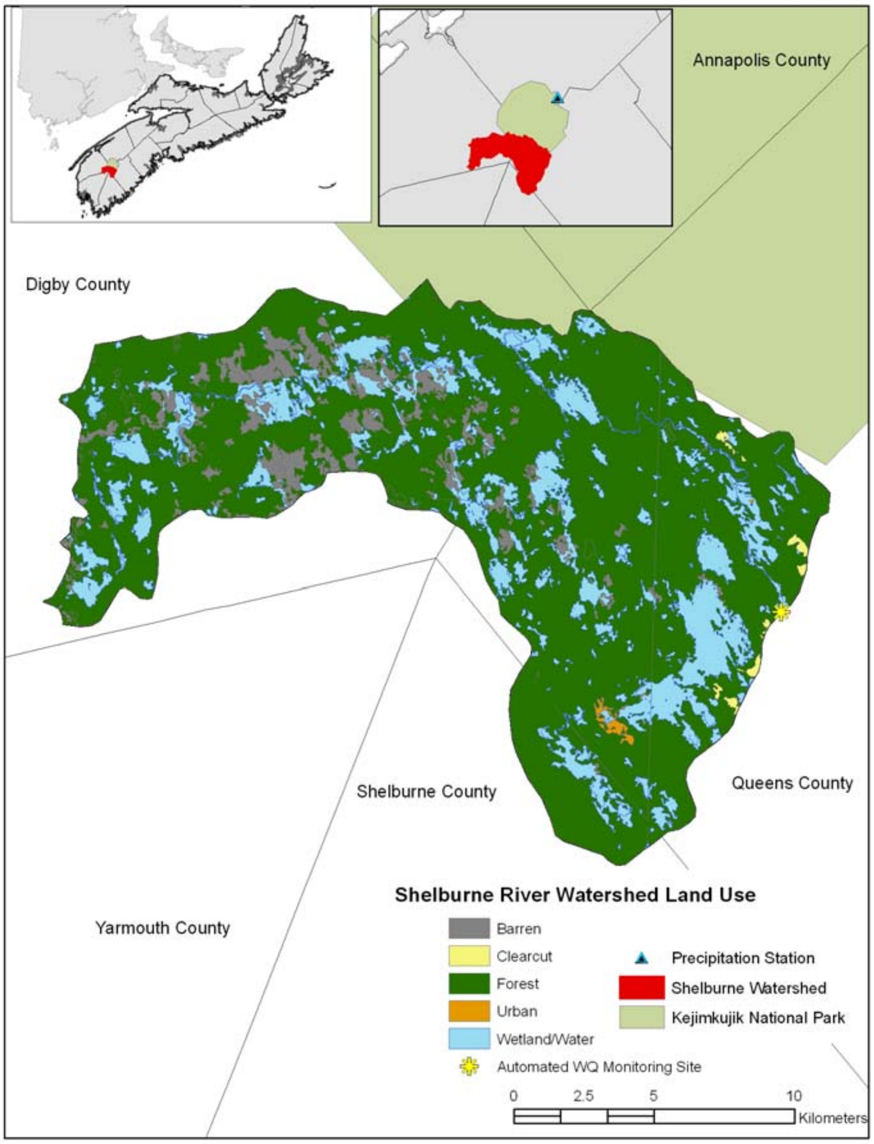


Figure 4.3-3. Land Use Mapping of Shelburne River Watershed.

### *4.3.2.2 Forest Type*

| Forest Type | Area km$^2$ | % of Total Area |
|---|---|---|
| Forested | 202.3 | 100.0 |
| Hardwood | 2.5 | 1.2 |
| Mixed Wood | 29.2 | 14.4 |
| Softwood | 169.2 | 83.7 |
| Unknown | 1.4 | 0.7 |

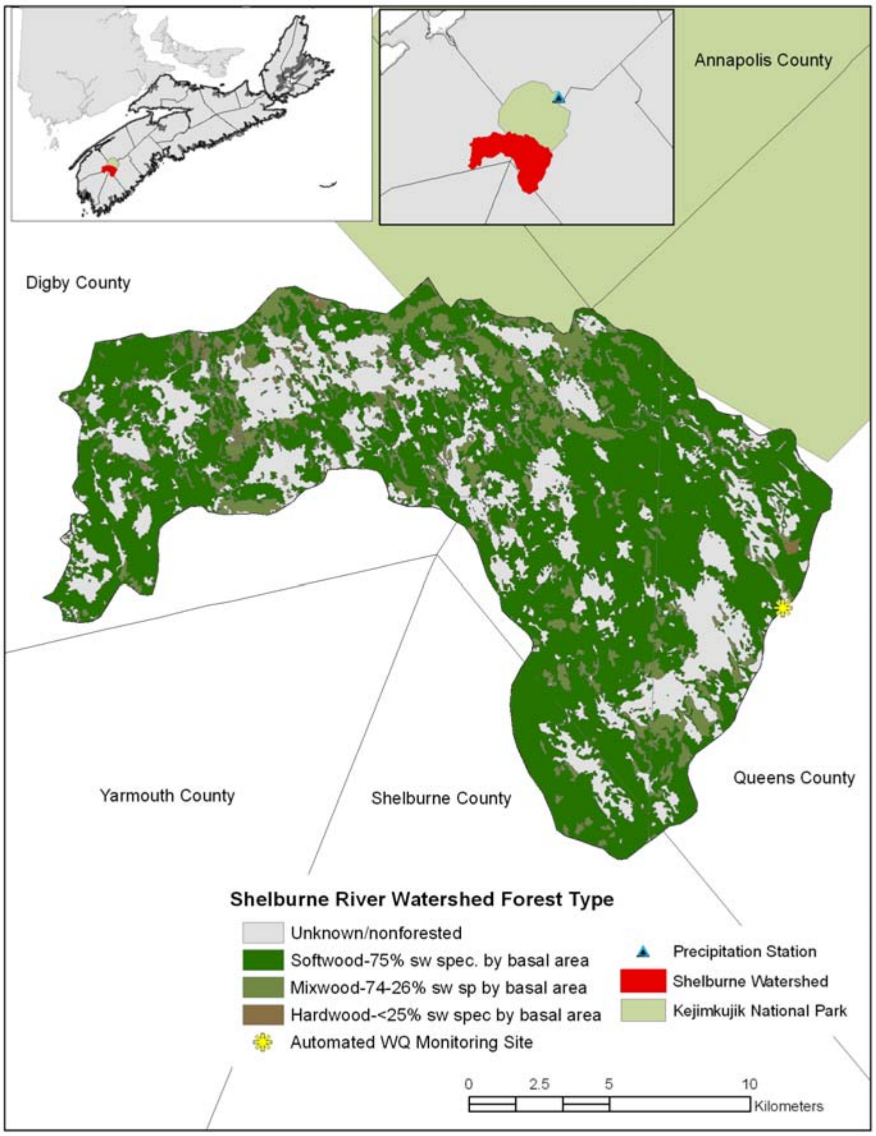


Figure 4.3-4. Forest Type Mapping of Shelburne River Watershed.

### 4.3.3 Water Quality Summary Information

Table 4.3-1. Hourly statistics of minimum, maximum, mean, and standard deviation and exceedences as per established water quality guidelines for hourly real time data for Shelburne River for the period 2002 –2005.

| Parameter | Year | Min | Max | Mean | SD | CWQ Guideline | | | Readings[5] | # of Exceedences | | | Exceedences As % of Readings | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWAL[1] | DW[1] | REC[1] | | | | | | | |
| | | | | | | | | | | | | | | | |
| Temperature, °C | 2002 | 0.0 | 30.3 | 10.8 | 8.3 | 20-21[2] | | | 3278 | 433 | | | 13 | | |
| | 2003 | 0.0 | 28.7 | 10.4 | 8.8 | | | | 8434 | 1345 | | | 16 | | |
| | 2004 | -0.2 | 27.9 | 9.7 | 8.8 | | | | 8447 | 1351 | | | 16 | | |
| | 2005 | -0.1 | 29.6 | 11.6 | 8.8 | | | | 7961 | 1684 | | | 21 | | |
| | | | | | | | | | | | | | | | |
| Turbidity, NTU | | | | | | | | | | DW <1[3] | DW ≤5[4] | REC | DW <1[3] | DW ≤5[4] | REC |
| | 2002 | 0.0 | 74.6 | 1.4 | 2.5 | | <1[3], ≤5[4] | ≤50 | 2382 | 1372 | 22 | 2 | 58 | <1 | <1 |
| | 2003 | 0.0 | 6.4 | 0.4 | 0.6 | | | | 1246 | 114 | 2 | 0 | 9 | <1 | 0 |
| | 2004 | 0.0 | 19.6 | 0.8 | 0.8 | | | | 6538 | 2395 | 23 | 0 | 37 | <1 | 0 |
| | 2005 | 0.0 | 106.4 | 1.3 | 3.2 | | | | 7620 | 3171 | 146 | 5 | 42 | 2 | <1 |
| | | | | | | | | | | | | | | | |
| Conductivity, uS/cm | 2002 | 24.2 | 44.6 | 34.2 | 4.7 | | | | | | | | | | |
| | 2003 | 24.2 | 45.3 | 34.6 | 5.6 | | | | | | | | | | |
| | 2004 | 21.3 | 46.9 | 34.2 | 7.0 | | | | | | | | | | |
| | 2005 | 24.2 | 41.7 | 32.2 | 5.3 | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Dissolved Oxygen, mg/L | 2002 | 5.4 | 14.2 | 10.0 | 2.5 | ≥5.0 | | | 3278 | 0 | | | 0 | | |
| | 2003 | 5.4 | 14.3 | 10.5 | 2.8 | | | | 8434 | 0 | | | 0 | | |
| | 2004 | 5.0 | 13.2 | 10.0 | 2.4 | | | | 8447 | 0 | | | 0 | | |
| | 2005 | 5.9 | 13.6 | 9.9 | 2.4 | | | | 7961 | 0 | | | 0 | | |
| | | | | | | | | | | | | | | | |
| pH, Units | | | | | | | | | | FWAL | DW | REC | FWAL | DW | REC |
| | 2002 | 4.2 | 4.8 | 4.4 | 0.2 | 6.5-9.0 | 6.5-8.5 | 6.5-9.5 | 2474 | 2474 | 2474 | 2474 | 100 | 100 | 100 |
| | 2003 | 4.2 | 4.7 | 4.4 | 0.1 | | | | 4186 | 4186 | 4186 | 4186 | 100 | 100 | 100 |
| | 2004 | 4.2 | 4.7 | 4.4 | 0.1 | | | | 8447 | 8447 | 8447 | 8447 | 100 | 100 | 100 |
| | 2005 | 4.1 | 4.7 | 4.4 | 0.1 | | | | 7961 | 7961 | 7961 | 7961 | 100 | 100 | 100 |

[1] FWAL: Freshwater Aquatic Life; DW: Drinking Water; REC: Recreational Uses.
[2] Upper permissible limit for salmon and trout (Alabaster and Lloyd. 1982). CCME DW guideline deemed to be inappropriate.
[3] Maximum Acceptable Concentration for water entering a distribution system.
[4] Aesthetic Objective. 5NTU may be permitted if demonstrated that the disinfection method is not compromised.
[5] The number of hourly readings possible in each of the years 2002, 2003 and 2005 is 8760. For 2004 the number is 8784. The number recorded in the table refers to the actual number of approved measurements.

### *4.3.3.1 Temperature*

Figure 4.3-5. Water temperature from August 2002 through November 2005 for the Shelburne River using hourly values. Gaps in the plot indicate missing data.

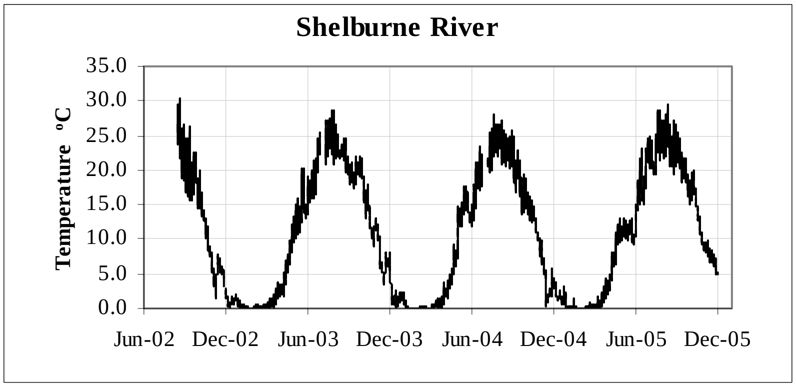


Figure 4.3-6. Water temperature from August 2002 through November 2005 for the Shelburne River using daily mean values. Gaps in the plot indicate missing data.

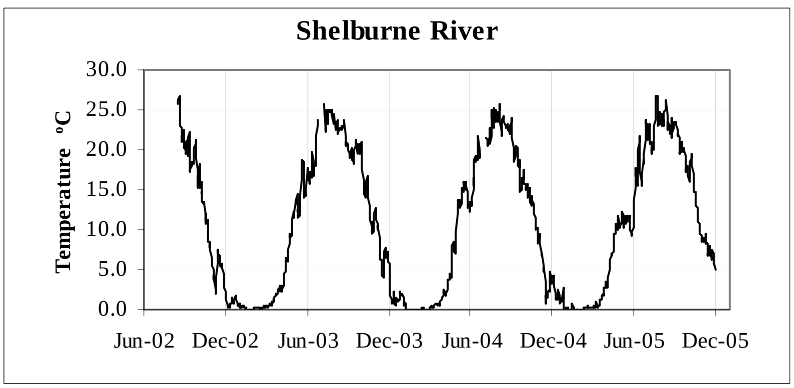

Figure 4.3-7. Air and water temperature from August 2002 through November 2005 for the Shelburne River using monthly mean values. Gaps in the plot indicate missing data.

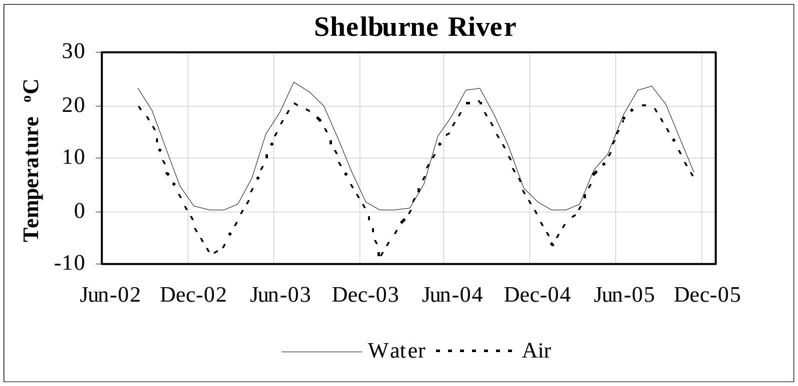


Table 4.3-2. Mean monthly water temperature for Shelburne River during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | °C | ------------- | ----- |
| August | 2002 | 23.3 | 20.3 | 26.8 | 2.2 |
| September | 2002 | 19.2 | 15.4 | 22.2 | 1.7 |
| October | 2002 | 11.8 | 5.9 | 18.1 | 3.5 |
| November | 2002 | 4.7 | 2.1 | 7.6 | 1.6 |
| December | 2002 | 0.9 | 0.2 | 2.2 | 0.5 |
| January | 2003 | 0.2 | 0.1 | 0.8 | 0.2 |
| February | 2003 | 0.2 | 0.1 | 0.5 | 0.1 |
| March | 2003 | 1.3 | 0.3 | 3.0 | 0.8 |
| April | 2003 | 6.1 | 2.2 | 12.2 | 3.1 |
| May | 2003 | 14.4 | 11.4 | 18.7 | 2.2 |
| June | 2003 | 18.7 | 15.9 | 23.9 | 2.5 |
| July | 2003 | 24.2 | 22.1 | 25.8 | 1.0 |
| August | 2003 | 22.4 | 20.4 | 24.6 | 1.1 |
| September | 2003 | 19.8 | 18.4 | 21.2 | 0.8 |
| October | 2003 | 13.7 | 9.6 | 19.5 | 2.7 |
| November | 2003 | 7.3 | 4.0 | 12.1 | 2.4 |
| December | 2003 | 1.6 | 0.4 | 5.7 | 1.1 |
| January | 2004 | 0.1 | -0.1 | 1.5 | 0.4 |
| February | 2004 | 0.0 | -0.2 | 0.2 | 0.1 |
| March | 2004 | 0.7 | 0.0 | 2.1 | 0.5 |
| April | 2004 | 5.0 | 1.8 | 9.7 | 2.5 |
| May | 2004 | 14.1 | 11.9 | 16.0 | 1.3 |

Table 4.3-2, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | $^oC$ | ------------- | ----- |
| June | 2004 | 17.7 | 13.0 | 21.8 | 2.7 |
| July | 2004 | 23.0 | 20.5 | 25.1 | 1.5 |
| August | 2004 | 23.3 | 21.8 | 25.8 | 0.9 |
| September | 2004 | 18.2 | 14.9 | 22.9 | 2.1 |
| October | 2004 | 12.7 | 8.2 | 15.8 | 2.2 |
| November | 2004 | 4.3 | 0.6 | 9.5 | 2.4 |
| December | 2004 | 1.6 | -0.1 | 4.1 | 1.1 |
| January | 2005 | 0.1 | -0.1 | 0.7 | 0.2 |
| February | 2005 | 0.2 | 0.0 | 0.4 | 0.1 |
| March | 2005 | 1.3 | 0.2 | 3.4 | 1.0 |
| April | 2005 | 7.8 | 2.7 | 11.6 | 2.9 |
| May | 2005 | 10.9 | 9.3 | 12.2 | 0.8 |
| June | 2005 | 18.5 | 12.1 | 23.8 | 3.0 |
| July | 2005 | 22.9 | 19.6 | 26.8 | 2.1 |
| August | 2005 | 23.5 | 21.5 | 26.3 | 1.2 |
| September | 2005 | 20.1 | 16.8 | 23.6 | 2.0 |
| October | 2005 | 13.9 | 8.6 | 19.5 | 3.6 |
| November | 2005 | 7.4 | 5.0 | 9.4 | 1.2 |

Table 4.3-3. Mean seasonal water temperature for Shelburne River during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | $^oC$ | ------------- | ----- |
| Summer | 2002 | 23.3 | 20.3 | 26.8 | 2.2 |
| Fall | 2002 | 11.9 | 2.1 | 22.2 | 6.4 |
| Winter | 2003 | 0.5 | 0.1 | 2.2 | 0.5 |
| Spring | 2003 | 7.3 | 0.3 | 18.7 | 5.9 |
| Summer | 2003 | 21.7 | 15.9 | 25.8 | 2.8 |
| Fall | 2003 | 13.6 | 4.0 | 21.2 | 5.5 |
| Winter | 2004 | 0.6 | -0.2 | 5.7 | 1.0 |
| Spring | 2004 | 6.6 | 0.0 | 16.0 | 5.9 |
| Summer | 2004 | 21.6 | 13.0 | 25.8 | 3.0 |
| Fall | 2004 | 11.8 | 0.6 | 22.9 | 6.1 |
| Winter | 2005 | 0.6 | -0.1 | 4.1 | 1.0 |
| Spring | 2005 | 6.6 | 0.2 | 12.2 | 4.4 |
| Summer | 2005 | 21.7 | 12.1 | 26.8 | 3.1 |
| Fall | 2005 | 13.9 | 5.0 | 23.6 | 5.7 |

Table 4.3-4. Mean annual water temperature for Shelburne River during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ------------- | $^oC$ | ------------- | ----- |
| 2002 | 10.8 | 0.2 | 26.8 | 8.3 |
| 2003 | 10.5 | 0.1 | 25.8 | 8.8 |
| 2004 | 9.7 | -0.2 | 25.8 | 8.8 |
| 2005 | 11.6 | -0.1 | 26.8 | 8.8 |

Missing value implies insufficient data to compute the statistic.

### *4.3.3.2 Turbidity*

Figure 4.3-8. Turbidity levels from August 2002 through November 2005 for the Shelburne River based on hourly values. Gaps in the plot indicate missing data.

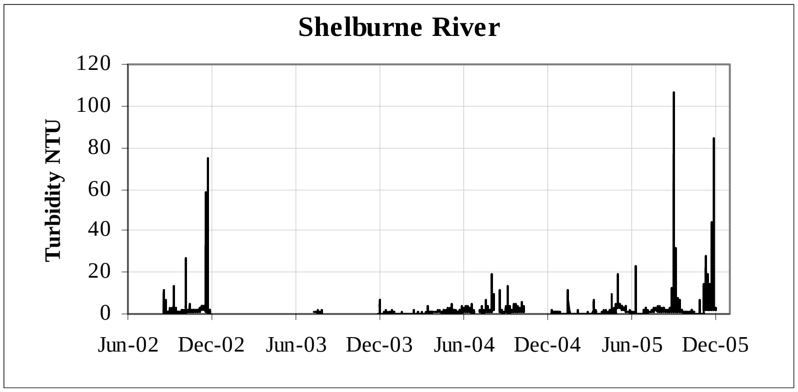


Figure 4.3-9. Turbidity levels from August 2002 through November 2005 for the Shelburne River based on daily mean values. Gaps in the plot indicate missing data.

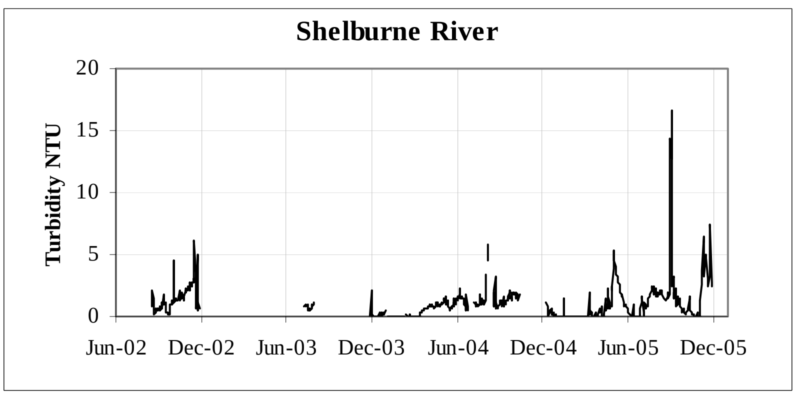

Figure 4.3-10. Turbidity levels and stream stage from August 2002 through November 2005 for the Shelburne River based on monthly mean values. Gaps in the plot indicate missing data.

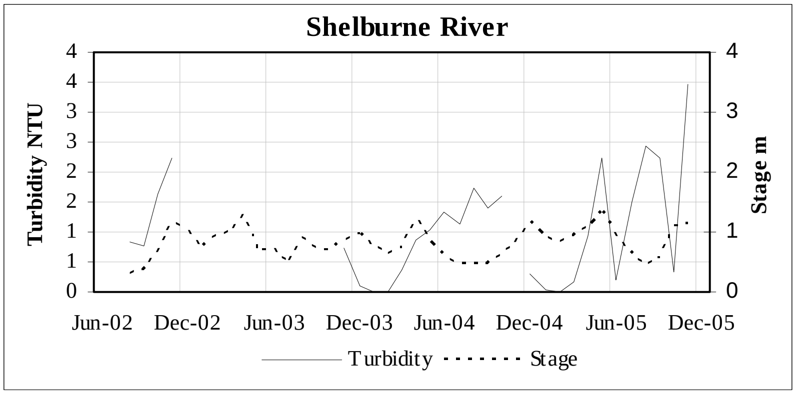


Table 4.3-5. Mean monthly turbidity for Shelburne River during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | NTU | ------------ | ----- |
| August | 2002 | 0.8 | 0.1 | 2.1 | 0.6 |
| September | 2002 | 0.8 | 0.1 | 1.8 | 0.4 |
| October | 2002 | 1.6 | 1.1 | 4.6 | 0.6 |
| November | 2002 | 2.2 | 0.6 | 6.2 | 1.3 |
| December | 2002 | | | | |
| January | 2003 | | | | |
| February | 2003 | | | | |
| March | 2003 | | | | |
| April | 2003 | | | | |
| May | 2003 | | | | |
| June | 2003 | | | | |
| July | 2003 | 0.8 | 0.5 | 1.2 | 0.2 |
| August | 2003 | | | | |
| September | 2003 | | | | |
| October | 2003 | | | | |
| November | 2003 | 0.7 | 0.0 | 2.1 | 1.2 |
| December | 2003 | 0.1 | 0.0 | 0.5 | 0.2 |
| January | 2004 | 0.0 | 0.0 | 0.1 | 0.0 |
| February | 2004 | 0.0 | 0.0 | 0.1 | 0.0 |
| March | 2004 | 0.4 | 0.0 | 0.9 | 0.3 |
| April | 2004 | 0.9 | 0.7 | 1.1 | 0.1 |
| May | 2004 | 1.0 | 0.5 | 1.6 | 0.3 |
| June | 2004 | 1.3 | 0.5 | 2.3 | 0.5 |

Table 4.3-5, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | NTU | ------------ | ----- |
| July | 2004 | 1.1 | 0.8 | 1.8 | 0.3 |
| August | 2004 | 1.7 | 0.7 | 5.9 | 1.5 |
| September | 2004 | 1.4 | 0.8 | 2.1 | 0.4 |
| October | 2004 | 1.6 | 1.3 | 1.9 | 0.2 |
| November | 2004 | | | | |
| December | 2004 | 0.3 | 0.0 | 1.1 | 0.3 |
| January | 2005 | 0.0 | 0.0 | 1.4 | 0.3 |
| February | 2005 | 0.0 | 0.0 | 0.1 | 0.0 |
| March | 2005 | 0.2 | 0.0 | 1.9 | 0.4 |
| April | 2005 | 0.9 | 0.0 | 3.9 | 0.9 |
| May | 2005 | 2.2 | 0.6 | 5.4 | 1.3 |
| June | 2005 | 0.2 | 0.0 | 1.3 | 0.4 |
| July | 2005 | 1.5 | 0.0 | 2.4 | 0.7 |
| August | 2005 | 2.4 | 1.2 | 14.4 | 2.7 |
| September | 2005 | 2.2 | 0.3 | 16.7 | 3.6 |
| October | 2005 | 0.3 | 0.0 | 1.6 | 0.4 |
| November | 2005 | 3.5 | 0.0 | 7.5 | 1.7 |

Table 4.3-6. Mean seasonal turbidity for Shelburne River during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | NTU | ------------ | ----- |
| Summer | 2002 | 0.8 | 0.1 | 2.1 | 0.6 |
| Fall | 2002 | 1.5 | 0.1 | 6.2 | 1.0 |
| Winter | 2003 | | | | |
| Spring | 2003 | | | | |
| Summer | 2003 | 0.8 | 0.5 | 1.2 | 0.2 |
| Fall | 2003 | 0.7 | 0.0 | 2.1 | 1.2 |
| Winter | 2004 | 0.0 | 0.0 | 0.5 | 0.1 |
| Spring | 2004 | 0.8 | 0.0 | 1.6 | 0.4 |
| Summer | 2004 | 1.4 | 0.5 | 5.9 | 0.9 |
| Fall | 2004 | 1.5 | 0.8 | 2.1 | 0.3 |
| Winter | 2005 | 0.1 | 0.0 | 1.4 | 0.3 |
| Spring | 2005 | 1.1 | 0.0 | 5.4 | 1.3 |
| Summer | 2005 | 1.4 | 0.0 | 14.4 | 1.9 |
| Fall | 2005 | 2.0 | 0.0 | 16.7 | 2.6 |

Table 4.3-7. Mean annual turbidity for Shelburne River during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ------------ NTU ------------ | | | ----- |
| 2002 | 1.4 | 0.1 | 6.2 | 1.0 |
| 2003 | 0.4 | 0.0 | 2.1 | 0.4 |
| 2004 | 0.8 | 0.0 | 5.9 | 0.7 |
| 2005 | 1.2 | 0.0 | 16.7 | 1.9 |

Missing value implies insufficient data to compute the statistic.

### *4.3.3.3 Conductivity*

Figure 4.3-11. Conductivity from August 2002 through November 2005 for the Shelburne River based on <u>hourly values</u>. Gaps in the plot indicate missing data.

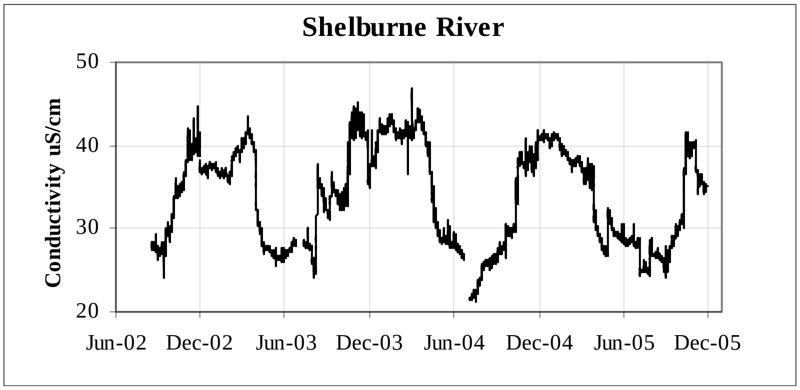


Figure 4.3-12. Conductivity from August 2002 through November 2005 for the Shelburne River based on <u>daily mean values</u>. Gaps in the plot indicate missing data.

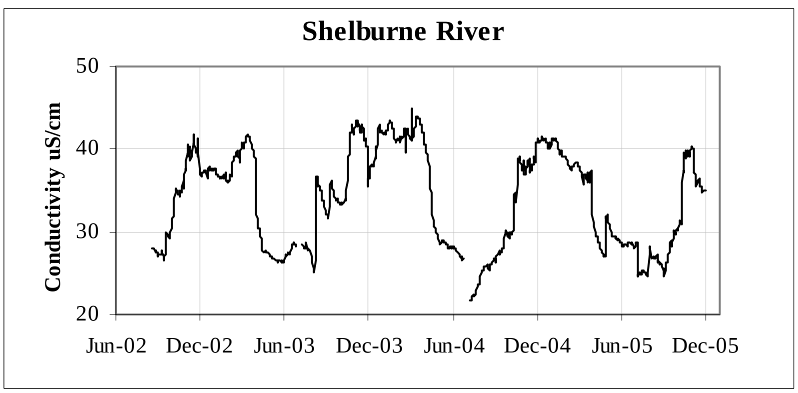

Figure 4.3-13. Conductivity and stream stage from August 2002 through November 2005 for the Shelburne River based on monthly mean values. Gaps in the plot indicate missing data.

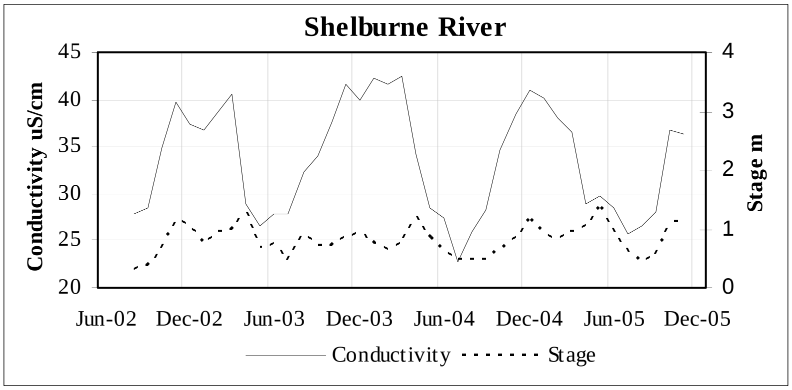


Table 4.3-8. Mean monthly conductivity for Shelburne River during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | -------- uS/cm -------- | | | ----- |
| August | 2002 | 27.8 | 27.0 | 28.0 | 0.3 |
| September | 2002 | 28.4 | 26.6 | 31.0 | 1.3 |
| October | 2002 | 34.8 | 31.4 | 37.7 | 1.5 |
| November | 2002 | 39.6 | 37.1 | 41.8 | 1.1 |
| December | 2002 | 37.3 | 36.5 | 37.9 | 0.3 |
| January | 2003 | 36.7 | 36.0 | 37.6 | 0.4 |
| February | 2003 | 38.6 | 36.2 | 40.2 | 1.2 |
| March | 2003 | 40.5 | 35.8 | 41.8 | 1.3 |
| April | 2003 | 28.8 | 27.2 | 33.2 | 1.7 |
| May | 2003 | 26.6 | 26.4 | 27.3 | 0.2 |
| June | 2003 | 27.7 | 26.6 | 28.7 | 0.6 |
| July | 2003 | 27.8 | 26.2 | 28.7 | 0.6 |
| August | 2003 | 32.3 | 25.1 | 36.8 | 3.7 |
| September | 2003 | 33.9 | 31.6 | 36.2 | 1.2 |
| October | 2003 | 37.7 | 33.2 | 43.0 | 4.0 |
| November | 2003 | 41.7 | 35.5 | 43.5 | 2.0 |
| December | 2003 | 39.8 | 36.4 | 43.0 | 2.1 |
| January | 2004 | 42.2 | 40.9 | 43.5 | 0.8 |
| February | 2004 | 41.6 | 39.6 | 42.6 | 0.6 |
| March | 2004 | 42.5 | 40.6 | 44.8 | 1.1 |
| April | 2004 | 34.2 | 29.2 | 40.6 | 4.1 |
| May | 2004 | 28.5 | 28.0 | 28.9 | 0.3 |
| June | 2004 | 27.4 | 26.6 | 28.3 | 0.6 |

Table 4.3-8, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | -------- uS/cm -------- | | | ----- |
| July | 2004 | 22.8 | 21.6 | 25.1 | 1.0 |
| August | 2004 | 25.9 | 25.3 | 26.8 | 0.5 |
| September | 2004 | 28.3 | 26.3 | 30.1 | 1.1 |
| October | 2004 | 34.6 | 29.5 | 39.0 | 3.8 |
| November | 2004 | 38.4 | 36.9 | 41.2 | 1.2 |
| December | 2004 | 40.9 | 40.0 | 41.6 | 0.4 |
| January | 2005 | 40.2 | 38.8 | 41.3 | 0.9 |
| February | 2005 | 38.1 | 37.5 | 38.8 | 0.3 |
| March | 2005 | 36.4 | 31.1 | 37.7 | 1.4 |
| April | 2005 | 29.0 | 27.0 | 32.1 | 1.5 |
| May | 2005 | 29.7 | 28.6 | 31.7 | 0.9 |
| June | 2005 | 28.4 | 28.0 | 28.8 | 0.2 |
| July | 2005 | 25.7 | 24.6 | 28.6 | 1.3 |
| August | 2005 | 26.5 | 25.1 | 28.2 | 0.7 |
| September | 2005 | 28.1 | 24.7 | 30.4 | 1.8 |
| October | 2005 | 36.7 | 30.5 | 40.3 | 3.8 |
| November | 2005 | 36.3 | 34.7 | 40.2 | 1.4 |

Table 4.3-9. Mean seasonal conductivity for Shelburne River during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Average | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ---------- uS/cm ---------- | | | ----- |
| Summer | 2002 | 27.8 | 27.0 | 28.0 | 0.3 |
| Fall | 2002 | 34.3 | 26.6 | 41.8 | 4.8 |
| Winter | 2003 | 37.5 | 36.0 | 40.2 | 1.1 |
| Spring | 2003 | 32.0 | 26.4 | 41.8 | 6.3 |
| Summer | 2003 | 29.6 | 25.1 | 36.8 | 3.3 |
| Fall | 2003 | 37.8 | 31.6 | 43.5 | 4.1 |
| Winter | 2004 | 41.2 | 36.4 | 43.5 | 1.7 |
| Spring | 2004 | 35.1 | 28.0 | 44.8 | 6.3 |
| Summer | 2004 | 25.3 | 21.6 | 28.3 | 2.0 |
| Fall | 2004 | 33.7 | 26.3 | 41.2 | 4.8 |
| Winter | 2005 | 39.8 | 37.5 | 41.6 | 1.3 |
| Spring | 2005 | 31.7 | 27.0 | 37.7 | 3.6 |
| Summer | 2005 | 26.9 | 24.6 | 28.8 | 1.4 |
| Fall | 2005 | 33.7 | 24.7 | 40.3 | 4.7 |

Table 4.3-10. Mean annual conductivity for Shelburne River during 2002-2005 based on mean daily data.

| Year | Average | Minimum | Maximum | SD |
|---|---|---|---|---|
| ---- | ---------- uS/cm ---------- | | | ------- |
| 2002 | 34.2 | 26.6 | 41.8 | 4.7 |
| 2003 | 34.6 | 25.1 | 43.5 | 5.6 |
| 2004 | 34.2 | 21.6 | 44.8 | 7.0 |
| 2005 | 32.2 | 24.6 | 41.3 | 5.3 |

Missing value implies insufficient data to compute the statistic.

### *4.3.3.4 Dissolved Oxygen*

Figure 4.3-14 Dissolved oxygen concentration from August 2002 through November 2005 for the Shelburne River based on hourly values. Gaps in the plot indicate missing data.

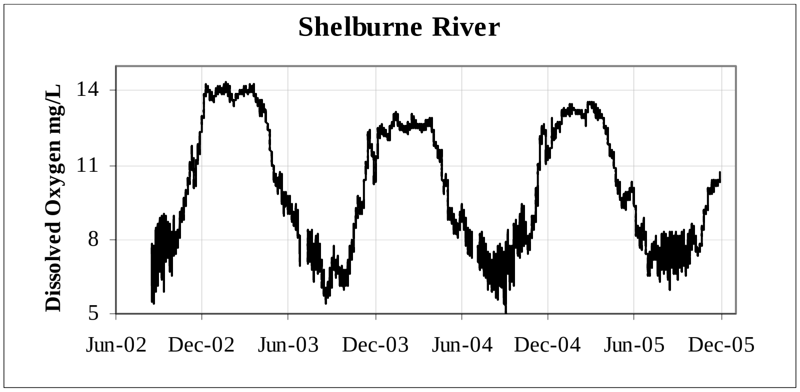


Figure 4.3-15 Dissolved oxygen concentration from August 2002 through November 2005 for the Shelburne River based on daily mean values. Gaps in the plot indicate missing data.

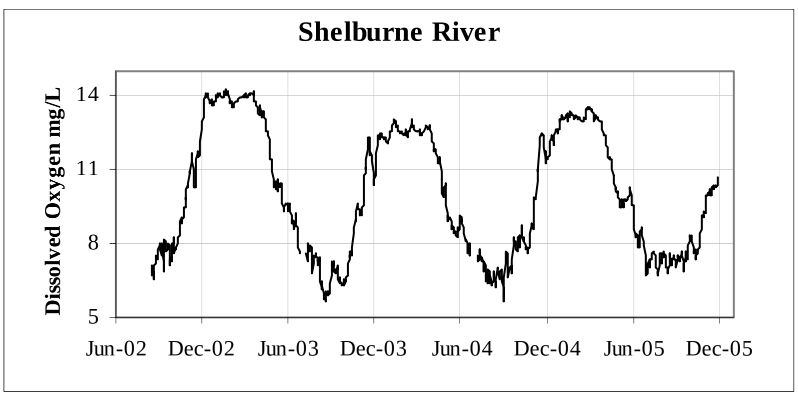

Figure 4.3-16 Dissolved oxygen concentration and stream stage from August 2002 through November 2005 for the Shelburne River based on monthly mean values. Gaps in the plot indicate missing data.

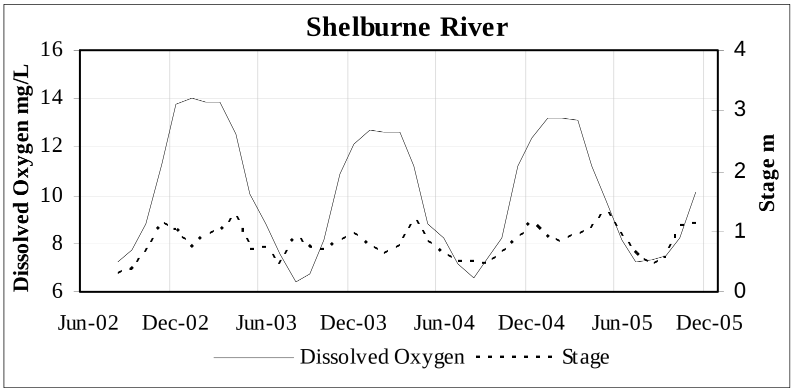


Table 4.3-11. Mean monthly dissolved oxygen for Shelburne River during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ---------- | mg/L | ---------- | ----- |
| August | 2002 | 7.2 | 6.6 | 8.0 | 0.4 |
| September | 2002 | 7.7 | 6.9 | 8.2 | 0.3 |
| October | 2002 | 8.8 | 7.6 | 10.4 | 0.8 |
| November | 2002 | 11.3 | 10.3 | 12.9 | 0.8 |
| December | 2002 | 13.8 | 12.9 | 14.1 | 0.3 |
| January | 2003 | 14.0 | 13.7 | 14.2 | 0.1 |
| February | 2003 | 13.8 | 13.5 | 14.1 | 0.2 |
| March | 2003 | 13.9 | 13.2 | 14.2 | 0.3 |
| April | 2003 | 12.5 | 10.6 | 13.6 | 0.9 |
| May | 2003 | 10.0 | 9.3 | 10.6 | 0.4 |
| June | 2003 | 8.8 | 7.6 | 9.6 | 0.6 |
| July | 2003 | 7.5 | 6.8 | 8.0 | 0.3 |
| August | 2003 | 6.4 | 5.7 | 7.4 | 0.6 |
| September | 2003 | 6.7 | 6.3 | 7.3 | 0.3 |
| October | 2003 | 8.2 | 6.5 | 9.6 | 1.0 |
| November | 2003 | 10.9 | 9.1 | 12.3 | 1.0 |
| December | 2003 | 12.1 | 10.6 | 12.5 | 0.5 |
| January | 2004 | 12.7 | 12.3 | 13.1 | 0.2 |
| February | 2004 | 12.6 | 12.3 | 13.0 | 0.2 |
| March | 2004 | 12.6 | 12.4 | 12.8 | 0.1 |
| April | 2004 | 11.2 | 9.9 | 12.4 | 0.7 |
| May | 2004 | 8.8 | 8.3 | 9.9 | 0.4 |

Table 4.3-11, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ---------- mg/L ---------- | | | ----- |
| June | 2004 | 8.3 | 7.5 | 9.1 | 0.5 |
| July | 2004 | 7.2 | 6.4 | 7.8 | 0.4 |
| August | 2004 | 6.6 | 5.7 | 7.1 | 0.3 |
| September | 2004 | 7.4 | 6.2 | 8.2 | 0.6 |
| October | 2004 | 8.2 | 7.6 | 8.8 | 0.4 |
| November | 2004 | 11.2 | 8.6 | 12.5 | 1.2 |
| December | 2004 | 12.3 | 11.4 | 13.2 | 0.5 |
| January | 2005 | 13.2 | 13.0 | 13.4 | 0.1 |
| February | 2005 | 13.2 | 12.9 | 13.5 | 0.2 |
| March | 2005 | 13.1 | 12.5 | 13.5 | 0.3 |
| April | 2005 | 11.2 | 9.9 | 12.4 | 0.8 |
| May | 2005 | 9.8 | 9.5 | 10.3 | 0.2 |
| June | 2005 | 8.2 | 6.7 | 9.5 | 0.6 |
| July | 2005 | 7.3 | 6.7 | 7.7 | 0.3 |
| August | 2005 | 7.3 | 6.8 | 7.7 | 0.2 |
| September | 2005 | 7.5 | 6.9 | 8.3 | 0.3 |
| October | 2005 | 8.2 | 7.4 | 9.3 | 0.6 |
| November | 2005 | 10.1 | 9.3 | 10.7 | 0.3 |

Table 4.3-12. Mean seasonal dissolved oxygen for Shelburne River during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ---------- mg/L ---------- | | | ----- |
| Summer | 2002 | 7.2 | 6.6 | 8.0 | 0.4 |
| Fall | 2002 | 9.3 | 6.9 | 12.9 | 1.6 |
| Winter | 2003 | 13.9 | 12.9 | 14.2 | 0.2 |
| Spring | 2003 | 12.1 | 9.3 | 14.2 | 1.7 |
| Summer | 2003 | 7.5 | 5.7 | 9.6 | 1.1 |
| Fall | 2003 | 8.6 | 6.3 | 12.3 | 1.9 |
| Winter | 2004 | 12.5 | 10.6 | 13.1 | 0.4 |
| Spring | 2004 | 10.9 | 8.3 | 12.8 | 1.7 |
| Summer | 2004 | 7.2 | 5.7 | 9.1 | 0.8 |
| Fall | 2004 | 8.9 | 6.2 | 12.5 | 1.8 |
| Winter | 2005 | 12.9 | 11.4 | 13.5 | 0.5 |
| Spring | 2005 | 11.3 | 9.5 | 13.5 | 1.5 |
| Summer | 2005 | 7.6 | 6.7 | 9.5 | 0.6 |
| Fall | 2005 | 8.6 | 6.9 | 10.7 | 1.2 |

Table 4.3-13. Mean annual dissolved oxygen for Shelburne River during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ---------- mg $L^{-1}$ ---------- | | | ----- |
| 2002 | 10.0 | 6.6 | 14.1 | 2.5 |
| 2003 | 10.5 | 5.7 | 14.2 | 2.8 |
| 2004 | 10.0 | 5.7 | 13.2 | 2.4 |
| 2005 | 9.9 | 6.7 | 13.5 | 2.4 |

Missing value implies insufficient data to compute the statistic.

### *4.3.3.5 pH*

Figure 4.3-17. pH from August 2002 through November 2005 for the Shelburne River based on <u>hourly values</u>. Gaps in the plot indicate missing data.

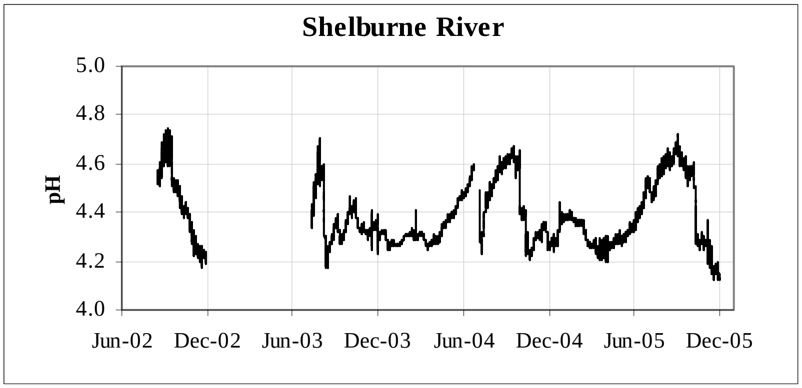


Figure 4.3-18. pH from August 2002 through November 2005 for the Shelburne River based on <u>daily mean values</u>. Gaps in the plot indicate missing data.

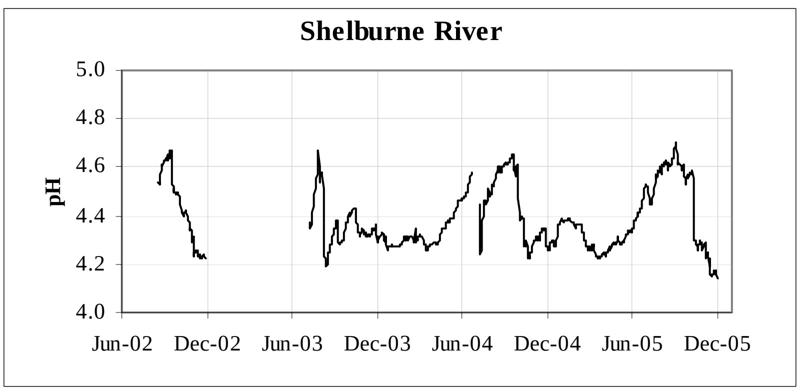

Figure 4.3-19. pH and stream stage from August 2002 through November 2005 for the Shelburne River based on monthly mean values. Gaps in the plot indicate missing data.

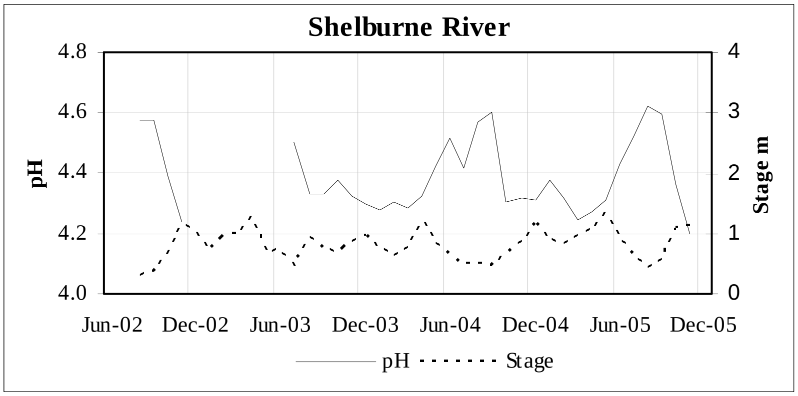


Table 4.3-14. Mean monthly pH for Shelburne River during 2002-2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| August | 2002 | 4.58 | 4.53 | 4.63 | 0.04 |
| September | 2002 | 4.58 | 4.49 | 4.67 | 0.07 |
| October | 2002 | 4.39 | 4.29 | 4.48 | 0.05 |
| November | 2002 | 4.24 | 4.22 | 4.28 | 0.02 |
| December | 2002 | | | | |
| January | 2003 | | | | |
| February | 2003 | | | | |
| March | 2003 | | | | |
| April | 2003 | | | | |
| May | 2003 | | | | |
| June | 2003 | | | | |
| July | 2003 | 4.50 | 4.35 | 4.67 | 0.10 |
| August | 2003 | 4.33 | 4.19 | 4.58 | 0.12 |
| September | 2003 | 4.33 | 4.28 | 4.40 | 0.04 |
| October | 2003 | 4.38 | 4.31 | 4.43 | 0.04 |
| November | 2003 | 4.33 | 4.29 | 4.36 | 0.02 |
| December | 2003 | 4.30 | 4.26 | 4.33 | 0.02 |
| January | 2004 | 4.28 | 4.27 | 4.31 | 0.01 |
| February | 2004 | 4.31 | 4.29 | 4.35 | 0.01 |
| March | 2004 | 4.29 | 4.26 | 4.32 | 0.02 |
| April | 2004 | 4.33 | 4.28 | 4.38 | 0.03 |
| May | 2004 | 4.42 | 4.37 | 4.47 | 0.03 |

Table 4.3-14, continued

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| June | 2004 | 4.52 | 4.47 | 4.58 | 0.04 |
| July | 2004 | 4.42 | 4.24 | 4.51 | 0.08 |
| August | 2004 | 4.57 | 4.49 | 4.62 | 0.03 |
| September | 2004 | 4.60 | 4.41 | 4.65 | 0.05 |
| October | 2004 | 4.31 | 4.22 | 4.40 | 0.07 |
| November | 2004 | 4.32 | 4.26 | 4.35 | 0.03 |
| December | 2004 | 4.31 | 4.26 | 4.39 | 0.04 |
| January | 2005 | 4.38 | 4.35 | 4.39 | 0.01 |
| February | 2005 | 4.32 | 4.26 | 4.36 | 0.04 |
| March | 2005 | 4.25 | 4.22 | 4.28 | 0.02 |
| April | 2005 | 4.27 | 4.23 | 4.31 | 0.02 |
| May | 2005 | 4.31 | 4.28 | 4.34 | 0.02 |
| June | 2005 | 4.43 | 4.35 | 4.53 | 0.06 |
| July | 2005 | 4.52 | 4.45 | 4.60 | 0.05 |
| August | 2005 | 4.62 | 4.57 | 4.69 | 0.03 |
| September | 2005 | 4.60 | 4.53 | 4.70 | 0.04 |
| October | 2005 | 4.37 | 4.26 | 4.59 | 0.13 |
| November | 2005 | 4.20 | 4.14 | 4.29 | 0.04 |

Table 4.3-15. Mean seasonal pH for Shelburne River during 2002-2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| Summer | 2002 | 4.58 | 4.53 | 4.63 | 0.04 |
| Fall | 2002 | 4.41 | 4.22 | 4.67 | 0.15 |
| Winter | 2003 | | | | |
| Spring | 2003 | | | | |
| Summer | 2003 | 4.40 | 4.19 | 4.67 | 0.14 |
| Fall | 2003 | 4.35 | 4.28 | 4.43 | 0.04 |
| Winter | 2004 | 4.29 | 4.26 | 4.35 | 0.02 |
| Spring | 2004 | 4.34 | 4.26 | 4.47 | 0.07 |
| Summer | 2004 | 4.51 | 4.24 | 4.62 | 0.09 |
| Fall | 2004 | 4.41 | 4.22 | 4.65 | 0.15 |
| Winter | 2005 | 4.34 | 4.26 | 4.39 | 0.04 |
| Spring | 2005 | 4.28 | 4.22 | 4.34 | 0.03 |
| Summer | 2005 | 4.53 | 4.35 | 4.69 | 0.09 |
| Fall | 2005 | 4.39 | 4.14 | 4.70 | 0.18 |

Table 4.3-16. Mean annual pH for Shelburne River during 2002-2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| 2002 | 4.43 | 4.22 | 4.67 | 0.15 |
| 2003 | 4.36 | 4.19 | 4.67 | 0.09 |
| 2004 | 4.39 | 4.22 | 4.65 | 0.12 |
| 2005 | 4.39 | 4.14 | 4.70 | 0.15 |

Missing value implies insufficient data to compute the statistic.

### 4.3.4 Overview of Shelburne River Water Quality

Water quality data for the period of record are typical of a predominantly forested watershed (75% of total area) with a significant surface water component (18% of total area) of which a potion exists as peat bog. Bedrock geology is a combination of areas of igneous and metamorphic bedrock.

Variation in water temperature follows a seasonal pattern very similar to that of air temperature, which is to be expected of a shallow flowing river. Seasonal minimum and maximum mean water temperatures ranged from lows of 0.5 and 0.6$^{o}$C for Winter (December to February) and highs of 21.6 and 23.3$^{o}$C for Summer (June to August).

Turbidity values are relatively low for most of the period of record with only 1 percent of all hourly measurements (2002-2005) greater than 5 NTU. There were three notable periods of increased turbidity readings. Multiple rain events over a 2-week period in November 2002 amounting to a total of 190 mm of rain resulted in turbidity levels raising to 75 NTU. A 4-day 53.6mm rainfall event in August 2005 resulted in turbidity levels reaching 106 NTU, remaining elevated throughout the 4-day event. In November of the same year, a 3-day event totalling 65 mm yielded maximum turbidity concentrations of 84 NTU.

On an annual basis, only minor fluctuations in conductivity levels were observed to occur. The variation appears to be repetitive and the trend somewhat resembles that of stage in that peak periods occur during the Winter season and lows during late-Spring and Summer months. Hourly conductivity readings during 2002-05 ranged from 21.6 to 44.8 uS/cm.

Dissolved oxygen concentrations show a pattern that is essentially the inverse of temperature, which is also typical of shallow surface waters with low biological productivity since the solubility of oxygen in water decreases as water temperature rises. Minimum concentrations occurred during the warmer months and at no time dipped below 5.7 mg/L.

The poorly drained and bog littered Shelburne River watershed produces runoff that is acidic and highly stained (colour 104-226 TCU, see Appendix III) which is typical of many areas in the Province. Hourly pH ranged from 4.2 to 4.7. Between 2002 and 2005, annual mean pH remained steady at 4.4. Given the more acidic aquatic environment, acceptable ranges of values published by the CCME for Drinking Water use and the Protection of Aquatic Life of 6.5 to 8.5 and 6.5 to 9.0, respectively, were exceeded for the entire monitoring period.

# 4.4 KELLEY RIVER
# 2005

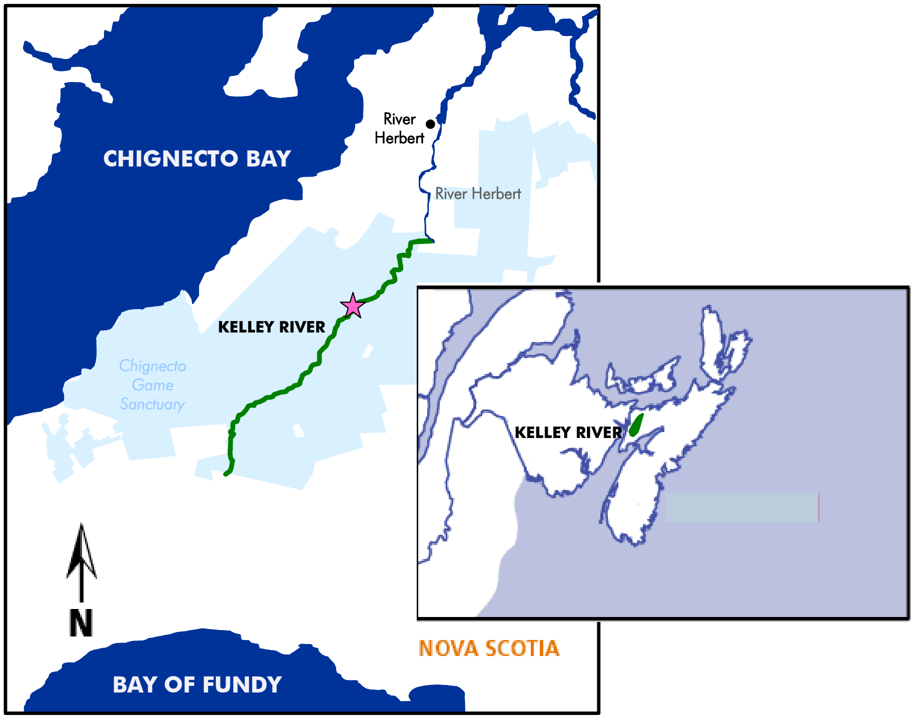


Figure 4.4-1. Location of Kelley River.

## 4.4.1 Background Information

*4.4.1.1 Location of Station*

The geographic location, in longitude and latitude, of the Automated Network Station on the Kelley River is 64°27'05" W, 45° 35'10"N and is denoted in Figure 4.4-1 by a star.

*4.4.1.2 Geographical Setting*

The Kelley River is located in Cumberland County, within the Chignecto Game Sanctuary. It flows northeast where it meets the River Herbert, which has its outlet in Cumberland Basin. The drainage area of the Kelley River is 64.5 $km^2$.

*4.4.1.3 Geology and Geomorphology*

The bedrock geology of the Kelley River watershed is dominated by sandstones, conglomerates and shales of varying grain size. The surficial geology is made up of a thin mantle of sandy till. The main river channel is characterized by glaciofluvial sands and gravels.

The dominant landform in the watershed is the undulating to moderately rolling plain with a thin mantle of stony till and peat bogs.

### *4.4.1.4 Forest Cover and Land Use*

The vegetation in the Kelley River watershed includes barrens, wetlands, bogs, and conifer-dominated forests. The upper reaches of the Kelley River watershed contain salmon spawning areas, sensitive wetlands and patches of old growth forest. 80% of the land within the watershed is forested, 12% is covered by wetlands and or water, and about 1 % characterized as under urban land use.

Figure 4.4-2. Kelley River looking upstream (left) and downstream (right) from the monitoring station.

### *4.4.1.5 Climate*

Normal (1971-2000) precipitation in the Kelley River watershed, as recorded at the Environment Canada Climate Station at Nappan is 1175 mm, comprised of 916 mm of rainfall and 265 cm of snowfall. The mean annual temperature is 5.8$^{o}$C with a mean monthly high of 18.4 $^{o}$C in July and a low of –7.3 $^{o}$C in January.

Figure 4.4-3. Kelley River monitoring station.

### *4.4.1.6 Wildlife and Habitat*

The Kelley River watershed provides habitat for many species of plants and animals, including moose, which was recently declared endangered on mainland Nova Scotia by the provincial government and black bear.

*4.4.1.7 Human Settlement and Industrial Development*

Centuries before the arrival of Europeans, the First Nations People travelled through and encamped in the area, which is now Cumberland County, following the annual migration of great herds of caribou into the province. The Cobequid Mountain Pass was used by native people and early European explorers. Industrial activities n the watershed include forestry, tourism and coal-mining. There are many kilometres of undeveloped riverbanks and coastlines which are popular with birders and hikers. The Chignecto Game Sanctuary, which the Kelley River flows through, was created in 1937, in part to protect native moose populations.

## 4.4.2 Land Use and Forest Type Summary Information

### *4.4.2.1 Land Use*

| Land Type | Area $km^2$ | % of Total Area |
|---|---|---|
| Agriculture | 0.04 | 0.1 |
| Barren | 0.1 | 0.2 |
| Clearcut | 4.3 | 6.7 |
| Forested | 51.8 | 80.3 |
| Urban | 0.8 | 1.2 |
| Wetland/Water | 7.4 | 11.5 |
| Total | 64.5 | 100.0 |

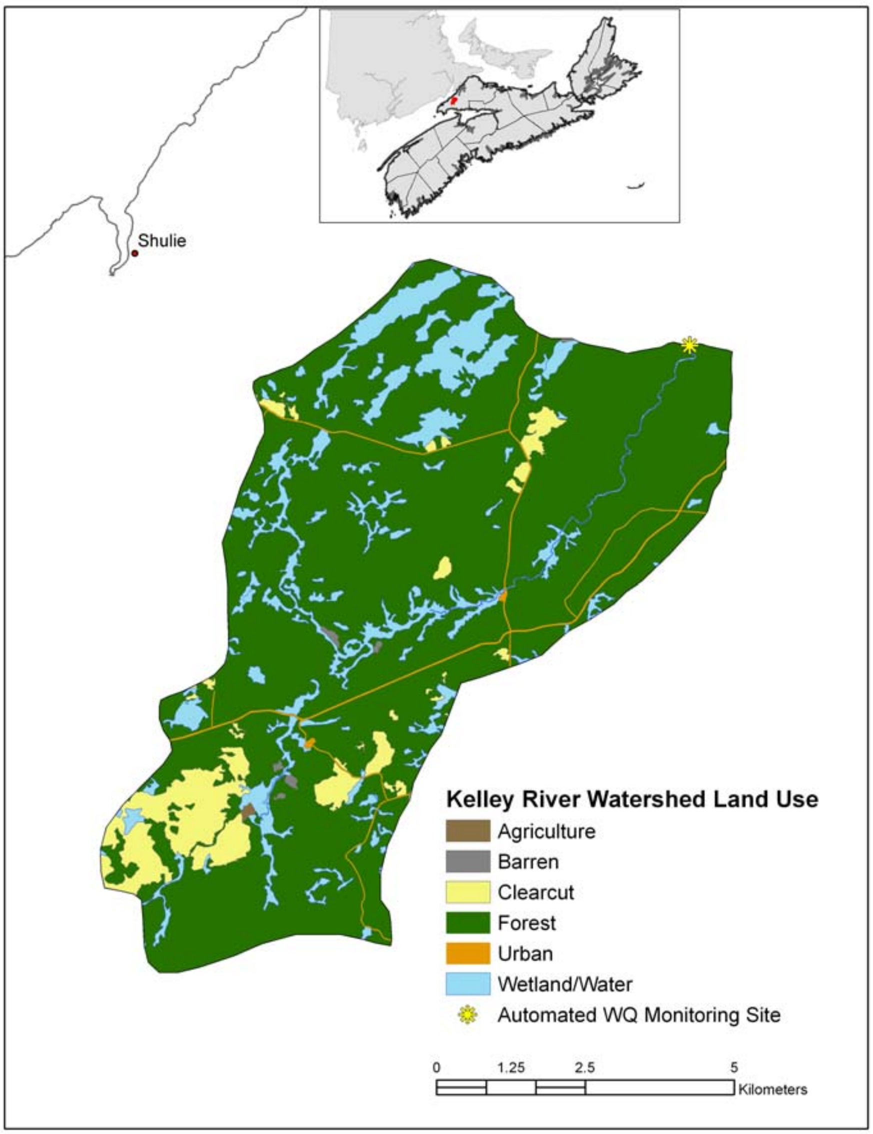


Figure 4.4-4. Land use mapping of Kelley River Watershed.

### *4.4.2.2 Forest Type*

| Forest Type | Area km$^2$ | % of Total Area |
|---|---|---|
| Forested | 51.8 | 100.0 |
| Hardwood | 9.8 | 18.9 |
| Mixed Wood | 4.3 | 8.3 |
| Softwood | 31.5 | 60.8 |
| Unknown | 6.2 | 12.0 |

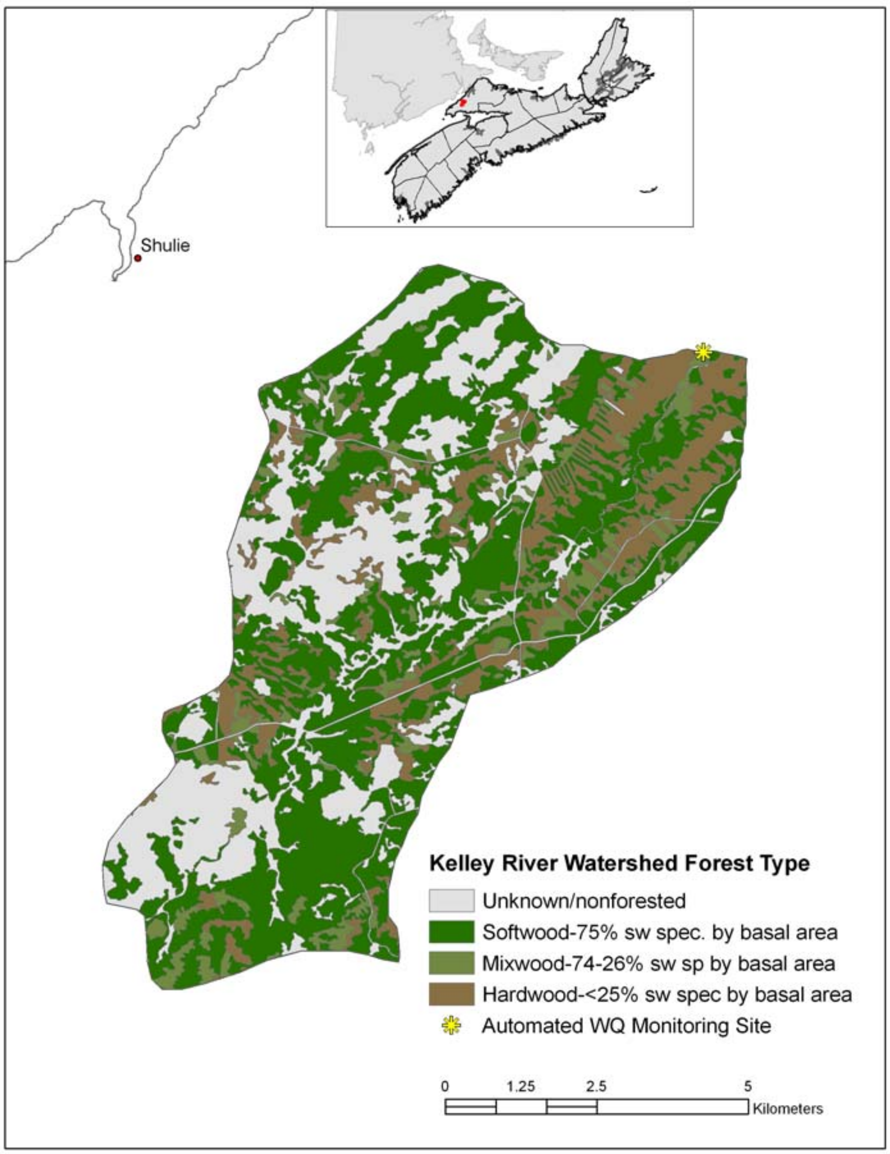


Figure 4.4-5. Forest type mapping of Kelley River Watershed.

### 4.4.3 Water Quality Summary Information

Table 4.4-1. Hourly statistics of minimum, maximum, mean, and standard deviation and exceedences as per established water quality guidelines for hourly real time data for Kelley River for 2005.

| Parameter | Year | Min | Max | Mean | SD | CWQ Guideline | | | Readings[5] | # of Exceedences | | | Exceedences As % of Readings | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWAL[1] | DW[1] | REC[1] | | | | | | | |
| | | | | | | | | | | | | | | | |
| Temperature, $^{o}$C | 2005 | -0.3 | 28.1 | 9.6 | 7.8 | 20-21[2] | | | 6910 | 441 | | | 6 | | |
| | | | | | | | | | | | | | | | |
| Turbidity, NTU | | | | | | | | | | DW <1[3] | DW ≤5[4] | REC | DW <1[3] | DW ≤5[4] | REC |
| | 2005 | 0.0 | 161.3 | 1.9 | 5.3 | | <1[3], ≤5[4] | ≤50 | 5293 | 3091 | 256 | 5 | 58 | 5 | <1 |
| | | | | | | | | | | | | | | | |
| Conductivity, uS/cm | 2005 | 16.4 | 43.7 | 25.6 | 5.6 | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Dissolved Oxygen, mg/L | 2005 | 5.8 | 15.2 | 10.8 | 2.5 | ≥5.0 | | | 7026 | 0 | | | 0 | | |
| | | | | | | | | | | | | | | | |
| pH, Units | | | | | | | | | | FWAL | DW | REC | FWAL | DW | REC |
| | 2005 | 4.4 | 6.9 | 5.5 | 0.6 | 6.5-9.0 | 6.5-8.5 | 6.5-9.5 | 6910 | 6568 | 6568 | 6568 | 95 | 95 | 95 |

[1] FWAL: Freshwater Aquatic Life; DW: Drinking Water; REC: Recreational Uses.
[2] Upper permissible limit for salmon and trout (Alabaster and Lloyd. 1982). CCME DW guideline deemed to be inappropriate.
[3] Maximum Acceptable Concentration for water entering a distribution system.
[4] Aesthetic Objective. 5NTU may be permitted if demonstrated that the disinfection method is not compromised.
[5] The number of hourly readings possible in each of the years 2002, 2003 and 2005 is 8760. For 2004 the number is 8784. The number recorded in the table refers to the actual number of approved measurements.

### *4.4.3.1 Temperature*

Figure 4.4-6. Water temperature from December 2004 through December 2005 for the Kelley River using <u>hourly values</u>. Gaps in the plot indicate missing data.

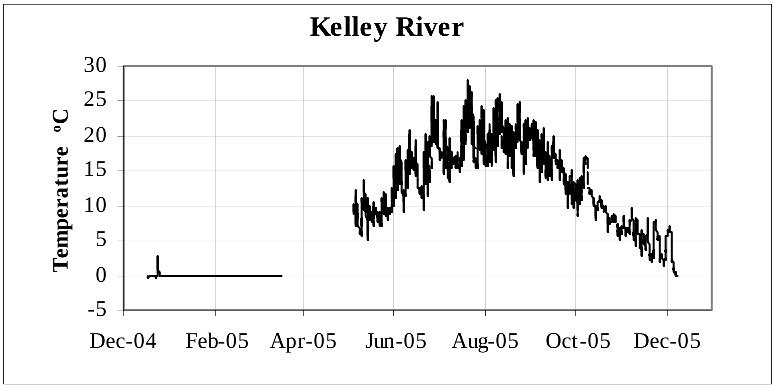


Figure 4.4-7. Water temperature from December 2004 through December 2005 for the Kelley River using <u>daily mean values</u>. Gaps in the plot indicate missing data.

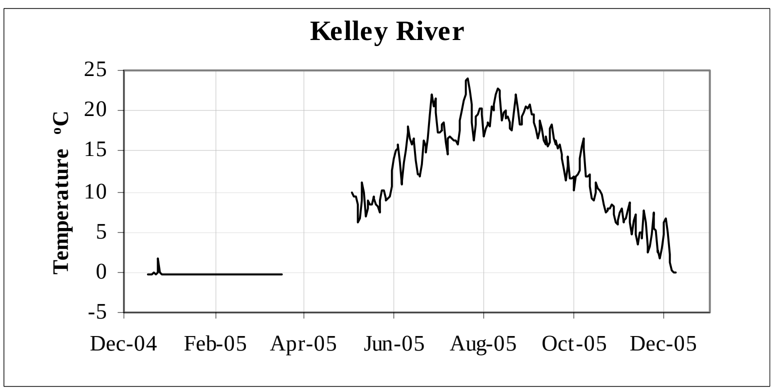

Figure 4.4-8. Air and water temperature from December 2004 through December 2005 for the Kelley River using monthly mean values. Gaps in the plot indicate missing data.

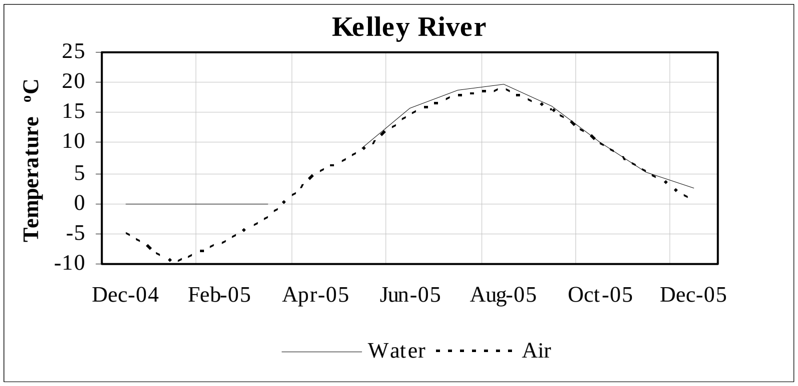


Table 4.4-2. Mean monthly water temperature for Kelley River from December 2004 through December 2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | °C | ------------- | ----- |
| December | 2004 | -0.1 | -0.3 | 1.8 | 0.5 |
| January | 2005 | -0.2 | -0.3 | -0.2 | 0.0 |
| February | 2005 | -0.2 | -0.3 | -0.2 | 0.0 |
| March | 2005 | -0.2 | -0.3 | -0.2 | 0.0 |
| April | 2005 | | | | |
| May | 2005 | 9.0 | 6.2 | 12.6 | 1.4 |
| June | 2005 | 15.9 | 10.9 | 22.1 | 3.1 |
| July | 2005 | 18.7 | 14.7 | 24.1 | 2.4 |
| August | 2005 | 19.7 | 16.8 | 22.8 | 1.6 |
| September | 2005 | 16.0 | 11.5 | 20.7 | 2.5 |
| October | 2005 | 10.2 | 6.0 | 16.5 | 2.8 |
| November | 2005 | 5.2 | 1.8 | 8.7 | 1.9 |
| December | 2005 | 2.6 | -0.2 | 6.6 | 2.9 |

Table 4.4-3. Mean seasonal water temperature for Kelley River for 2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------- | °C | ------------- | ----- |
| Winter | 2005 | -0.2 | -0.3 | 1.8 | 0.2 |
| Spring | 2005 | 5.5 | -0.3 | 12.6 | 4.7 |
| Summer | 2005 | 18.1 | 10.9 | 24.1 | 2.9 |
| Fall | 2005 | 10.5 | 1.8 | 20.7 | 5.0 |

Table 4.4-4 Mean annual water temperature for Kelley River for 2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ------------- | °C | ------------- | ----- |
| 2005 | 9.7 | -0.3 | 24.1 | 7.7 |

Missing value implies insufficient data to compute the statistic.

### *4.4.3.2 Turbidity*

Figure 4.4-9. Turbidity levels from December 2004 through December 2005 for the Kelley River using hourly values. Gaps in the plot indicate missing data.

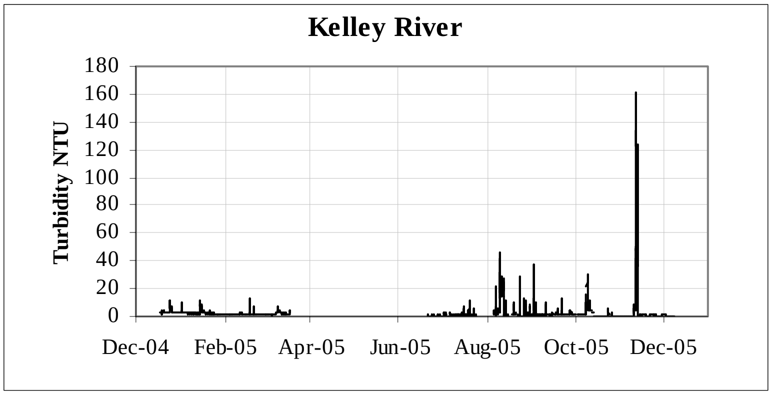


Figure 4.4-10. Turbidity levels from December 2004 through December 2005 for the Kelley River using daily mean values. Gaps in the plot indicate missing data.

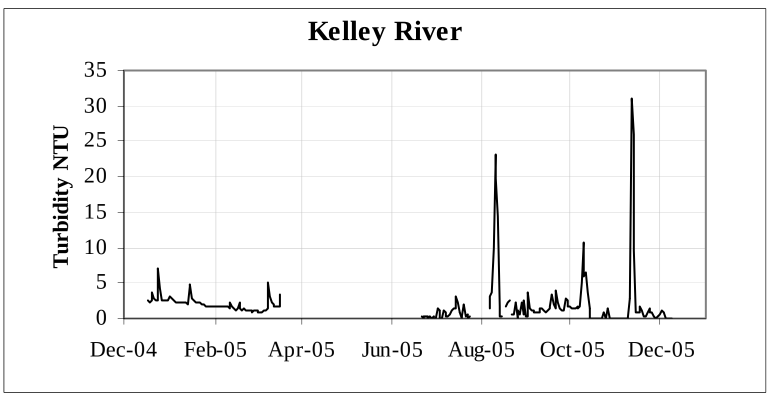

Figure 4.4-11. Turbidity levels and stream stage from December 2004 through December 2005 for the Kelley River using monthly mean values. Gaps in the plot indicate missing data.

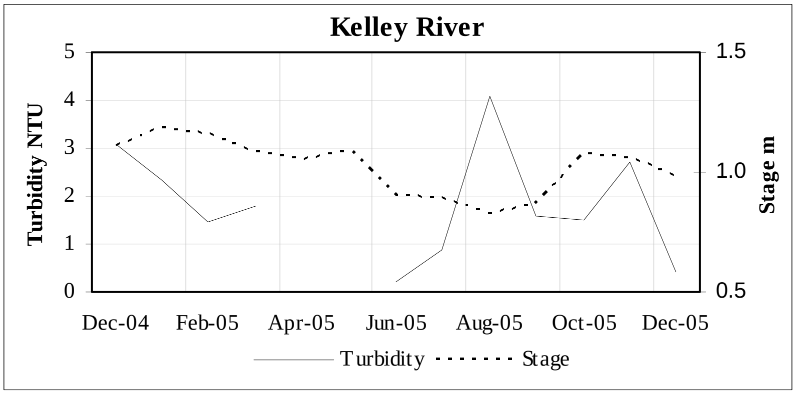


Table 4.4-5. Mean monthly turbidity for Kelley River from December 2004 through December 2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | NTU | ------------ | ----- |
| December | 2004 | 3.1 | 2.2 | 7.0 | 1.2 |
| January | 2005 | 2.3 | 1.6 | 4.7 | 0.7 |
| February | 2005 | 1.5 | 1.0 | 2.3 | 0.4 |
| March | 2005 | 1.8 | 0.9 | 5.0 | 1.1 |
| April | 2005 | | | | |
| May | 2005 | | | | |
| June | 2005 | 0.2 | 0.1 | 0.4 | 0.1 |
| July | 2005 | 0.9 | 0.1 | 3.2 | 0.8 |
| August | 2005 | 4.1 | 0.1 | 23.1 | 6.4 |
| September | 2005 | 1.6 | 0.2 | 3.9 | 0.9 |
| October | 2005 | 1.5 | 0.0 | 10.9 | 2.5 |
| November | 2005 | 2.7 | 0.0 | 31.0 | 7.3 |
| December | 2005 | 0.4 | 0.0 | 1.2 | 0.5 |

Table 4.4-6. Mean seasonal turbidity for Kelley River for 2005 based on mean daily data.

Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | NTU | ------------ | ----- |
| Winter | 2005 | 2.1 | 1.0 | 7.0 | 0.9 |
| Spring | 2005 | 1.8 | 0.9 | 5.0 | 1.1 |
| Summer | 2005 | 2.1 | 0.1 | 23.1 | 4.4 |
| Fall | 2005 | 1.9 | 0.0 | 31.0 | 4.4 |

Table 4.4-7. Mean annual turbidity for Kelley River for 2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ------------ | NTU | ------------ | ----- |
| 2005 | 1.9 | 0.0 | 31.0 | 3.6 |

Missing value implies insufficient data to compute the statistic.

*4.4.3.3 Conductivity*

Figure 4.4-12. Conductivity from December 2004 through December 2005 for the Kelley River using <u>hourly values</u>. Gaps in the plot indicate missing data.

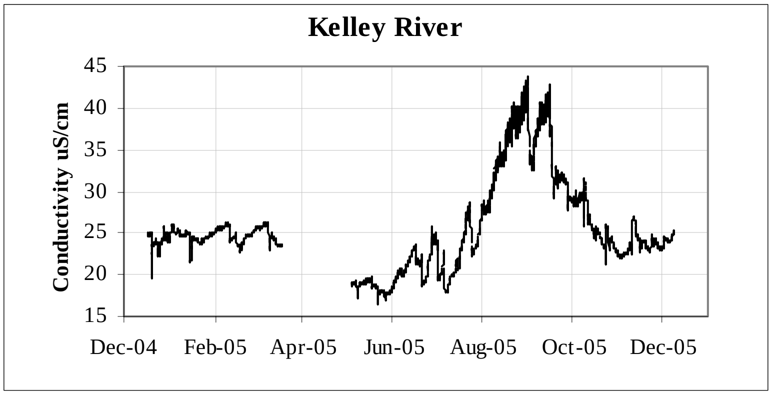


Figure 4.4-13. Conductivity from December 2004 through December 2005 for the Kelley River using <u>daily mean values</u>. Gaps in the plot indicate missing data.

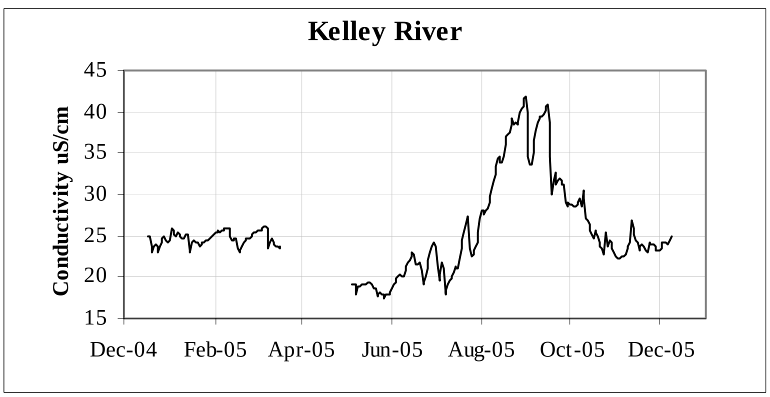

Figure 4.4-14. Conductivity and stream stage from December 2004 through December 2005 for the Kelley River using monthly mean values. Gaps in the plot indicate missing data.

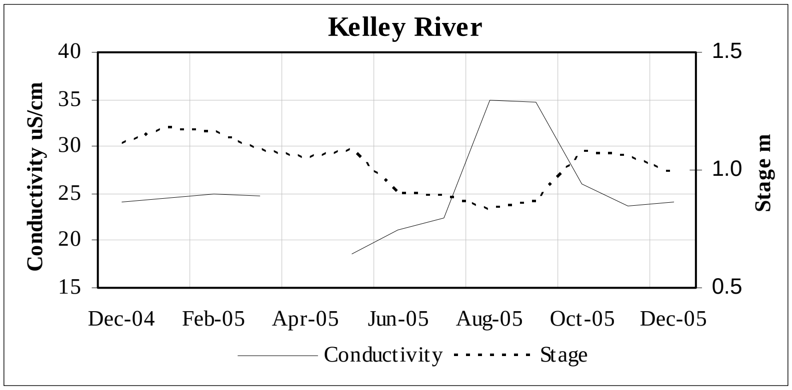


Table 4.4-8. Mean monthly conductivity for Kelley River from December 2004 through December 2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ---------- | uS/cm | ---------- | ----- |
| December | 2004 | 24.1 | 23.0 | 25.0 | 0.6 |
| January | 2005 | 24.6 | 23.0 | 25.9 | 0.6 |
| February | 2005 | 24.9 | 23.0 | 26.0 | 0.8 |
| March | 2005 | 24.8 | 23.4 | 26.2 | 1.1 |
| April | 2005 | | | | |
| May | 2005 | 18.6 | 17.5 | 19.4 | 0.6 |
| June | 2005 | 21.2 | 18.6 | 24.3 | 1.6 |
| July | 2005 | 22.4 | 18.0 | 27.3 | 2.6 |
| August | 2005 | 34.9 | 27.6 | 41.8 | 4.6 |
| September | 2005 | 34.7 | 28.6 | 41.0 | 4.1 |
| October | 2005 | 26.0 | 22.5 | 30.5 | 2.4 |
| November | 2005 | 23.6 | 22.2 | 26.8 | 1.1 |
| December | 2005 | 24.2 | 23.4 | 25.0 | 0.5 |

Table 4.4-9. Mean seasonal conductivity for Kelley River for 2005 based on mean daily data.
Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ---------- | uS/cm | ---------- | ----- |
| Winter | 2005 | 24.6 | 23.0 | 26.0 | 0.8 |
| Spring | 2005 | 20.9 | 17.5 | 26.2 | 3.2 |
| Summer | 2005 | 26.2 | 18.0 | 41.8 | 7.0 |
| Fall | 2005 | 28.1 | 22.2 | 41.0 | 5.5 |

Table 4.4-10. Mean annual conductivity for Kelley River for 2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ---- | ---------- | uS/cm | ---------- | ------- |
| 2005 | 25.6 | 17.5 | 41.8 | 5.6 |

Missing value implies insufficient data to compute the statistic.

*4.4.3.4 Dissolved Oxygen*

Figure 4.4-15. Dissolved oxygen concentration from December 2004 through December 2005 for the Kelley River using <u>hourly values</u>. Gaps in the plot indicate missing data.

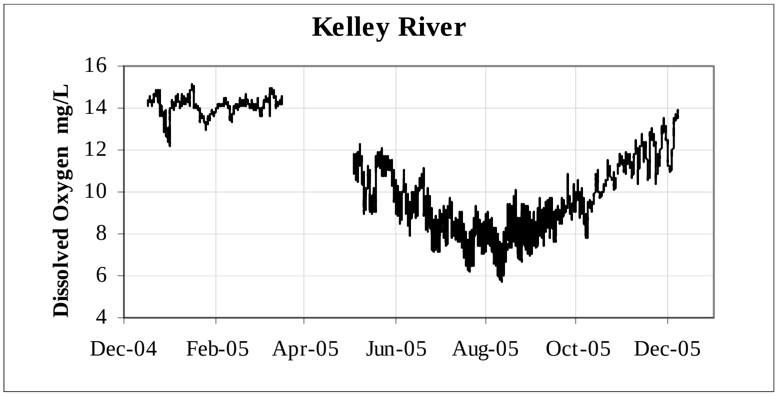


Figure 4.4-16. Dissolved oxygen concentration from December 2004 through December 2005 for the Kelley River using <u>daily mean values</u>. Gaps in the plot indicate missing data.

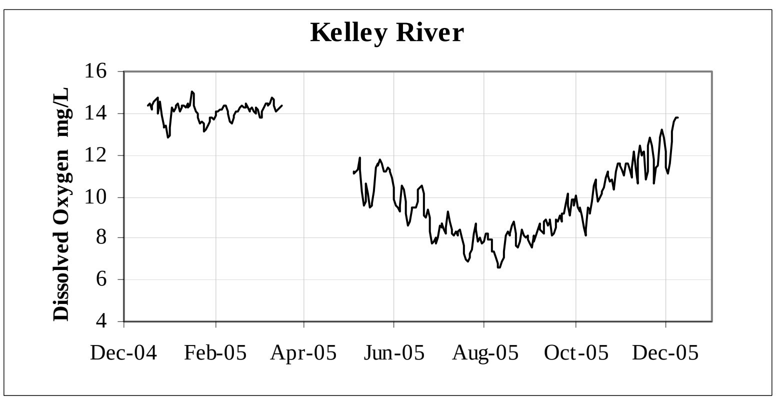

Figure 4.4-17. Dissolved oxygen and stream stage from December 2004 through December 2005 for the Kelley River using monthly mean values. Gaps in the plot indicate missing data.

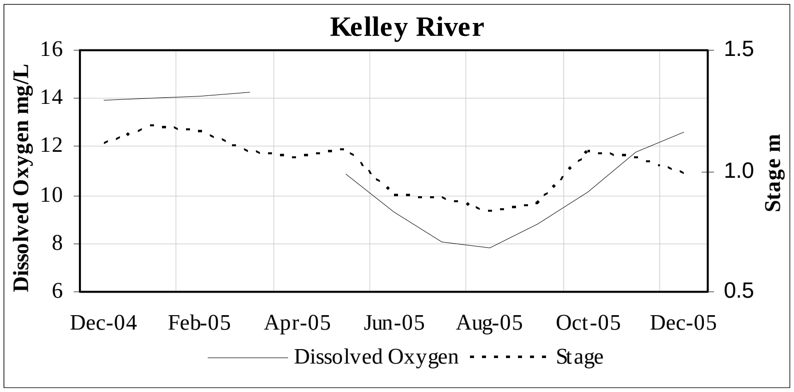


Table 4.4-11. Mean monthly dissolved oxygen for Kelley River from December 2004 through December 2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ | mg/L | ------------ | ----- |
| December | 2004 | 14.0 | 12.9 | 14.7 | 0.6 |
| January | 2005 | 14.0 | 13.1 | 15.1 | 0.5 |
| February | 2005 | 14.1 | 13.6 | 14.4 | 0.2 |
| March | 2005 | 14.3 | 13.8 | 14.8 | 0.2 |
| April | 2005 | | | | |
| May | 2005 | 10.9 | 9.5 | 11.9 | 0.7 |
| June | 2005 | 9.3 | 7.8 | 10.5 | 0.8 |
| July | 2005 | 8.1 | 6.9 | 9.3 | 0.6 |
| August | 2005 | 7.8 | 6.6 | 8.8 | 0.6 |
| September | 2005 | 8.8 | 7.6 | 10.2 | 0.6 |
| October | 2005 | 10.1 | 8.2 | 11.6 | 0.9 |
| November | 2005 | 11.8 | 10.6 | 13.2 | 0.7 |
| December | 2005 | 12.6 | 11.1 | 13.8 | 1.1 |

Table 4.4-12. Mean seasonal dissolved oxygen for Kelley River for 2005 based on mean daily data.
Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ------------ mg/L | | ------------ | ----- |
| Winter | 2005 | 14.1 | 12.9 | 15.1 | 0.4 |
| Spring | 2005 | 12.2 | 9.5 | 14.8 | 1.8 |
| Summer | 2005 | 8.4 | 6.6 | 10.5 | 0.9 |
| Fall | 2005 | 10.2 | 7.6 | 13.2 | 1.4 |

Table 4.4-13. Mean annual dissolved oxygen for Kelley River for 2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ------------ mg/L | | ------------ | ----- |
| 2005 | 10.8 | 6.6 | 15.1 | 2.4 |

Missing value implies insufficient data to compute the statistic.

### *4.4.3.5 pH*

Figure 4.4-18. pH from December 2004 through December 2005 for the Kelley River using <u>hourly values</u>. Gaps in the plot indicate missing data.

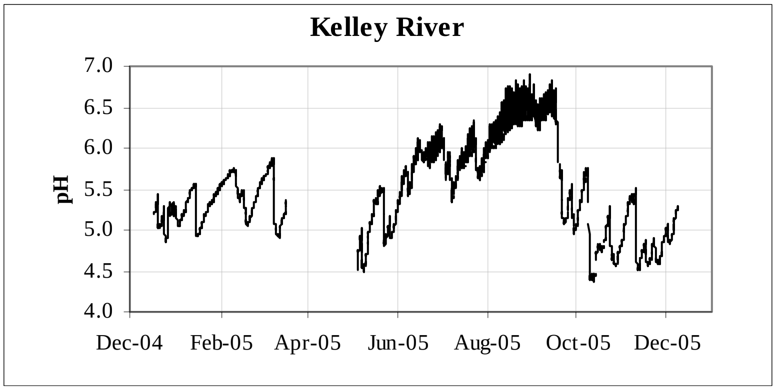


Figure 4.4-19. pH from December 2004 through December 2005 for the Kelley River using <u>daily mean values</u>. Gaps in the plot indicate missing data.

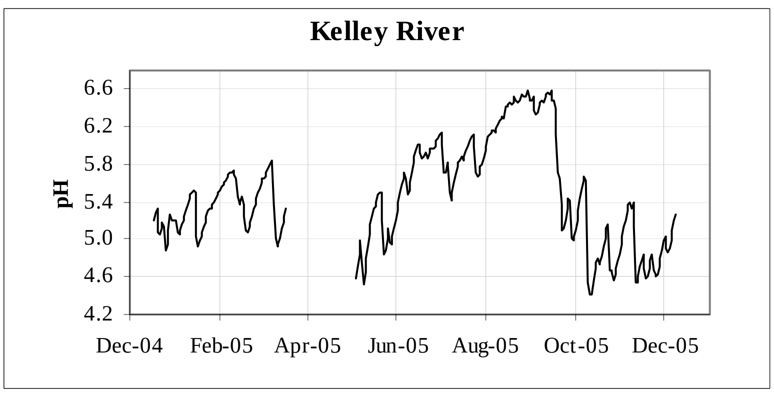

Figure 4.4-20. pH and stream stage from December 2004 through December 2005 for the Kelley River using monthly mean values. Gaps in the plot indicate missing data.

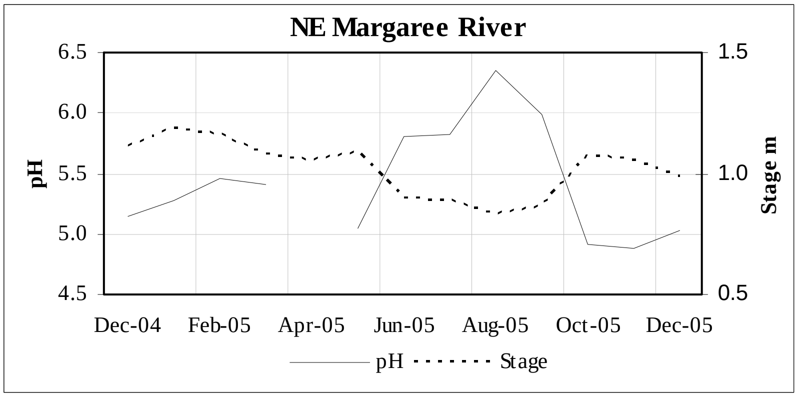


Table 4.4-14. Mean monthly pH for Kelley River from December 2004 through December 2005 based on mean daily data.

| Month | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| December | 2004 | 5.15 | 4.89 | 5.33 | 0.12 |
| January | 2005 | 5.27 | 4.93 | 5.53 | 0.18 |
| February | 2005 | 5.47 | 5.08 | 5.73 | 0.20 |
| March | 2005 | 5.41 | 4.93 | 5.84 | 0.34 |
| April | 2005 | | | | |
| May | 2005 | 5.04 | 4.53 | 5.50 | 0.28 |
| June | 2005 | 5.81 | 5.30 | 6.11 | 0.22 |
| July | 2005 | 5.83 | 5.41 | 6.13 | 0.18 |
| August | 2005 | 6.36 | 5.98 | 6.58 | 0.17 |
| September | 2005 | 5.98 | 4.99 | 6.59 | 0.61 |
| October | 2005 | 4.91 | 4.41 | 5.67 | 0.38 |
| November | 2005 | 4.88 | 4.54 | 5.40 | 0.28 |
| December | 2005 | 5.03 | 4.86 | 5.26 | 0.14 |

Table 4.4-15. Mean seasonal pH for Kelley River for 2005 based on mean daily data.
Winter = {Dec, Jan, Feb}, Spring = {Mar, Apr, May}
Summer = {Jun, Jul, Aug}, Fall = {Sept, Oct, Nov}

| Season | Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- | ----- |
| Winter | 2005 | 5.32 | 4.89 | 5.73 | 0.22 |
| Spring | 2005 | 5.18 | 4.53 | 5.84 | 0.35 |
| Summer | 2005 | 6.00 | 5.30 | 6.58 | 0.32 |
| Fall | 2005 | 5.25 | 4.41 | 6.59 | 0.68 |

Table 4.4-16. Mean annual pH for Kelley River for 2005 based on mean daily data.

| Year | Mean | Minimum | Maximum | SD |
|---|---|---|---|---|
| ----- | ----- | ----- | ----- | ----- |
| 2005 | 5.49 | 4.41 | 6.59 | 0.57 |

Missing value implies insufficient data to compute the statistic.

### 4.4.4 Overview of Kelley River Water Quality

Water quality data for the period of record are fairly typical of a predominantly forested watershed (80% of total area) located on sedimentary bedrock.

Variation in water temperature followed a seasonal pattern very similar to that of air temperature, which is to be expected of a shallow flowing river. For 2005 (the only year for which data were gathered), seasonal minimum and maximum water temperatures were -0.2$^{o}$C for Winter (December to February) and 18.1$^{o}$C for Summer (June to August). Based on hourly records, 6 percent of the 6910 temperature measurements exceeded the permissible temperature limit of 20-21 $^{o}$C for salmon and trout, all of which occurring in the months of July and August.

Turbidity values were relatively low for most of the period of record, although there were three main events during which concentrations were markedly higher. Between August 6 and 13, hourly concentrations reached 46 NTU, remaining in a range of 15-46 NTU for roughly 72 hours. However, there was no supporting rainfall or rise in river stage to justify the increase. There were two other major events during 2005. Between October 7 and13, roughly 122mm of rainfall fell over a 5-day period, resulting in hourly turbidity levels peaking at 30 NTU and remaining between 10 and 30 NTU for 13 hours. From November 10 to 14, 38mm of rainfall resulted in the most dramatic rise in turbidity levels. During this period, a maximum reading of 160 NTU was recorded, while sustaining a range of 35-160 NTU for 5 hours. Overall, less than 1 percent of hourly turbidity measurements were greater than 50 NTU, the CCME limit for recreational use.

Water conductivity of Kelley River is characteristic of dilute waters ranging from 18 to 42 uS/cm. Peak measurements occurred during the low flow summer period which is indicative of the dominant influence of groundwater seepage. The annual mean for 2005 was 25.6 uS/cm.

Dissolved oxygen concentrations followed a trend that is essentially the inverse of temperature which is also typical of shallow surface waters with low biological productivity since the solubility of oxygen in water decreases as water temperature rises. At no time during 2005 did hourly concentrations dip below 6.6 mg/L, remaining well above a suggested threshold for the protection of aquatic life of 5.0 mg/L.

pH varied throughout 2005 from an hourly low of 4.4 to a high of 6.6. The Kelley River watershed contains massive wetland areas (11.5 % of total area) which are known sources of organic acids that play a role in lowering pH. These acids are typically released into downstream receiving water during periods of high flow. pH was observed to increase as stage decreased, indicating a less dominant effect of acidic wetland runoff. During periods of low flow, higher pH groundwater is suspected as playing a more significant role. The more acidic conditions of Kelley River saw an annual mean pH of 5.5 and over 95 percent of the 6910 hourly readings taken during 2005 falling outside the acceptable ranges of values published by the CCME for Drinking Water use and the Protection of Aquatic Life of 6.5 to 8.5 and 6.5 to 9.0, respectively.

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

Information generated by this monitoring program clearly demonstrates the variation in water quality that exists for natural or near natural surface water resources in Nova Scotia. As such, the water quality network will be able to provide valuable information on the future trends in the parameters measured. The data generated by the network should also be of value when comparing trends in other provinces for these parameters.

In an ideal world, regular analysis of other physical and chemical parameters would provide valuable information and possibly greater insight into ecosystem and hydrologic changes that may occur due to human activities, climate change, etc.. However, the present suite of analysis, the fact that they are automated and therefore relatively inexpensive do provide information that can be used to make statements about some environmental changes and can be used for State of Environment Reporting, for example.

Factors playing major roles in the quality of runoff for the three river and single lake systems are considered to be geology, vegetative cover and presence of wetland areas.

Table 5.0-1 consolidates annual mean data for each of the four monitoring sites to aid in the comparison of water quality between watersheds. However, caution must be applied when doing so since mean values are based on incomplete datasets.

All stations experienced trends in water temperature which for the most part mimicked that of air temperature. Although maximum and minimum water temperatures did not match air temperature extremes, river waters more quickly responded to changes in air temperature than was the case for Pockwock Lake. The response time lag observed for Pockwock Lake can be explained by the fact that the time required to heat the body of water down to the depth at which the temperature sensor was located (5 m) was much longer compared to the much shallower river systems.

With the exception of Pockwock Lake, an aquatic environment where the effects of surface runoff are significantly dampened by dilution effects, all of the flowing systems experienced episodes of increased water turbidity in varying degrees during and following some precipitation events. Eroded soil particles and stream bed-load were considered to be the main contributors. For Pockwock Lake, it is suggested that algal production is the main cause of summertime losses in water transparency, a water body which rarely saw turbidity measurements exceed 5 NTU. The North East Margaree River experienced several episodes in which hourly turbidity levels for short periods of time remained in the range of 10 to 100 NTU. The Shelburne River experienced fewer events of this nature, but still recorded turbidity peaks between 70 and 106 NTU.

Water conductivity in Pockwock Lake, Shelburne River and Kelley River is reflective of dilute waters with mean annual ranges of 38 - 40, 32 - 35, and 26 (2005 only) uS/cm, respectively. Conductivity levels were observed to remain fairly constant on a daily basis throughout the period of record with only minor shifts outside annual mean ranges.

North East Margaree River mean annual conductivity was much higher, ranging from 161 – 172 uS/cm which indicates a much greater dissolved solids content. With the exception of Pockwock Lake, the effects of precipitation and snowmelt runoff containing low concentrations of dissolved solids were observed for the river systems through pronounced inverse trends with water stage. During higher flow periods, conductivity levels were lower compared to low flow periods when the effects of groundwater seepage, assumed to contain higher concentrations of dissolved solids, played a more significant role.

All four systems remained well-oxygenated throughout the monitoring period with daily mean concentrations ranging from 5.7 – 15.5 mg/L. Trends illustrated patterns which were essentially the inverse of water temperature explainable by the fact that the solubility of oxygen in water decreases with the rise in temperature. The levels of dissolved oxygen were also characteristic of low biological productivity.

Table 5.0-1. A summary of water quality annual mean values for the four monitoring stations for the parameters measured between 2002 and 2005.

| | Temperature $^{o}C$ | Turbidity NTU | Conductivity uS/cm | Dissolved Oxygen mg/L | pH |
|---|---|---|---|---|---|
| | | | | | |
| Pockwock Lake | | | | | |
| 2002 | 18.1 | - | 39.4 | 8.4 | 5.4 |
| 2003 | 10.8 | 0.3 | 37.7 | 10.8 | 5.3 |
| 2004 | 9.9 | 1.2 | 39.9 | 10.8 | 5.3 |
| 2005 | 16.4 | 1.0 | 37.8 | 8.8 | 5.1 |
| | | | | | |
| NE Margaree River | | | | | |
| 2002 | 9.9 | 1.0 | 161.6 | 11.0 | 7.2 |
| 2003 | 8.7 | 1.8 | 165.4 | 11.3 | 7.1 |
| 2004 | 6.4 | 1.6 | 171.9 | 12.2 | 7.2 |
| 2005 | 8.1 | 0.9 | 161.2 | 11.3 | 7.2 |
| | | | | | |
| Shelburne River | | | | | |
| 2002 | 10.8 | 1.4 | 34.2 | 10.0 | 4.4 |
| 2003 | 10.5 | 0.4 | 34.6 | 10.5 | 4.4 |
| 2004 | 9.7 | 0.8 | 34.2 | 10.0 | 4.4 |
| 2005 | 11.6 | 1.2 | 32.2 | 9.9 | 4.4 |
| | | | | | |
| Kelley River | | | | | |
| 2005 | 9.7 | 1.9 | 25.6 | 10.8 | 5.5 |

Acidity of surface waters in the four areas represented by the watersheds being monitored is a reflection of the surficial geology, vegetative landscape and likely the quality of precipitation. The lower pH of Shelburne River (pH 4.4) is characteristic of poorly buffered and organic acids associated with highly coloured water. A major source of these acids and colour is sphagnum bogs, which are assumed to constitute a significant portion of the 48 $km^2$ of wetland/water area identified for this watershed. Pockwock Lake and Kelley River watersheds produced a slightly less acidic runoff with annual mean pH ranging from 5.1 to 5.4 and 5.5 (2005 only), respectively. Water colour is less prominent in both watersheds indicating a reduced influence of wetland areas as compared to runoff in the Shelburne River watershed. A reduced soil buffering capacity and the effects of acid precipitation are in evidence for these two watersheds. The North East Margaree River, on the other hand, appears to be well-buffered with an annual mean pH ranging from 7.1 to 7.2. Only 8 percent of this watershed is made up of water/wetland areas.

A critical component that maximizes the effectiveness and allows for more accurate interpretation of the results for any type of monitoring program is data coverage or completeness. Table 5.0-2 describes the completeness of the Network's four hourly datasets by year and by parameter. The table provides ranges of hourly data coverage using results from individual monitoring stations. For example, the range of coverage in 2002 for temperature was 24 to 55 percent, indicating that for one of the four monitoring stations hourly measurements were recorded for 24 percent of all available hours, while another of the four stations saw measurements recorded for 55 percent of those hours. Two of the four stations had percentages falling between these two extremes. It is obvious from the information provided that although a general increase in the percent of hours for which reliable data were collected since 2002 has occurred, there is still room for improvement. The inability of the current program to detect and address equipment malfunctions in a timely manner appears to be the principle cause resulting in data record voids. The most logical approach and recommendation to overcome this inadequacy is to increase the frequency of field visits. During the winter months when access at times is a problem, alternate forms of off-road transportation (i.e. all-terrain vehicle, snowmobile) may be a solution.

Table 5.0-2. A summary of the ranges of real time hourly data coverage for all stations as a percent of total available hours for each year of operation.

| **Year** | **Temperature** | **Turbidity** | **Conductivity** | **Dissolved Oxygen** | **pH** |
|---|---|---|---|---|---|
| 2002 | 24 – 55 | 0 – 27 | 24 – 50 | 24 – 55 | 24 – 55 |
| 2003 | 79 – 96 | 14 – 61 | 79 - 96 | 69 – 96 | 48 – 90 |
| 2004 | 93 – 96 | 55 – 87 | 93 – 96 | 93 – 96 | 93 – 96 |
| 2005 | 47 - 92 | 47 - 87 | 47 - 92 | 47 - 92 | 47 - 92 |

## 6.0 REFERENCES

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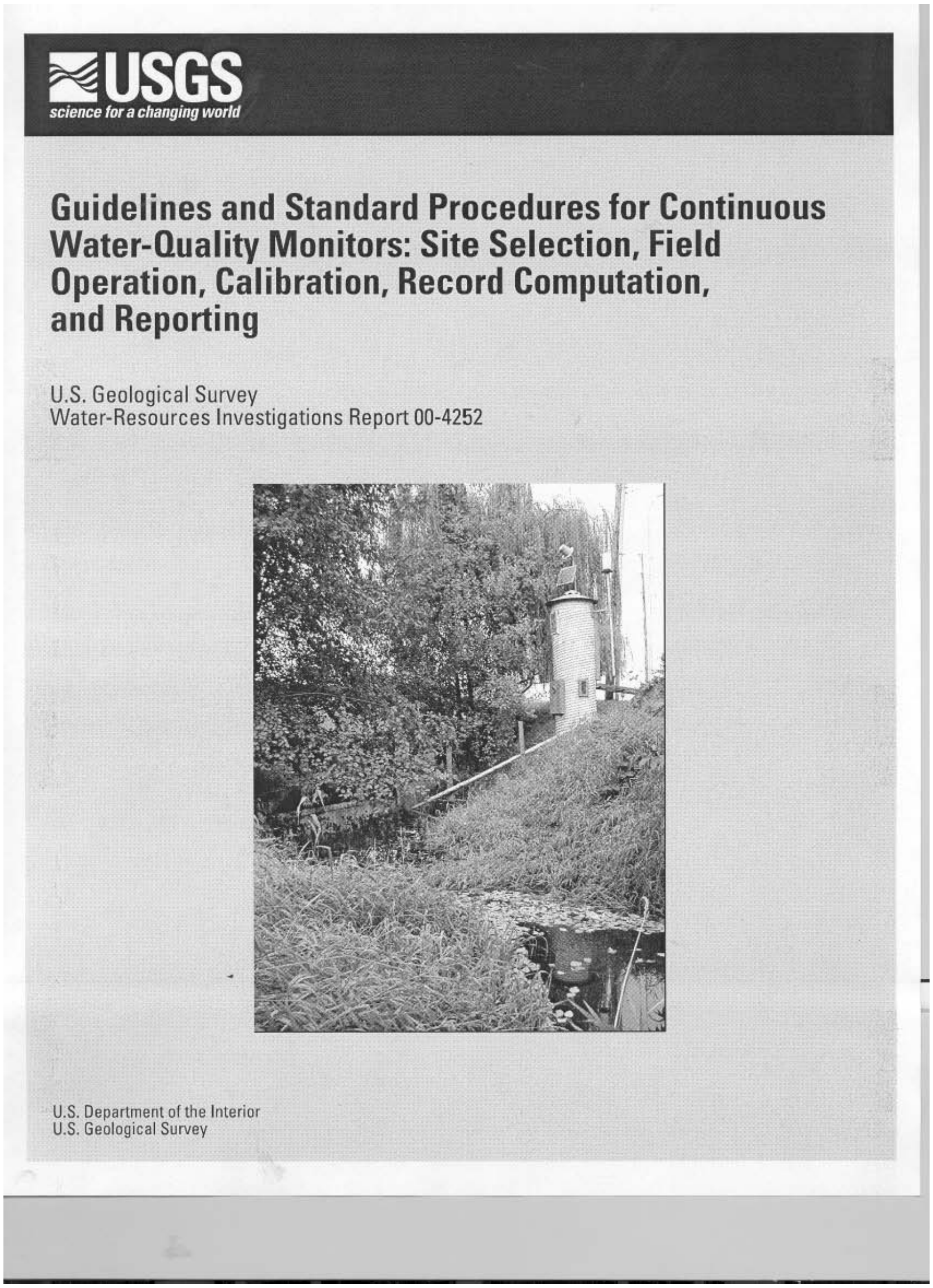
Health Canada. 2003. Guideline for Drinking Water Quality.

Wagner. R.J., H.C. Mattraw, G.F. Ritz, and B.A. Smith. 2000. Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. USGS Report 00-4252.

## APPENDIX I – DATA COLLECTION
## USGS METHODS (WAGNER ET AL. 2000)

Contact Darrell Taylor ((902) 424-2570) or Alan Tattrie ((902) 424-2591) at NSEL for information on how to obtain a complete version of this document.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U.S. Geological Survey
Water-Resources Investigations Report 00-4252

U.S. Department of the Interior
U.S. Geological Survey

# Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting

By Richard J. Wagner, Harold C. Mattraw, George F. Ritz, and Brett A. Smith

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 00–4252

Reston, Virginia
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**HYDROLAB ADVANCED MAINTENANCE WORKSHOP MANUAL (CAMPBELL SCIENTIFIC CANADA CORP. 2005)**

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HYDROLAB ADVANCED
MAINTENANCE
WORKSHOP MANUAL

REVISION: *MAY 2005*

CAMPBELL SCIENTIFIC CANADA CORP.

Water Quality Instrumentation Training, **Introduction**

Water Quality Instrumentation Training, **Introduction**

# APPENDIX II – DATA QUALITY ASSURANCE/QUALITY CONTROL

## II.1 DATA COLLECTION AND DATA HANDLING

The Network employs Hydrolab™ models DS4, DS4a, DS5, and DS5x datasondes equipped with temperature, pH, conductivity, dissolved oxygen, and turbidity sensors (Appendix V). Readings are taken at hourly intervals beginning at 0000 hours and ending at 2300 hours for the day of record then stored on a datalogger.

The three stream sites employ Sutron dataloggers that log hydrolab parameters through an SDI port. Every three hours, the data is transmitted via GOES satellite to Wallops Command and Data Acquisition (CDA) in Wallops Island, Virginia. From here the data becomes part of the National Environmental Satellite, Data, and Information Service (NESDIS) maintained by the National Oceanic and Atmospheric Administration (NOAA). NESDIS is queried by CMC in Dorval (Water Survey of Canada) and the data is pushed to the all regional New Leaf server as telemetry data. A batch file was set up in September 2004 that pushes the telemetry data for the three NS sites to a federal ftp site outside the firewall. This transfer occurs on a daily basis and can be queried by the province of Nova Scotia. This telemetry data is used to gauge sensor performance and to identify anomalous readings and to validate telemetry datalogger data (it is also used by the technologist to assess his next site visit).

Every 4 to 8 weeks depending on site access and other factors, the Sutron dataloggers are manually downloaded by the Water Survey of Canada onto field computers or PCMCIA ramcard in Sutron logger format (.LG1). Raw data logger files are transferred from field laptops or PCMCIA ramcard to a secure database in Fredericton, Nova Scotia or Newfoundland. This raw data contained in the .LG1 files are used for data correction and archiving as they form the most complete record.

The Pockwock Lake station employs a Campbell Scientific CR510 datalogger with a landline connection to a dedicated terminal in the NSEL Central Region office. Automated downloads occur on a daily basis.

## II.2 NORMALIZATION OF DATA RECORDS

The first step in the normalization procedure is one which rates the accuracy of each segment of continuous field data based on one of four accuracy classifications (Table II-1) ranging from poor to excellent. A specific rating is assigned to each data segment according to the magnitude of the difference between Hydrolab sensor readings taken at the beginning and end of the data segment and the respective reading at the time of sensor field calibration. A calibrated (using commercially available liquid standards, see Appendix V) portable Quanta P hand held water quality meter is used for field calibration. If the magnitude of the difference exceeds a maximum allowable limit (Table II-2), the entire data segment for that parameter, or portion thereof, is rejected and deleted from the permanent data record. A degree of professional judgement is applied in the entire process. The timeframe covered by each data segment varies depending on the timing of field visits. At the present time, a strict scheduling routine does not exist for the purpose of downloading stored data from the Sutron data logger and equipment maintenance. Since the start-up of the program, time between site visits ranged from 2 to 7 months. Winter conditions play a major role in determining the frequency of visits possible between late-November and early-May.

The next step in the normalization procedure is the examination of the individual data series for anomalous sensor readings due to occurrences such as sensor failure, data logger malfunction and sensor fouling by submerged debris. If any suspect readings are detected, the series of readings leading up to and immediately following those in question, as well as readings for other network parameters are considered when deciding if the suspect data points should be omitted from the data set. A record of all data omissions is kept.

Other gaps in a data series are the direct result of routine servicing in which the datasondes are inactive for up to a day.

Table II-1. Water Quality Data Rating System (adopted from USGS WRI Report 00-4252).

| Parameter | Rating | | | |
|---|---|---|---|---|
| | **Excellent** | **Good** | **Fair** | **Poor** |
| | | | | |
| **Water Temperature** | ≤ +/- 0.20 °C | > +/- 0.2 to 0.5 °C | > +/- 0.5 to 0.8 °C | > +/- 0.8 °C |
| | | | | |
| **Specific Conductance** | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| | | | | |
| **Dissolved Oxygen** | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| | | | | |
| **pH** | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| | | | | |
| **Turbidity** | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

Explanation of symbols: ≤, less than or equal to; +/-, plus or minus value shown; °C, degree Celsius; >, greater than; %, percent; mg/L, milligrams per litre; pH unit, standard pH unit.

TableII-2. Data Rejection Criteria (adapted from USGS 2000). Maximum allowable limits for continuous water-quality monitoring sensors (+/-, plus or minus value shown; $^{o}$C, degree Celsius; mg/L, milligrams per litre; pH unit, standard pH unit).

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| Temperature | +/- 2.0 $^{o}$C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

The final step in the normalization procedure is a linear adjustment of the data segment. Microsoft Excel software is used for this function. Annual Data Quality Analysis reports are generated by NSEL for each monitoring site that provide a detailed listing of these data verification procedures. These reports can be found in Section II.4 of this Appendix.

## II.3 DATA OMISSION

As earlier pointed out in this section, data are rejected due to probe and/or logger malfunction, probe interference due to submerged debris, and exceedence of established maximum allowable limits. For this report, individual data sets provided by NSEL have undergone further scrutiny by CWRS staff prior to carrying out statistical analysis and based on professional judgement, some additional data were deleted.

Data listed in Table II-3 were deleted from their respective data sets because they could not be explained by either environmental influences (precipitation event occurring within a 48-hour period leading up to the measurement) or supported by complimentary changes for any other recorded parameter (within a 12-hour window of the measurement). For turbidity, readings before and after the measurement in question were typically <2 NTU and more often 0 NTU. For conductivity, recorded before and after measurements were steady at 50-80 uS/cm above those omitted.

TableII-3. List of data deleted from NSEL dataset based on professional judgement.

| Date | | Time | Parameter | Reading | Comment |
|---|---|---|---|---|---|
| **NE Margaree River** | | | | | |
| **2002** | Dec 30 | 1000 | Turbidity | 4.5 | 0 NTU 6 hr before/after |
| | | 1700 | Turbidity | 7.0 | 0 NTU 6 hr before/after |
| | | 1800 | Conductivity | 75.6 | 165 uS/cm 6 hr before |
| | | 1900 | Conductivity | 77.1 | |
| | | 2000 | Conductivity | 88.0 | 172 uS/cm @ 2100 |
| **2005** | Feb 19 | 0100 | Conductivity | 72 | 125 uS/cm @ 6 hr before<br>135 uS/cm @ 0200 |
| **Shelburne River** | | | | | |
| **2002** | Aug 21 | 0300 | Turbidity | 18.7 | Mean for Aug 21 = 1.0 NTU |
| | | 0500 | " | 18.7 | No precipitation |
| | | 2200 | " | 43.7 | All other parameters steady |
| | | 2300 | " | 32.7 | |
| **2004** | May 10 | 1300 | Turbidity | 10.9 | <1NTU 6 hr before/after |
| **2005** | July 26 | 0600 | Turbidity | 21.2 | No precipitation |
| | | 0700 | " | 17.6 | All other parameters steady |
| | | 0800 | " | 84.4 | |
| | July 31 | 0600 | Turbidity | 65.9 | No precipitation |
| | | 0700 | " | 13.8 | All other parameters steady |
| | Aug 4 | 1100 | Turbidity | 32.9 | <2NTU 6 hr before/after |
| | Aug 26 | 1300 | Turbidity | 9.9 | No precipitation |
| | | 1400 | " | 23.6 | All other parameters steady |
| | Aug 28 | 0900 | Turbidity | 16.2 | <2.5NTU 6 hr before/after |
| | | 1100 | " | 46.1 | |
| | | 1600 | " | 17.2 | |
| | Sept 4 | 0100 | Turbidity | 60.3 | <1.0NTU 6 hr before/after |
| | | 0700 | " | 148.0 | All other parameters steady |
| | | 0800 | " | 14.1 | |
| | Sept 9 | 1500 | Turbidity | 12.7 | <1.5NTU 6 hr before/after<br>All other parameters steady |
| | Sept 10 | 0100 | Turbidity | 11.6 | <3NTU 6 hr before/after |
| | | 1000 | " | 29.8 | No precipitation |
| | | 1200 | " | 16.9 | All other parameters steady |
| | | 2200 | " | 32.7 | |
| | Sept 11 | 0200 | Turbidity | 9.4 | <1.5NTU 6 hr |
| | | 1000 | " | 13.6 | before/during/after |
| | | 1500 | " | 20.2 | All other parameters steady |
| | | 2000 | " | 28.3 | |

TableII-3 continued,

| Date | Time | Parameter | Reading | Comment |
|---|---|---|---|---|
| Sept 12 | 1200 | Turbidity | 62.7 | <2.0NTU 6 hr before/after<br>All other parameters steady |
| Nov 14 | 1800 | Turbidity | 50.3 | <3.0NTU 6 hr before/after |
| | 2100 | " | 11.9 | All other parameters steady |
| **Kelley River** | | | | |
| **2005** Oct 24 | 0100 | Turbidity | 85.5 | <5.0NTU 6 hr before/0NTU after<br>All other parameters steady |

For the NE Margaree River, stage measurements remained constant for the entire period January 9 and March 10, 2004. This occurrence is strange given that a fluctuation in stage would have been expected due to the fact that a total of 181.3mm of precipitation fell during this period. Historical EC records do not specify whether it fell as rain or snow. Air temperature throughout this period suggests it fell mainly as snow. It is highly unlikely that a balance existed between runoff and recharge such that water levels in the NE Margaree River remained unchanged. Further investigation is recommended and if necessary, records altered. The impact on the quality of water quality data and its interpretation is considered negligible.

## II.4 ANNUAL REPORTING

Operational reports are prepared on an annual basis for each monitoring station that provide detailed summaries of station descriptions and data quality analyses. Station description reports include such information as geographical location, watershed area, period of hydrometric and water quality records and water quality parameters measured. Data quality analysis reporting contains information on equipment, watercourse characteristics, instrument calibration, and data management.

Station description and data quality analysis reports contained in this section cover the complete period of operation, specifically:

Pockwock Lake 2002-2005
North East Margaree River 2002-2005
Shelburne River 2002-2005
Kelley River 2005

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**MONITORING STATION DESCRIPTION**

*Pockwock Lake - 2002*

Year: 2002

LOCATION: Latitude $44^0$ 46' 56" N Longitude $63^0$ 50' 43" W

GROSS DRAINAGE AREA: 54.0 $km^2$

WATER QUALITY RECORD LENGTH: 1 year

WATER QUALITY PEROID OF RECORD: 2002

**Water Quality measurement**

| **Period of record** | **Water Quality Parameters** | **Operation schedule** | **Gauge type** |
|---|---|---|---|
| 2002 | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO

Water Quality monitoring equipment is located in a five inch perforated PVC pipe insitu to lake via shore deployment method. The location has not changed since installation in 2002. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; °C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 °C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records [≤, less than or equal to; +/-, plus or minus value shown; °C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 °C | > +/- 0.2 to 0.5 °C | > +/- 0.5 to 0.8 °C | > +/- 0.8 °C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

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**MONITORING STATION DESCRIPTION**

*Pockwock Lake - 2003*

Year: 2003

LOCATION: Latitude 44$^0$ 46’ 56” N Longitude 63$^0$ 50’ 43” W

GROSS DRAINAGE AREA: 54.0 km$^2$

WATER QUALITY RECORD LENGTH: 2 years

WATER QUALITY PEROID OF RECORD: 2002 - 2003

**Water Quality measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2002 – 2003 | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO

Water Quality monitoring equipment is located in a five inch perforated PVC pipe insitu to lake via shore deployment method. The location has not changed since installation in 2002. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; $^{o}$C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 $^{o}$C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records [≤, less than or equal to; +/-, plus or minus value shown; $^{o}$C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 $^{o}$C | > +/- 0.2 to 0.5 $^{o}$C | > +/- 0.5 to 0.8 $^{o}$C | > +/- 0.8 $^{o}$C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

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Nova Scotia Environment and Labour
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**MONITORING STATION DESCRIPTION**

*Pockwock Lake - 2004*

Year: 2004

LOCATION: Latitude $44^0$ 46' 56" N Longitude $63^0$ 50' 43" W

GROSS DRAINAGE AREA: 54.0 $km^2$

WATER QUALITY RECORD LENGTH: 3 years

WATER QUALITY PEROID OF RECORD: 2002 - 2004

**Water Quality measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2002 – 2004 | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO

Water Quality monitoring equipment is located in a five inch perforated PVC pipe insitu to lake via shore deployment method. The location has not changed since installation in 2002. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; °C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 °C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records
[≤, less than or equal to; +/-, plus or minus value shown; °C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 °C | > +/- 0.2 to 0.5 °C | > +/- 0.5 to 0.8 °C | > +/- 0.8 °C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

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Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**MONITORING STATION DESCRIPTION**

*Pockwock Lake - 2005*

Year: 2005

LOCATION: Latitude 44$^0$ 46’ 56” N Longitude 63$^0$ 50’ 43” W

GROSS DRAINAGE AREA: 54.0 km$^2$

WATER QUALITY RECORD LENGTH: 4 years

WATER QUALITY PEROID OF RECORD: 2002 - 2005

**Water Quality measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2002 – 2005 | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: YES

Water Quality monitoring equipment is located in a five inch perforated PVC pipe insitu to lake via shore deployment method. The location has not changed since installation in 2002 Water Quality data is recorded hourly and stored in Campbells Scientific CR510 datalogger. The data is downloaded daily via landline connect to logger.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; $^{o}C$, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 $^{o}C$ |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records [≤, less than or equal to; +/-, plus or minus value shown; $^{o}C$, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 $^{o}C$ | > +/- 0.2 to 0.5 $^{o}C$ | > +/- 0.5 to 0.8 $^{o}C$ | > +/- 0.8 $^{o}C$ |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

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Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**MONITORING STATION DESCRIPTION**

*North East Margaree - 2002*

Year: 2002

LOCATION COORDINATES: Latitude 46$^0$ 22’ 10” N Longitude 60$^0$ 58’ 36” W

GROSS DRAINAGE AREA: 368 km$^2$

HYDROMETRIC RECORD LENGTH: 86 years

HYDROMETRIC PEROID OF RECORD: 1916 – PRESENT

**Hydrometric measurement**

| Period of record | Type | Operation schedule | Gauge type |
|---|---|---|---|
| 1916 – 1920 | Flow | Continuous | Manual |
| 1921 – 1921 | Flow | Seasonal | Manual |
| 1922 – 1927 | Flow | Continuous | Manual |
| 1928 – 1928 | Flow | Seasonal | Manual |
| 1929 – 1941 | Flow | Continuous | Manual |
| 1942 - 2002 | Flow | Continuous | Recorder |

HYDROMETRIC REAL-TIME DATA AVAILABLE: YES

WATER QUALITY RECORD LENGTH: 1 YEAR

WATER QUALITY PERIOD OF RECORD: 2002

**Water Quality measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2002 | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO
Water Quality monitoring equipment is located in a five inch perforated white PVC pipe insitu to river via shore deployment method. The location has not changed since

installation in 2002. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; $^{o}$C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| **Measured physical property** | **Maximum allowable limits for water-quality Sensor values** |
|---|---|
| Temperature | +/- 2.0 $^{o}$C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records [≤, less than or equal to; +/-, plus or minus value shown; $^{o}$C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 $^{o}$C | > +/- 0.2 to 0.5 $^{o}$C | > +/- 0.5 to 0.8 $^{o}$C | > +/- 0.8 $^{o}$C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

Prepared 10/04/06 by A. M. Tattrie

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**MONITORING STATION DESCRIPTION**

*North East Margaree - 2003*

Year: 2003

LOCATION: Latitude $46^0$ 22’ 10” N Longitude $60^0$ 58’ 36” W

GROSS DRAINAGE AREA: 368 $km^2$

HYDROMETRIC RECORD LENGTH: 87 years

HYDROMETRIC PEROID OF RECORD: 1916 – PRESENT

**Hydrometric Measurement**

| Period of record | Type | Operation schedule | Gauge type |
|---|---|---|---|
| 1916 – 1920 | Flow | Continuous | Manual |
| 1921 – 1921 | Flow | Seasonal | Manual |
| 1922 – 1927 | Flow | Continuous | Manual |
| 1928 – 1928 | Flow | Seasonal | Manual |
| 1929 – 1941 | Flow | Continuous | Manual |
| 1942 - 2003 | Flow | Continuous | Recorder |

HYDROMETRIC REAL-TIME DATA AVAILABLE: YES

WATER QUALITY RECORD LENGTH: 2 YEARS

WATER QUALITY PEROID OF RECORD: 2002 – present

**Water Quality Measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2002 – 2003 | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO
Water Quality monitoring equipment is located in a five inch perforated white PVC pipe insitu to river via shore deployment method. The location has not changed since

installation in 2002. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; $^{o}$C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 $^{o}$C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records
[≤, less than or equal to; +/-, plus or minus value shown; $^{o}$C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 $^{o}$C | > +/- 0.2 to 0.5 $^{o}$C | > +/- 0.5 to 0.8 $^{o}$C | > +/- 0.8 $^{o}$C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

Prepared 10/04/06 by A. M. Tattrie

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**MONITORING STATION DESCRIPTION**

*North East Margaree - 2004*

Year: 2004

LOCATION: Latitude 46$^0$ 22’ 10” N Longitude 60$^0$ 58’ 36” W

GROSS DRAINAGE AREA: 368 km$^2$

HYDROMETRIC RECORD LENGTH: 88 years

HYDROMETRIC PEROID OF RECORD: 1916 – PRESENT

**Hydrometric Measurement**

| Period of record | Type | Operation schedule | Gauge type |
|---|---|---|---|
| 1916 – 1920 | Flow | Continuous | Manual |
| 1921 – 1921 | Flow | Seasonal | Manual |
| 1922 – 1927 | Flow | Continuous | Manual |
| 1928 – 1928 | Flow | Seasonal | Manual |
| 1929 – 1941 | Flow | Continuous | Manual |
| 1942 - 2004 | Flow | Continuous | Recorder |

HYDROMETRIC REAL-TIME DATA AVAILABLE: YES

WATER QUALITY RECORD LENGTH: 3 YEARS

WATER QUALITY PEROID OF RECORD: 2002 – 2004

**Water Quality Measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2001 – 2004 | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO

Water Quality monitoring equipment is located in a five inch perforated white PVC pipe insitu to river via shore deployment method. The location has not changed since

installation in 2002. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; °C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 °C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records
[≤, less than or equal to; +/-, plus or minus value shown; °C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 °C | > +/- 0.2 to 0.5 °C | > +/- 0.5 to 0.8 °C | > +/- 0.8 °C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

Prepared 10/04/06 by A. M. Tattrie

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**MONITORING STATION DESCRIPTION**

*North East Margaree - 2005*

Year: 2005

LOCATION: Latitude $46^0$ 22’ 10” N Longitude $60^0$ 58’ 36” W

GROSS DRAINAGE AREA: 368 $km^2$

HYDROMETRIC RECORD LENGTH: 89 years

HYDROMETRIC PEROID OF RECORD: 1916 – PRESENT

**Hydrometric Measurement**

| Period of record | Type | Operation schedule | Gauge type |
|---|---|---|---|
| 1916 – 1920 | Flow | Continuous | Manual |
| 1921 – 1921 | Flow | Seasonal | Manual |
| 1922 – 1927 | Flow | Continuous | Manual |
| 1928 – 1928 | Flow | Seasonal | Manual |
| 1929 – 1941 | Flow | Continuous | Manual |
| 1942 - 2005 | Flow | Continuous | Recorder |

HYDROMETRIC REAL-TIME DATA AVAILABLE: YES

WATER QUALITY RECORD LENGTH: 4 YEARS

WATER QUALITY PEROID OF RECORD: 2002 – 2005

**Water Quality Measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2002 – 2005 | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO

Water Quality monitoring equipment is located in a five inch perforated white PVC pipe insitu to river via shore deployment method. The location has not changed since

installation in 2002. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.
NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; °C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 °C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records
[≤, less than or equal to; +/-, plus or minus value shown; °C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 °C | > +/- 0.2 to 0.5 °C | > +/- 0.5 to 0.8 °C | > +/- 0.8 °C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

Prepared 10/04/06 by A. M. Tattrie

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**MONITORING STATION DESCRIPTION**

*Shelburne River - 2002*

Year: 2002

LOCATION COORDINATES: Latitude $44^0$ 12' 59" N Longitude $65^0$ 14' 32" W

GROSS DRAINAGE AREA: 268 $km^2$

HYDROMETRIC RECORD LENGTH: 3 years

HYDROMETRIC PEROID OF RECORD: 1999 – 2002

**Hydrometric measurement**

| Period of record | Type | Operation schedule | Gauge type |
|---|---|---|---|
| 1999 - present | Flow | Continuous | Recorder |

HYDROMETRIC REAL-TIME DATA AVAILABLE: YES

WATER QUALITY RECORD LENGTH: 1 YEAR

WATER QUALITY PEROID OF RECORD: 2002

**Water Quality measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2002 | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO

Water Quality monitoring equipment is located in a five inch perforated white PVC pipe insitu to river via shore deployment method. The location has not changed since installation in 2002. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; °C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 °C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records [≤, less than or equal to; +/-, plus or minus value shown; °C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 °C | > +/- 0.2 to 0.5 °C | > +/- 0.5 to 0.8 °C | > +/- 0.8 °C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

Prepared 10/04/06 by A. M. Tattrie

Nova Scotia Environment and Labour
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**MONITORING STATION DESCRIPTION**

*Shelburne River - 2003*

Year: 2003

LOCATION COORDINATES: Latitude $44^0$ 12’ 59” N Longitude $65^0$ 14’ 32” W

GROSS DRAINAGE AREA: 268 $km^2$

HYDROMETRIC RECORD LENGTH: 4 years

HYDROMETRIC PEROID OF RECORD: 1999 – 2003

**Hydrometric measurement**

| Period of record | Type | Operation schedule | Gauge type |
|---|---|---|---|
| 1999 - present | Flow | Continuous | Recorder |

HYDROMETRIC REAL-TIME DATA AVAILABLE: YES

WATER QUALITY RECORD LENGTH: 2 YEARS

WATER QUALITY PEROID OF RECORD: 2002 to present

**Water Quality measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2002 to present | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO

Water Quality monitoring equipment is located in a five inch perforated white PVC pipe insitu to river via shore deployment method. The location has not changed since installation in 2002. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; °C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 °C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records
[≤, less than or equal to; +/-, plus or minus value shown; °C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 °C | > +/- 0.2 to 0.5 °C | > +/- 0.5 to 0.8 °C | > +/- 0.8 °C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

Prepared 10/04/06 by A. M. Tattrie

Nova Scotia Environment and Labour
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**MONITORING STATION DESCRIPTION**

*Shelburne River - 2004*

Year: 2004

LOCATION COORDINATES: Latitude 44$^0$ 12’ 59” N Longitude 65$^0$ 14’ 32” W

GROSS DRAINAGE AREA: 268 km$^2$

HYDROMETRIC RECORD LENGTH: 5 years

HYDROMETRIC PEROID OF RECORD: 1999 – 2004

**Hydrometric measurement**

| Period of record | Type | Operation schedule | Gauge type |
|---|---|---|---|
| 1999 - present | Flow | Continuous | Recorder |

HYDROMETRIC REAL-TIME DATA AVAILABLE: YES

WATER QUALITY RECORD LENGTH: 3 YEARS

WATER QUALITY PEROID OF RECORD: 2002 to present

**Water Quality measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2002 to present | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO

Water Quality monitoring equipment is located in a five inch perforated white PVC pipe insitu to river via shore deployment method. The location has not changed since installation in 2002. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; °C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 °C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records [≤, less than or equal to; +/-, plus or minus value shown; °C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 °C | > +/- 0.2 to 0.5 °C | > +/- 0.5 to 0.8 °C | > +/- 0.8 °C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

Prepared 10/04/06 by A. M. Tattrie

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**MONITORING STATION DESCRIPTION**

*Shelburne River - 2005*

Year: 2005

LOCATION COORDINATES: Latitude $44^0$ 12' 59" N Longitude $65^0$ 14' 32" W

GROSS DRAINAGE AREA: 268 $km^2$

HYDROMETRIC RECORD LENGTH: 6 years

HYDROMETRIC PEROID OF RECORD: 1999 – 2005

**Hydrometric measurement**

| Period of record | Type | Operation schedule | Gauge type |
|---|---|---|---|
| 1999 - present | Flow | Continuous | Recorder |

HYDROMETRIC REAL-TIME DATA AVAILABLE: YES

WATER QUALITY RECORD LENGTH: 4 YEARS

WATER QUALITY PEROID OF RECORD: 2002 to present

**Water Quality measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2002 to present | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO

Water Quality monitoring equipment is located in a five inch perforated white PVC pipe insitu to river via shore deployment method. The location has not changed since installation in 2002. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

**Data Rejection Criteria.** Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; °C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 °C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

**Data Quality Rating.** Rating continuous water-quality records [≤, less than or equal to; +/-, plus or minus value shown; °C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 °C | > +/- 0.2 to 0.5 °C | > +/- 0.5 to 0.8 °C | > +/- 0.8 °C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

Prepared 10/04/06 by A. M. Tattrie

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**MONITORING STATION DESCRIPTION**

*Kelley River*
2005

LOCATION: Latitude 45$^0$ 35' 10" N Longitude 64$^0$ 27' 05" W

GROSS DRAINAGE AREA: 63.2 $km^2$

HYDROMETRIC RECORD LENGTH: 37 years

HYDROMETRIC PEROID OF RECORD: 1969 – PRESENT

**Hydrometric measurement**

| Period of record | Type | Operation schedule | Gauge type |
|---|---|---|---|
| 1969 - present | Flow | Continuous | Recorder |

HYDROMETRIC REAL-TIME DATA AVAILABLE: YES

WATER QUALITY RECORD LENGTH: 1 YEAR

WATER QUALITY PEROID OF RECORD: 2005

**Water Quality measurement**

| Period of record | Water Quality Parameters | Operation schedule | Gauge type |
|---|---|---|---|
| 2005 | Temperature, Turbidity, pH, Dissolved Oxygen and Specific Conductance | Continuous | Recorder |

WATER QUALITY REAL-TIME DATA AVAILABLE: NO

Water Quality monitoring equipment is located in a five inch perforated white PVC pipe insitu to river via shore deployment method. The location has not changed since

installation in 2004. Water Quality data is recorded hourly and stored by Environment Canada Sutron Logger. The data is downloaded manually on maintenance visit.

NOTE: All data management decisions were based on Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation, and Reporting. U.S Geological Survey. Water-Resources Investigations Report 00-4252.

Excluding:
-cross-section measurement and adjustments p. 17 and 22.

Also, modification to following two tables:

Data Rejection Criteria. Maximum allowable limits for continuous water-quality monitoring sensors. [+/-, plus or minus value shown; $^{o}$C, degree Celsius; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Maximum allowable limits for water-quality Sensor values |
|---|---|
| | |
| Temperature | +/- 2.0 $^{o}$C |
| Specific conductance | +/- 30 percent |
| Dissolved oxygen | The greater of +/- 2.0 mg/L or 20 percent |
| pH | +/- 2 pH units |
| Turbidity | The greater of 15 NTUs or 30 percent |

Data Quality Rating. Rating continuous water-quality records
[≤ , less than or equal to; +/-, plus or minus value shown; $^{o}$C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

| Measured physical property | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Water temperature | ≤ +/- 0.20 $^{o}$C | > +/- 0.2 to 0.5 $^{o}$C | > +/- 0.5 to 0.8 $^{o}$C | > +/- 0.8 $^{o}$C |
| Specific conductance | The greater of ≤ +/- 3% or ≤ +/- 5 uS/cm | The greater of > +/- 3 to 10 % or > +/- 5 to 15 uS/cm | The greater of > +/- 10 to 15 % or > +/- 15 to 25 uS/cm | The greater of > +/- 15 % or 25 uS/cm |
| Dissolved oxygen | ≤ +/- 0.3 mg/L | > +/- 0.3 to 0.5 mg/L | > +/- 0.5 to 0.8 mg/L | > +/- 0.8 mg/L |
| pH | ≤ +/- 0.2 units | > +/- 0.2 to 0.5 units | > +/- 0.5 to 0.8 units | > +/- 0.8 units |
| Turbidity | The greater of ≤ +/- 5% or ≤ +/- 2 NTUs | The greater of > +/- 5 to 10% or > +/- 2 to 5 NTUs | The greater of > +/- 10 to 15% or > +/- 5 to 8 NTUs | The greater of > +/- 15% or > +/- 8 NTUs |

Prepared 10/04/06 by A. M. Tattrie

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**DATA QUALITY ANALYSIS**

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*Pockwock Lake - 2002*

POCKWOCK LAKE, HALIFAX COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the lake via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period August 1, 2002 to October 29, 2002.

Lake Characteristics:

Station located at the outlet of lake in front of pumping station for water treatment plant. Water quality monitoring equipment located 5 meters below the water surface. Average water depth at station is 10 meters.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by grab sampling and a hand held YSI Dissolved Oxygen meter prior to unit being removed. Hydrolab unit is then taken off site for sensor maintenance and calibrating. Once the Hydrolab sensors have stabilized it is returned to the site. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab are:

August 1, 2002
October 29, 2002

Field Verifications:

Data from the Hydrolab were verified in the field during the 2002 season by grab sampling and a hand held YSI Dissolved Oxygen meter. The grab samples were

analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Conductivity | DO | Turbidity |
|---|---|---|---|---|---|---|
| 08/01/2002 | 10/29/2002 | Fair | Good | Good | Poor | N/A |

Data Correction:

Data correction was made to collected data by comparing the YSI Dissolved Oxygen water quality meter measurements for Temperature and DO. The grab sample lab results for pH, Conductivity and Turbidity were used for any data correction. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Missing Data:

Periods of missing data due to logger malfunctions:

All data lost from November 8, 2002 to December 31, 2002.

No Turbidity data for 2002 due to broken Turbidity sensor.

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**DATA QUALITY ANALYSIS**

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*Pockwock Lake - 2003*

POCKWOCK LAKE, HALIFAX COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the lake via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period February 4, 2003, to November 6, 2003

Lake Characteristics:

Station located at the outlet of lake in front of pumping station for water treatment plant. Water quality monitoring equipment located 5 meters below the water surface. Average water depth at station is 10 meters.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by grab sampling and a hand held YSI Dissolved Oxygen meter prior to unit being removed. The calibration of the replacement Hydrolab unit was preformed at NSEL office prior to field trip using calibration standards. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab were:

May 21, 2003
July 17, 2003
November 6,2003

Field Verifications:

Data from the Hydrolab were verified in the field during the 2003 season by grab sampling and a hand held YSI Dissolved Oxygen meter. The grab samples were

analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Conductivity | DO | Turbidity |
|---|---|---|---|---|---|---|
| 02/04/2003 | 05/21/2003 | Good | Fair | Good | Fair | N/A |
| 05/21/2003 | 07/17/2003 | Good | Excellent | Excellent | Good | Good |
| 07/17/2003 | 11/06/2003 | Good | Excellent | Excellent | Poor | Fair |

Data Correction:

Data correction was made to collected data by comparing the YSI Dissolved Oxygen water quality meter measurements for Temperature and DO. The grab sample lab results for pH, Conductivity and Turbidity were used for any data correction. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Missing Data:

Periods of missing data due to logger malfunctions:

All data lost from January 1, 2003 to February 4, 2003.

No Turbidity data from February 4, 2003 to May 21, 2003 due to broken sensor.

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

# DATA QUALITY ANALYSIS

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*Pockwock Lake - 2004*

POCKWOCK LAKE, HALIFAX COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the lake via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period November 6, 2003, to December 6, 2004.

Lake Characteristics:

Station located at the outlet of lake in front of pumping station for water treatment plant. Water quality monitoring equipment located 5 meters below the water surface. Average water depth at station is 10 meters.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by a freshly calibrated portable Quanta P hand held water quality meter prior to unit being removed. Also a grab sample is taken for backup QAQC purposes. The calibration of the replacement Hydrolab unit was preformed at NSEL office prior to field trip using calibration standards. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab were:

November 6, 2003
April 27, 2004
June 28, 2004
July 21, 2004 (Verification only)
October 20, 2004
December 6, 2004

Field Verifications:

Data from the Hydrolab were verified in the field during the 2004 season using a freshly calibrated portable Quanta P hand held water quality meter. The backup QAQC grab samples were analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Conductivity | DO | Turbidity |
|---|---|---|---|---|---|---|
| 11/06/2003 | 04/27/2004 | Excellent | Excellent | Excellent | Poor | Poor |
| 04/27/2004 | 06/28/2004 | Excellent | Poor | Good | Poor | Excellent |
| 06/28/2004 | 07/21/2004 | Excellent | Poor | Excellent | Good | Excellent |
| 07/21/2004 | 10/20/2004 | Excellent | Poor | Good | Poor | Rejected |
| 10/20/2004 | 12/06/2004 | Excellent | Good | Good | Excellent | Good |

Data Correction:

Data correction was made to collected data by comparing the freshly calibrated portable Quanta P water quality meter measurements for Temperature, Conductivity, pH and DO. The backup QAQC grab sample lab results for Turbidity were used periodically for data correction due to Quanta P Turbidity sensor issues. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Missing Data:

Periods of missing data due to logger malfunctions: scattered through out the year.

Removed Turbidity data form 07/21/2004 to 10/20/04. It was outside the Maximum allowable limits.

Removed Turbidity data form 03/10/2004 to 04/27/04, due to sensor fouling.

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**DATA QUALITY ANALYSIS**

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*Pockwock Lake - 2005*

POCKWOCK LAKE, HALIFAX COUNTY, NOVA SCOTIA

Equipment: Campbells Scientific CR510 Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the lake via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period June 13, 2005, to December 6, 2005.

Lake Characteristics:

Station located at the outlet of lake in front of pumping station for water treatment plant. Water quality monitoring equipment located 5 meters below the water surface. Average water depth at station is 10 meters.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by a freshly calibrated portable Quanta P hand held water quality meter prior to unit being removed. Also a grab sample is taken for backup QAQC purposes. The calibration of the replacement Hydrolab unit was preformed at NSEL office prior to field trip using calibration standards. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab were:

June 13, 2005
September 17, 2005
November 4, 2005
December 6, 2005

Field Verifications:

Data from the Hydrolab were verified in the field during the 2005 season using a freshly calibrated portable Quanta P hand held water quality meter. The backup QAQC grab samples were analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Conductivity | DO | Turbidity |
|---|---|---|---|---|---|---|
| 06/13/2005 | 09/07/2005 | Excellent | Good | Excellent | Poor | Excellent |
| 09/12/2005 | 11/04/2005 | Excellent | Excellent | Excellent | Excellent | Good |
| 11/04/2005 | 12/06/2005 | Excellent | Fair | Good | Excellent | Excellent |

Data Correction:

Data correction was made to collected data by comparing the freshly calibrated portable Quanta P water quality meter measurements for Temperature, Conductivity, pH and DO. The backup QAQC grab sample lab results for Turbidity were used periodically for data correction due to Quanta P Turbidity sensor issues. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Missing Data:

Periods of missing data due to logger malfunctions: January 1, 2005 to June 13, 2005. September 7, 2005 to September 12, 2005.

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

## DATA QUALITY ANALYSIS

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*North East Margaree River– 2002*

NORTH EAST MARGAREE, INVERNESS COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the river via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period June 12, 2002 to January 9, 2003.

Channel Characteristics:

Channel above station is not straight. It comes in from two widely separated streams at sharp angles. Channel below station is straight for about 60m. Flow to the station and away from it is very swift and deep. Right bank is high, rocky, and wooded and not liable to flooding. Left bank is low, wooded and liable to flooding in many places. Stream bed is gravel and ledge rock.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by grab sampling and a hand held YSI Dissolved Oxygen meter prior to unit being removed. Hydrolab unit is then taken off site for sensor maintenance and calibrating. Once the Hydrolab sensors have stabilized it is returned to the site. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab are:

June 12, 2002
September 25, 2002
September 26, 2002
December 4, 2002
January 9, 2003

Field Verifications:

Data from the Hydrolab were verified in the field during the 2002 season by grab sampling and a hand held YSI Dissolved Oxygen meter. The grab samples were analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Conductivity | DO | Turbidity |
|---|---|---|---|---|---|---|
| 06/12/02 | 09/25/02 | Excellent | Good | Good | Fair | Rejected |
| 09/26/02 | 12/04/02 | Excellent | Good | Good | Good | Rejected |
| 12/04/02 | 01/09/03 | Excellent | Good | Good | Fair | Excellent |

Data Correction:

Data correction was made to collected data by comparing the YSI Dissolved Oxygen water quality meter measurements for Temperature and DO. The grab sample lab results for pH, Conductivity and Turbidity were used for any data correction. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Data Rejected:

Rejected 06/12/02 to 12/04/02 period of Turbidity data because of a cracked turbidity sensor.

Specific Conductance blank values are due to inaccurate data logger reaching at full scale (i.e. 327.67 us/cm). This problem was corrected in 2003.

Missing Data:

Periods of missing data due to sensor maintenance:

09/25/02 to 09/26/02

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**DATA QUALITY ANALYSIS**

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*North East Margaree River – 2003*

NORTH EAST MARGAREE, INVERNESS COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the river via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period January 9, 2003 to November 20, 2003.

Channel Characteristics:

Channel above station is not straight. It comes in from two widely separated streams at sharp angles. Channel below station is straight for about 60m. Flow to the station and away from it is very swift and deep. Right bank is high, rocky, and wooded and not liable to flooding. Left bank is low, wooded and liable to flooding in many places. Stream bed is gravel and ledge rock.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by grab sampling and a hand held YSI Dissolved Oxygen meter prior to unit being removed. The calibration of the replacement Hydrolab unit was preformed at NSEL office prior to field trip using calibration standards. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab were:

January 9, 2003
May 6, 2003
July 8, 2003
November 20, 2003

Field Verifications:
Data from the Hydrolab were verified in the field during the 2003 season by grab sampling and a hand held YSI Dissolved Oxygen meter. The grab samples were

analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Conductivity | DO | Turbidity |
|---|---|---|---|---|---|---|
| 01/09/2003 | 05/06/2003 | Good | Good | Good | Poor | Fair |
| 05/06/2003 | 07/08/2003 | Excellent | Excellent | Good | Poor | Good |
| 07/08/2003 | 11/20/2003 | Excellent | Fair | Fair | Poor | Good |

Data Correction:

Data correction was made to collected data by comparing the YSI Dissolved Oxygen water quality meter measurements for Temperature and DO. The grab sample lab results for pH, Conductivity and Turbidity were used for any data correction. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Special Data Correction:

Turbidity data had a one-point data shift for period: 01/10/2003 to 01/16/2003.

Data Rejected:

Periods of turbidity data rejected because the data were outside the Maximum allowable limits for Turbidity (The greater of 15 NTUs or 30 percent):

02/22/2003 to 05/06/2003
05/27/2003 to 07/08/2003

Missing Data:

Periods of missing data due to logger malfunctions:
01/16/2003 to 02/21/2003 logger malfunction
12/17/2003 to 12/26/2003 logger malfunction

Dates of missing data due to sensor maintenance:
01/09/2003
05/06/2003

Some Turbidity values removed because of debris in front of sensor. Reached this conclusion comparing Turbidity values to Conductivity and stage height values.

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**DATA QUALITY ANALYSIS**

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*North East Margaree River - 2004*

NORTH EAST MARGAREE, INVERNESS COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the river via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period November 20, 2003 to December 15, 2004.

Channel Characteristics:

Channel above station is not straight. It comes in from two widely separated streams at sharp angles. Channel below station is straight for about 60m. Flow to the station and away from it is very swift and deep. Right bank is high, rocky, and wooded and not liable to flooding. Left bank is low, wooded and liable to flooding in many places. Stream bed is gravel and ledge rock.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by a freshly calibrated portable Quanta P hand held water quality meter prior to unit being removed. Also a grab sample is taken for backup QAQC purposes. The calibration of the replacement Hydrolab unit was preformed at NSEL office prior to field trip using calibration standards. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab were:

November 20, 2003
May 5, 2004
July 8, 2004
October 26, 2004
December 15, 2004

Field Verifications:

Data from the Hydrolab were verified in the field during the 2004 season using a freshly calibrated portable Quanta P hand held water quality meter. The backup QAQC grab samples were analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Conductivity | DO | Turbidity |
|---|---|---|---|---|---|---|
| 11/20/2003 | 05/25/2004 | Good | Good | Good | Poor | Good |
| 05/25/2004 | 07/08/2004 | Excellent | Excellent | Excellent | Poor | Excellent |
| 07/08/2004 | 10/26/2004 | Excellent | Excellent | Fair | Good | Fair |
| 10/26/2004 | 12/15/2004 | Excellent | Excellent | Good | Fair | Good |

Data Correction:

Data correction was made to collected data by comparing the freshly calibrated portable Quanta P water quality meter measurements for Temperature, Conductivity, pH and DO. The backup QAQC grab sample lab results for Turbidity were used periodically for data correction due to Quanta P Turbidity sensor issues. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Missing Data:

Periods of missing data due to logger malfunctions:

04/22/2004 to 04/26/2004 logger malfunction
08/24/2004 to 09/01/2004 logger disconnected for this period to upgrade shelter.
10/26/2004 to 11/03/2004 some hourly readings missing due to logger malfunction.

Some Turbidity values removed because of debris in front of sensor. Reached this conclusion comparing Turbidity values to Conductivity and stage height values.

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**DATA QUALITY ANALYSIS**

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*North East Margaree River - 2005*

NORTH EAST MARGAREE, INVERNESS COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the river via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period December 15, 2004, to December 1, 2005.

Channel Characteristics:

Channel above station is not straight. It comes in from two widely separated streams at sharp angles. Channel below station is straight for about 60m. Flow to the station and away from it is very swift and deep. Right bank is high, rocky, and wooded and not liable to flooding. Left bank is low, wooded and liable to flooding in many places. Stream bed is gravel and ledge rock.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by a freshly calibrated portable Quanta P hand held water quality meter prior to unit being removed. Also a grab sample is taken for backup QAQC purposes. The calibration of the replacement Hydrolab unit was preformed at NSEL office prior to field trip using calibration standards. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab were:

December 15, 2004
May 11, 2005
June 29, 2005
September 14, 2005
December 1, 2005

Field Verifications:

Data from the Hydrolab were verified in the field during the 2005 season using a freshly calibrated portable Quanta P hand held water quality meter. The backup QAQC grab samples were analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Conductivity | DO | Turbidity |
|---|---|---|---|---|---|---|
| 12/15/2004 | 05/11/2005 | Excellent | Good | Excellent | Fair | Rejected |
| 05/11/2005 | 06/29/2005 | Excellent | Excellent | Excellent | Fair | Excellent |
| 06/29/2005 | 09/14/2005 | Excellent | Poor | Fair | Good | Poor |
| 09/14/2005 | 12/01/2005 | Excellent | Good | Good | Excellent | Poor |

Data Correction:

Data correction was made to collected data by comparing the freshly calibrated portable Quanta P water quality meter measurements for Temperature, Conductivity, pH and DO. The backup QAQC grab sample lab results for Turbidity were used periodically for data correction due to Quanta P Turbidity sensor issues. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Missing Data:

Rejected Turbidity data from December 15, 2004 to May 11, 2005, because it exceeded the Maximum allowable limits for Turbidity (The greater of 15 NTUs or 30 percent).

Some Turbidity values removed because of debris in front of sensor. Reached this conclusion comparing Turbidity values to Conductivity and stage height values.

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**DATA QUALITY ANALYSIS**

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*Shelburne River - 2002*

SHELBURNE RIVER, QUEENS COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the river via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period August 16, 2002 to November 27, 2002.

Channel Characteristics:

Channel above station is straight for 60 metres and channel below station is straight for 300 metres. Both banks are rocky, wooded and liable to flooding. Streambed is rock, gravel and ledge rock.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by grab sampling and a hand held YSI Dissolved Oxygen meter prior to unit being removed. Hydrolab unit is then taken off site for sensor maintenance and calibrating. Once the Hydrolab sensors have stabilized it is returned to the site. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab are:

August 16, 2002
November 27, 2002

Field Verifications:

Data from the Hydrolab were verified in the field during the 2002 season by grab sampling and a hand held YSI Dissolved Oxygen meter. The grab samples were

analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Specific Conductance | DO | Turbidity |
|---|---|---|---|---|---|---|
| 08/16/2002 | 11/27/2002 | Excellent | Excellent | Excellent | Good | Fair |

Data Correction:

Data correction was made to collected data by comparing the YSI Dissolved Oxygen water quality meter measurements for Temperature and DO. The grab sample lab results for pH, Conductivity and Turbidity were used for any data correction. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Missing Data:

Some Turbidity values removed because of debris in front of sensor. Reached this conclusion comparing Turbidity values to Conductivity and stage height values.

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**DATA QUALITY ANALYSIS**

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*Shelburne River - 2003*

SHELBURNE RIVER, QUEENS COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the river via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period November 28, 2002 to November 28, 2003.

Channel Characteristics:

Channel above station is straight for 60 metres and channel below station is straight for 300 metres. Both banks are rocky, wooded and liable to flooding. Streambed is rock, gravel and ledge rock.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by grab sampling and a hand held YSI Dissolved Oxygen meter prior to unit being removed. The calibration of the replacement Hydrolab unit was preformed at NSEL office prior to field trip using calibration standards. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab were:

November 28, 2002
July 10, 2003
July 29, 2003
November 28, 2003

Field Verifications:

Data from the Hydrolab were verified in the field during the 2003 season by grab sampling and a hand held YSI Dissolved Oxygen meter. The grab samples were analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Specific Conductance | DO | Turbidity |
|---|---|---|---|---|---|---|
| 11/28/2002 | 06/27/2003 | Good | Rejected | Excellent | Poor | Rejected |
| 07/10/2003 | 07/29/2003 | Excellent | Good | Excellent | Poor | Fair |
| 07/29/2003 | 11/28/2003 | Good | Excellent | Excellent | Fair | Rejected |

Data Correction:
Data correction was made to collected data by comparing the YSI Dissolved Oxygen water quality meter measurements for Temperature and DO. The grab sample lab results for pH, Conductivity and Turbidity were used for any data correction. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Special Data Correction:
Performed one point data correction for all sensor data from November 28, 2002 to June 27, 2003 based on verification results on November 28, 2002.

Missing Data:

Periods of missing data:

All sensor data from June 27, 2003, 00:00 to July 10, 2003, 13:00, due to Hydrolab pulled out of the flow.

Turbidity data from November 28, 2002 to June 26, 2003 due to data logger and sensor problems.

Turbidity data from July 29, 2003 to November 28, 2003 due to broken Turbidity sensor.

pH data from November 28, 2002 to June 27, 2003 due to faulty pH sensor

Some Turbidity values removed because of debris in front of sensor. Reached this conclusion comparing Turbidity values to Conductivity and stage height values.

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**DATA QUALITY ANALYSIS**

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*Shelburne River - 2004*

SHELBURNE RIVER, QUEENS COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the river via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period November 28, 2003 to December 9, 2004.

Channel Characteristics:

Channel above station is straight for 60 metres and channel below station is straight for 300 metres. Both banks are rocky, wooded and liable to flooding. Streambed is rock, gravel and ledge rock.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by a freshly calibrated portable Quanta P hand held water quality meter prior to unit being removed. Also a grab sample is taken for backup QAQC purposes. The calibration of the replacement Hydrolab unit was preformed at NSEL office prior to field trip using calibration standards. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab were:

November 28, 2003
June 22, 2004
July 6, 2004
September 29, 2004
December 9, 2004

Field Verifications:

Data from the Hydrolab were verified in the field during the 2004 season using a freshly calibrated portable Quanta P hand held water quality meter. The backup QA/QC grab samples were analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Specific Conductance | DO | Turbidity |
|---|---|---|---|---|---|---|
| 11/28/2003 | 06/22/2004 | Excellent | Excellent | Excellent | Poor | Fair |
| 07/06/2004 | 09/29/2004 | Excellent | Fair | Good | Poor | Excellent |
| 09/29/2004 | 12/09/2004 | Excellent | Good | Good | Fair | Fair |

Data Correction:

Data correction was made to collected data by comparing the freshly calibrated portable Quanta P water quality meter measurements for Temperature, Conductivity, pH and DO. The backup QAQC grab sample lab results for Turbidity were used periodically for data correction due to Quanta P Turbidity sensor issues. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Missing Data:

Periods of missing data:

06/22/2004 to 07/06/2004 for all parameters

Turbidity data removed for period from 10/10/2004 to 12/09/2004 due to debris around Turbidity sensor.

Some Turbidity values removed because of debris in front of sensor. Reached this conclusion comparing Turbidity values to Conductivity and stage height values.

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**DATA QUALITY ANALYSIS**

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*Shelburne River - 2005*

SHELBURNE RIVER, QUEENS COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the river via shore line deployment method.

Published records: Hourly water quality measurements.

Primary Records: Covering the period December 9, 2004 to November 29, 2005.

Channel Characteristics:

Channel above station is straight for 60 metres and channel below station is straight for 300 metres. Both banks are rocky, wooded and liable to flooding. Streambed is rock, gravel and ledge rock.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by a freshly calibrated portable Quanta P hand held water quality meter prior to unit being removed. Also a grab sample is taken for backup QAQC purposes. The calibration of the replacement Hydrolab unit was preformed at NSEL office prior to field trip using calibration standards. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab were:

December 9, 2004
April 27, 2005
July 5, 2005
November 3, 2005
November 29, 2005

Field Verifications:

Data from the Hydrolab were verified in the field during the 2005 season using a freshly calibrated portable Quanta P hand held water quality meter. The backup QAQC grab samples were analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Specific Conductance | DO | Turbidity |
|---|---|---|---|---|---|---|
| 12/09/2004 | 04/27/2005 | Good | Fair | Good | Good | Poor |
| 04/27/2005 | 07/05/2005 | Good | Excellent | Good | Good | Good |
| 07/05/2005 | 11/03/2005 | Excellent | Excellent | Excellent | Excellent | Excellent |
| 11/03/2005 | 11/29/2005 | Excellent | Good | Excellent | Good | Excellent |

Data Correction:

Data correction was made to collected data by comparing the freshly calibrated portable Quanta P water quality meter measurements for Temperature, Conductivity, pH and DO. The backup QAQC grab sample lab results for Turbidity were used periodically for data correction due to Quanta P Turbidity sensor issues. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Missing Data:

03/06/2005 09:00 to 03/07/2005 03:00 due to logger malfunction.

Some Turbidity values removed because of debris in front of sensor. Reached this conclusion comparing Turbidity values to Conductivity and stage height values.

Nova Scotia Environment and Labour
Automated Water Quality Monitoring Network

**DATA QUALITY ANALYSIS**

WATER QUALITY PARAMETERS

Temperature, pH, Conductivity, Dissolved Oxygen and Turbidity

*Kelley River – 2005*

KELLEY RIVER, CUMBERLAND COUNTY, NOVA SCOTIA

Equipment: Sutron Data logger and Hydrolab Water Quality Sonde located in a five inch diameter perforated PVC pipe insitu to the river via shore line deployment method.

Published records: Hourly water quality measurements

Primary Records: Covering the period December 17, 2004, to December 8, 2005.

Channel Characteristics:

Both banks are low, rocky with vegetation and grasses right to water's edge. The stream bottom is composed of gravels and boulders and some ledge rock. The approach and departure of flows is general straight and fast except for gauge pool. Flow is natural.

Calibration:

During the ice-free season data from the seasoned Hydrolab unit is verified by a freshly calibrated portable Quanta P hand held water quality meter prior to unit being removed. Also a grab sample is taken for backup QAQC purposes. The calibration of the replacement Hydrolab unit was preformed at NSEL office prior to field trip using calibration standards. The dates of removal of seasoned Hydrolab and installation of freshly calibrated Hydrolab were:

December 17, 2004
May 4, 2005
June 21, 2005
October 3, 2005
December 8, 2005

Field Verifications:
Data from the Hydrolab were verified in the field during the 2005 season using a freshly calibrated portable Quanta P hand held water quality meter. The backup QAQC grab samples were analysed for pH, Conductivity and Turbidity. Data verification was performed on the seasoned Hydrolab on removal and the freshly calibrated Hydrolab that was installed.

Data Rating:

| Period from | Period to | Temperature | pH | Conductivity | DO | Turbidity |
|---|---|---|---|---|---|---|
| 12/17/2004 | 03/17/2005 | Excellent | Excellent | Good | Poor | Excellent |
| 05/04/2005 | 06/21/2005 | Excellent | Fair | Good | Poor | Rejected |
| 06/21/2005 | 10/13/2005 | Excellent | Excellent | Excellent | Good | Good |
| 10/13/2005 | 12/08/2005 | Excellent | Good | Good | Good | Excellent |

Data Correction:

Data correction was made to collected data by comparing the freshly calibrated portable Quanta P water quality meter measurements for Temperature, Conductivity, pH and DO. The backup QAQC grab sample lab results for Turbidity were used periodically for data correction due to Quanta P Turbidity sensor issues. The field verification and Hydrolab recorded values were compared using the Criteria for Water Quality Data Shifts table. Shifts were made to the recorded data as required.

Note: Data from December 17, 2004 to March 17, 2005 was adjusted and rated based on one point verification on December 17, 2004.

Missing Data:

All data from March 18, 2005 to May 4, 2005 due to Hydrolab internal battery failure. Hydrolab was not connected to Environment Canada's Sutron datalogger until May 4, 2005 and unit was operating on internal power and memory.

Rejected Turbidity data from May 4, 2005 to June 21, 2005 because it exceeded the Maximum allowable limits for Turbidity (The greater of 15 NTUs or 30 percent).

Some Turbidity values removed from July 25, 2005 to August 28, 2005 because of debris in front of sensor. Reached this conclusion comparing Turbidity values to Conductivity and stage height values.

Missing some hourly readings throughout the year due to Hydrolab and Sutron datalogger issues.

## APPENDIX III – WATER QUALITY DATASET (FINAL VALIDATED)

## REAL TIME WATER QUALITY DATASET

These data are available upon request by contacting the Water and Wastewater Branch, NSEL. Phone: (902) 424-2553 or electronically via the NSEL Water Line E-mail address: delwater@gov.ns.ca.

## GRAB SAMPLE WATER QUALITY DATA

As part of its routine monitoring program, NSEL collects grab samples for chemical analyses. These data represent that work.

Table III-1. Grab sample water quality data.

| Sample Station | Date Sampled | Aluminium | Boron | Barium | Beryllium | Tin | Calcium | Cadmium | Cobalt | Chromium | Copper | Iron |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ug/L | ug/L | ug/L | ug/L | ug/L | mg/L | ug/L | ug/L | ug/L | ug/L | ug/L |
| NE Margaree | 1-Dec-05 | 49 | <5 | 20 | <2 | <2 | 10.5 | <2 | <2 | <2 | <2 | 23 |
| NE Margaree | 14-Sep-05 | 139 | 6 | 23 | <2 | <2 | 10.1 | <2 | <2 | <2 | <2 | 126 |
| NE Margaree | 29-Jun-05 | 17 | <5 | 30 | <2 | <2 | 21.1 | <2 | <2 | <2 | <2 | <20 |
| NE Margaree | 11-May-05 | 75 | <5 | 21 | <2 | <2 | 8.5 | <2 | <2 | <2 | <2 | 25 |
| NE Margaree | 15-Dec-04 | 48 | 5 | 20 | <2 | <2 | 9.6 | <2 | <2 | <2 | <2 | <20 |
| NE Margaree | 26-Oct-04 | 30 | <5 | 25 | <2 | <2 | 12 | <0.3 | <1 | <2 | <2 | <50 |
| NE Margaree | 8-Jul-04 | 25 | <5 | 26 | <2 | <2 | 16.4 | <2 | <2 | <2 | <2 | <20 |
| NE Margaree | 20-Nov-03 | 48 | 7 | 23 | <2 | <2 | 10.2 | <2 | <2 | <2 | <2 | 47 |
| NE Margaree | 8-Jul-03 | 20 | 6 | 26 | <2 | <2 | 19 | <2 | <2 | <2 | <2 | <20 |
| NE Margaree | 6-May-03 | 117 | <5 | 16 | <2 | <2 | 6.2 | <2 | <2 | <2 | <2 | 36 |
| NE Margaree | 9-Jan-03 | 20 | 5 | 24 | <5 | | 14 | <0.3 | <1 | <2 | <2 | <20 |
| NE Margaree | 22-Jun-06 | 55 | 6 | 30 | <2 | <2 | 16.3 | <2 | <2 | <2 | ,2 | 40 |
| | | | | | | | | | | | | |
| Shelburne River | 29-Nov-05 | 314 | <5 | 3 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 193 |
| Shelburne River | 3-Nov-05 | 387 | 4 | 4 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 249 |
| Shelburne River | 5-Jul-05 | 277 | <5 | 3 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 239 |
| Shelburne River | 27-Apr-05 | 245 | <5 | 3 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 139 |
| Shelburne River | 9-Dec-04 | 289 | <5 | 3 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 143 |
| Shelburne River | 9-Dec-04 | 293 | <5 | 3 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 151 |
| Shelburne River | 29-Sep-04 | 253 | 4 | 3 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 268 |
| Shelburne River | 22-Jun-04 | 256 | <5 | 3 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 202 |
| Shelburne River | 28-Nov-03 | 438 | <5 | 4 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 328 |
| Shelburne River | 29-Jul-03 | 254 | <5 | 3 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 173 |

Table III-1, continued

| Sample Station | Date Sampled | Aluminium | Boron | Barium | Beryllium | Tin | Calcium | Cadmium | Cobalt | Chromium | Copper | Iron |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ug/L | ug/L | ug/L | ug/L | ug/L | mg/L | ug/L | ug/L | ug/L | ug/L | ug/L |
| Shelburne River | 10-Jul-03 | 251 | <5 | 3 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 198 |
| Shelburne River | 5-Jul-06 | 372 | <5 | 3 | <2 | <2 | <0.5 | <2 | <2 | <2 | <2 | 301 |
| | | | | | | | | | | | | |
| Kelley River | 13-Oct-05 | 345 | 6 | 23 | <2 | <2 | 1.1 | <2 | <2 | <2 | <2 | 728 |
| Kelley River | 21-Jun-05 | 171 | <5 | 7 | <2 | <2 | 0.6 | 3 | <2 | <2 | <2 | 404 |
| Kelley River | 17-Dec-04 | 135 | 3 | 11 | <2 | <2 | 0.7 | <2 | <2 | <2 | <2 | 257 |
| Kelley River | 26-Aug-04 | 147 | 8 | 6 | <2 | <2 | 1.3 | <2 | <2 | <2 | <2 | 457 |
| Kelley River | 27-Jul-06 | 254 | <5 | 13 | <2 | <2 | 0.8 | <2 | <2 | <2 | <2 | 787 |
| Kelley River | 18-May-06 | 162 | <5 | 7 | <2 | <2 | 0.7 | <2 | <2 | <2 | <2 | 333 |

| Sample Station | Date Sampled | Vanadium | Magnesium | Hardness as CaCo3 mg/L | Manganese | Nickel | Potassium | Lead | Antimony | Selenium | Sodium | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ug/L | mg/L | | ug/L | ug/L | mg/L | ug/L | ug/L | ug/L | mg/L | ug/L |
| NE Margaree | 1-Dec-05 | <2 | 1.2 | 31.1 | 2 | <2 | <0.5 | <2 | <2 | <2 | 11 | <2 |
| NE Margaree | 14-Sep-05 | <2 | 1.2 | 30.1 | 4 | <2 | <0.5 | <2 | <2 | <2 | 10.9 | <5 |
| NE Margaree | 29-Jun-05 | <2 | 1.8 | 60.1 | <2 | <2 | 0.6 | <2 | <2 | <2 | 28.2 | 6 |
| NE Margaree | 11-May-05 | <2 | 1.1 | 25.7 | <2 | <2 | <0.5 | <2 | <2 | <2 | 9.9 | <2 |
| NE Margaree | 15-Dec-04 | <2 | 1.2 | 28.9 | 3 | <2 | <0.5 | <2 | <2 | <2 | 10.4 | <2 |
| NE Margaree | 26-Oct-04 | <2 | 1.4 | 35.7 | 2 | <2 | 0.4 | <0.5 | <2 | <2 | 14.2 | 10 |
| NE Margaree | 8-Jul-04 | <2 | 1.6 | 47.5 | 2 | <2 | 0.5 | <2 | <2 | <2 | 21.1 | <2 |
| NE Margaree | 20-Nov-03 | <2 | 1.4 | 31.2 | 3 | <2 | <0.5 | <2 | <2 | <2 | 10.4 | 3 |
| NE Margaree | 8-Jul-03 | <2 | 1.7 | 54.4 | 3 | <2 | 0.5 | <2 | <2 | <2 | 24.7 | <2 |
| NE Margaree | 6-May-03 | <2 | 0.8 | 18.8 | 3 | <2 | <0.5 | <2 | <2 | <2 | 6.4 | <5 |
| NE Margaree | 9-Jan-03 | <2 | 1.5 | 41.1 | 2 | <2 | 0.4 | <0.5 | <2 | <2 | 15.4 | <2 |
| NE Margaree | 22-Jun-06 | <2 | 1.6 | 47.2 | 3 | <2 | 0.6 | <2 | <2 | <2 | 21.7 | <2 |
| | | | | | | | | | | | | |
| Shelburne River | 29-Nov-05 | <2 | <0.5 | | 11 | <2 | <0.5 | <2 | <2 | <2 | 2.2 | <2 |
| Shelburne River | 3-Nov-05 | <2 | <0.5 | | 13 | <2 | <0.5 | <2 | <2 | <2 | 2.4 | 3 |
| Shelburne River | 5-Jul-05 | <2 | <0.5 | | 11 | <2 | <0.5 | <2 | <2 | <2 | 2.2 | <5 |
| Shelburne River | 27-Apr-05 | <2 | <0.5 | | 13 | <2 | <0.5 | <2 | <2 | <2 | 2.5 | <2 |
| Shelburne River | 9-Dec-04 | <2 | <0.5 | | 13 | <2 | <0.5 | <2 | <2 | <2 | 2.7 | <2 |

## Table III-1, continued

| Sample Station | Date Sampled | Vanadium | Magnesium | Hardness as CaCo3 mg/L | Manganese | Nickel | Potassium | Lead | Antimony | Selenium | Sodium | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ug/L | mg/L | | ug/L | ug/L | mg/L | ug/L | ug/L | ug/L | mg/L | ug/L |
| Shelburne River | 9-Dec-04 | <2 | <0.5 | | 14 | <2 | <0.5 | <2 | <2 | <2 | 2.7 | <2 |
| Shelburne River | 29-Sep-04 | <2 | <0.5 | | 12 | <2 | <0.5 | <2 | <2 | <2 | 2.9 | <2 |
| Shelburne River | 22-Jun-04 | <2 | <0.5 | | 14 | 3 | <0.5 | <2 | <2 | <2 | 2.7 | <2 |
| Shelburne River | 28-Nov-03 | <2 | <0.5 | | 14 | <2 | <0.5 | <2 | <2 | <2 | 2.8 | 18 |
| Shelburne River | 29-Jul-03 | <2 | <0.5 | | 16 | <2 | <0.5 | <2 | <2 | <2 | 2.5 | <2 |
| Shelburne River | 10-Jul-03 | <2 | <0.5 | | 12 | <2 | <0.5 | <2 | <2 | <2 | 2.2 | <5 |
| Shelburne River | 5-Jul-06 | <2 | <0.5 | | 10 | <2 | <0.5 | <2 | <2 | <2 | 2.4 | 2 |
| Kelley River | 13-Oct-05 | <2 | 0.6 | 5.2 | 263 | <2 | <0.5 | <2 | <2 | <2 | 2.5 | <5 |
| Kelley River | 21-Jun-05 | <2 | <0.5 | | 28 | <2 | <0.5 | <2 | <2 | <2 | 2.4 | 7 |
| Kelley River | 17-Dec-04 | <2 | <0.5 | | 103 | <2 | <0.5 | <2 | <2 | <2 | 2.3 | 3 |
| Kelley River | 26-Aug-04 | <2 | 0.7 | 6.1 | 17 | <2 | <0.5 | <2 | <2 | <2 | 3.9 | <2 |
| Kelley River | 27-Jul-06 | <2 | <0.5 | | 170 | <2 | <0.5 | <2 | <2 | <2 | 2.3 | 3 |
| Kelley River | 18-May-06 | <2 | <0.5 | | 46 | <2 | <0.5 | <2 | <2 | <2 | 2.4 | 78 |

| Sample Station | Date Sampled | Time | Conductivity | pH | Chlorophyll a | Turbidity | Alkalinity as CaCO3 mg/L | Bicarbonate as CaCo3 mg/L | Carbonate as CaCO3 mg/L | Chloride | Colour | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | uS/cm | | mg/m3 | NTU | | | | mg/L | TCU | mg/L |
| NE Margaree | 1-Dec-05 | 13:00 | 129 | 7.3 | 1.1 | 0.42 | 10 | 9.97 | 0.02 | 17 | 9.8 | 1.7 |
| NE Margaree | 1-Dec-05 | 14:00 | 128 | 7.1 | | 0.32 | | | | | | |
| NE Margaree | 14-Sep-05 | 15:00 | 131 | 7 | | 0.17 | | | | | | |
| NE Margaree | 14-Sep-05 | 14:00 | 130 | 7 | 0.4 | 0.36 | 13 | 12.98 | 0.01 | 18 | 54.3 | 7.3 |
| NE Margaree | 29-Jun-05 | 14:00 | 281 | 7.2 | | 0.18 | | | | | | |
| NE Margaree | 29-Jun-05 | 13:00 | 279 | 7.3 | 0.4 | 0.26 | 18 | 17.96 | 0.03 | 44 | 5.7 | 1.7 |
| NE Margaree | 11-May-05 | 11:00 | 105 | 7.1 | 0.3 | 0.37 | 9.9 | 9.88 | 0.01 | 15 | 16.3 | 1.9 |
| NE Margaree | 11-May-05 | 12:00 | 104 | 7.1 | | 0.25 | | | | | | |
| NE Margaree | 15-Dec-04 | 14:00 | 120 | 7.8 | | 0.17 | | | | | | |
| NE Margaree | 15-Dec-04 | 13:00 | 118 | 7.8 | 0.1 | 0.31 | 9.6 | 9.51 | 0.06 | 17 | 18 | 2.1 |
| NE Margaree | 26-Oct-04 | 13:00 | 157 | 7.2 | | 0.11 | | | | | | |
| NE Margaree | 26-Oct-04 | 12:00 | 158 | 7.2 | 0.2 | 0.18 | 14 | 13.97 | 0.02 | 22 | 17 | 2.5 |
| NE Margaree | 8-Jul-04 | 9:00 | 206 | 7.5 | | 0.13 | | | | | | |

Table III-1, continued

| Sample Station | Date Sampled | Time | Conductivity | pH | Chlorophyll a | Turbidity | Alkalinity as CaCO3 mg/L | Bicarbonate as CaCo3 mg/L | Carbonate as CaCO3 mg/L | Chloride | Colour | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | uS/cm | | mg/m3 | NTU | | | | mg/L | TCU | mg/L |
| NE Margaree | 8-Jul-04 | 8:00 | 206 | 7.7 | 0.6 | 0.27 | 18 | 17.89 | 0.08 | 30 | 12.3 | 2.9 |
| NE Margaree | 20-Nov-03 | 13:00 | 116 | 7.3 | | 0.18 | | | | | | |
| NE Margaree | 20-Nov-03 | 12:00 | 123 | 7.1 | 0.4 | 0.43 | 11 | 10.98 | 0.01 | 18 | 9 | 3.8 |
| NE Margaree | 8-Jul-03 | 13:00 | 267 | 7.3 | | 0.13 | | | | | | |
| NE Margaree | 8-Jul-03 | 12:00 | 265 | 7.4 | 0.3 | 0.13 | 18 | 17.94 | 0.04 | 42 | 6.5 | 1.6 |
| NE Margaree | 6-May-03 | 13:00 | 78 | 6.8 | | 0.37 | | | | | | |
| NE Margaree | 6-May-03 | 12:00 | 77.4 | 7.4 | 0.4 | 0.51 | 5.3 | 5.27 | 0.01 | 11 | 19 | 3.2 |
| NE Margaree | 9-Jan-03 | 12:00 | 180 | 7.4 | 0.3 | 0.12 | 12 | 12 | 0.03 | 26 | 5.3 | 1.4 |
| NE Margaree | 26-Sep-02 | 10:00 | 127 | 7.2 | | 0.19 | | | | | | |
| NE Margaree | 25-Sep-02 | 14:00 | 96.2 | 7 | | 0.26 | | | | | | |
| NE Margaree | 12-Jun-02 | 9:00 | 110 | 7.2 | | 0.21 | | | | | | |
| NE Margaree | 22-Jun-06 | | 190 | 7.4 | | 0.26 | | | | | | |
| NE Margaree | 22-Jun-06 | | 189 | 7.1 | 1.7 | 0.33 | 14 | 13.98 | 0.02 | 28 | 20.5 | 3.1 |
| | | | | | | | | | | | | |
| Shelburne River | 29-Nov-05 | 11:00 | 32.1 | 4.3 | 0.7 | 0.82 | <1 | | | 3.8 | 182 | 19.3 |
| Shelburne River | 29-Nov-05 | 12:00 | 34.8 | 4.3 | | 1.13 | | | | | | |
| Shelburne River | 3-Nov-05 | 12:00 | 37.8 | 4.3 | | 0.53 | | | | | | |
| Shelburne River | 3-Nov-05 | 11:00 | 35.9 | 4.3 | 0.5 | 0.55 | <1 | | | 3.8 | 214 | 22.1 |
| Shelburne River | 5-Jul-05 | 11:00 | 25.4 | 4.5 | 2.5 | 0.67 | <1 | | | 3.4 | 168 | 15 |
| Shelburne River | 5-Jul-05 | 12:00 | 24.3 | 4.6 | | 0.62 | | | | | | |
| Shelburne River | 27-Apr-05 | 11:00 | 28.4 | 4.5 | 0.9 | 0.84 | <1 | | | 3.9 | 110 | 11.2 |
| Shelburne River | 27-Apr-05 | 12:00 | 30 | 4.5 | | 0.64 | | | | | | |
| Shelburne River | 9-Dec-04 | 11:00 | 38 | 4.4 | 0.6 | 0.78 | <1 | | | 4.6 | 206 | 18 |
| Shelburne River | 9-Dec-04 | 10:00 | 36.1 | 4.4 | 0.5 | 0.84 | <1 | | | 4.5 | 184 | 18.2 |
| Shelburne River | 29-Sep-04 | 7:00 | 28.2 | 4.6 | 0.8 | 0.83 | <1 | | | 5 | 108 | 11.8 |
| Shelburne River | 29-Sep-04 | 8:00 | 29.6 | 4.6 | | 0.57 | | | | | | |
| Shelburne River | 6-Jul-04 | 12:00 | 29.2 | 4.6 | | 0.68 | | | | | | |
| Shelburne River | 22-Jun-04 | 10:00 | 30.7 | 4.5 | 1.7 | 0.55 | <1 | | | 4.2 | 118 | 11.1 |
| Shelburne River | 28-Nov-03 | 10:00 | 38 | 4.3 | 0.8 | 0.85 | <1 | | | 5 | 173 | 19 |
| Shelburne River | 28-Nov-03 | 11:00 | 38.5 | 4.3 | | 0.44 | | | | | | |
| Shelburne River | 29-Jul-03 | 11:00 | 27.2 | 4.7 | 1.5 | 1.1 | <1 | | | 4 | 104 | 10.1 |
| Shelburne River | 29-Jul-03 | 12:00 | 27.5 | 4.6 | | 0.97 | | | | | | |

Table III-1, continued

| Sample Station | Date Sampled | Time | Conductivity | pH | Chlorophyll a | Turbidity | Alkalinity as CaCO3 mg/L | Bicarbonate as CaCo3 mg/L | Carbonate as CaCO3 mg/L | Chloride | Colour | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | uS/cm | | mg/m3 | NTU | | | | mg/L | TCU | mg/L |
| Shelburne River | 10-Jul-03 | 13:00 | 30.1 | 4.5 | | 0.72 | | | | | | |
| Shelburne River | 10-Jul-03 | 12:00 | 29.5 | 4.6 | 1.9 | 0.93 | <1 | | | 4.2 | 127 | 12.6 |
| Shelburne River | 28-Nov-02 | 11:18 | 39.3 | 4.3 | | 0.73 | | | | | | |
| Shelburne River | 27-Nov-02 | 12:15 | 38.4 | 4.3 | | 0.62 | | | | | | |
| Shelburne River | 12-Aug-02 | 10:36 | 29.4 | 4.7 | | 0.69 | | | | | | |
| Shelburne River | 5-Jul-06 | | 27.1 | 4.5 | 3.9 | 0.55 | <1 | | | 3.9 | 226 | 20 |
| | | | | | | | | | | | | |
| Kelley River | 13-Oct-05 | 10:00 | 25.9 | 4.7 | | 0.96 | | | | | | |
| Kelley River | 13-Oct-05 | 9:00 | 26.2 | 4.7 | 0.2 | 0.98 | <1 | | | 3.4 | 133.5 | 17.9 |
| Kelley River | 21-Jun-05 | 13:00 | 21.1 | 6.2 | | 0.64 | | | | | | |
| Kelley River | 21-Jun-05 | 12:00 | 21 | 5.9 | 0.6 | 0.62 | 3.6 | 3.6 | 0 | 3.1 | 92.1 | 12.5 |
| Kelley River | 17-Dec-04 | 13:00 | 22.9 | 5.2 | 0.5 | 0.62 | 1.2 | 1.2 | 0 | 3.2 | 82 | 8.5 |
| Kelley River | 26-Aug-04 | 11:00 | 34 | 6.5 | 0.4 | 0.63 | 5.9 | 5.9 | 0 | 4.8 | 86.3 | 13.7 |
| Kelley River | 27-Jul-06 | | 22.1 | 5.1 | 1.1 | 0.55 | 1.7 | 1.7 | 0 | 3 | 173 | 20.6 |
| Kelley River | 27-Jul-06 | | 22.2 | 5.3 | | 0.68 | | | | | | |
| Kelley River | 18-May-06 | | 22.5 | 6.1 | 1.8 | 0.7 | 2.3 | 2.3 | 0 | 2.9 | 84.9 | 10.1 |
| | | | | | | | | | | | | |
| Pockwock Lake | 6-Dec-04 | 11:00 | 39.1 | 5.2 | | 0.32 | | | | | | |
| Pockwock Lake | 6-Dec-04 | 10:00 | 39.3 | 5.3 | | 0.3 | | | | | | |
| Pockwock Lake | 20-Oct-04 | 10:00 | 39.6 | 5.4 | | 0.25 | | | | | | |
| Pockwock Lake | 20-Oct-04 | 11:00 | 39.8 | 5.4 | | 0.24 | | | | | | |
| Pockwock Lake | 28-Jun-04 | 13:00 | 40 | 5.3 | | 0.27 | | | | | | |
| Pockwock Lake | 28-Jun-04 | 12:00 | 40 | 5.3 | | 0.29 | | | | | | |
| Pockwock Lake | 27-Apr-04 | 11:00 | 39.1 | 5.1 | | 0.41 | | | | | | |
| Pockwock Lake | 27-Apr-04 | 10:00 | 39.1 | 5.1 | | 0.33 | | | | | | |
| Pockwock Lake | 6-Nov-03 | 10:00 | 39.3 | 5.3 | | 0.32 | | | | | | |
| Pockwock Lake | 6-Nov-03 | 9:00 | 39.2 | 5.5 | | 0.36 | | | | | | |
| Pockwock Lake | 17-Jul-03 | 10:00 | 37.7 | 5.3 | | 0.34 | | | | | | |
| Pockwock Lake | 17-Jul-03 | 9:00 | 38 | 5.3 | | 0.34 | | | | | | |
| Pockwock Lake | 21-May-03 | 11:21 | 38.2 | 5.3 | | 0.35 | | | | | | |
| Pockwock Lake | 21-May-03 | 12:00 | 37.7 | 5.1 | | 0.3 | | | | | | |
| Pockwock Lake | 8-Nov-02 | 9:30 | 38.3 | 5.4 | | | | | | | | |

Table III-1, continued

| Sample Station | Date Sampled | Time | Conductivity | pH | Chlorophyll a | Turbidity | Alkalinity as CaCO3 mg/L | Bicarbonate as CaCo3 mg/L | Carbonate as CaCO3 mg/L | Chloride | Colour | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | uS/cm | | mg/m3 | NTU | | | | mg/L | TCU | mg/L |
| Pockwock Lake | 29-Oct-02 | 9:00 | 39.4 | 5.4 | | 0.34 | | | | | | |
| Pockwock Lake | 1-Aug-02 | 9:30 | 40.2 | 5.4 | | | | | | | | |
| Pockwock Lake | 30-Jul-02 | 10:10 | 40.1 | 5.4 | | 0.28 | | | | | | |

| Sample Station | Date Sampled | Silica | Sulfate | Total Nitrogen | Total Phosphorus | Nitrate+Nitrite | Ammonia | Ortho Phosphorus | Suspended Solids |
|---|---|---|---|---|---|---|---|---|---|
| | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| NE Margaree | 1-Dec-05 | 7.3 | 21 | 0.17 | 0.008 | 0.08 | <0.01 | <0.005 | <0.6 |
| NE Margaree | 14-Sep-05 | 6.3 | 20 | 0.17 | 0.011 | 0.03 | <0.01 | <0.005 | 1 |
| NE Margaree | 29-Jun-05 | 6.3 | 39 | 0.18 | 0.028 | 0.05 | 0.04 | <0.005 | 1.2 |
| NE Margaree | 11-May-05 | 6 | 15 | 0.08 | 0.007 | 0.03 | 0.01 | <0.005 | <0.6 |
| NE Margaree | 15-Dec-04 | 6.8 | 19 | 0.25 | 0.043 | 0.11 | <0.01 | 0.002 | <0.6 |
| NE Margaree | 26-Oct-04 | 7 | 22 | 0.14 | 0.033 | <0.01 | <0.01 | <0.001 | <1.5 |
| NE Margaree | 8-Jul-04 | 6.6 | 33 | 0.09 | 0.05 | 0.03 | 0.02 | <0.001 | <3.0 |
| NE Margaree | 20-Nov-03 | 7.6 | 16 | 0.11 | 0.037 | 0.06 | <0.01 | <0.001 | 1.5 |
| NE Margaree | 8-Jul-03 | 7.3 | 39 | 0.11 | 0.012 | 0.04 | <0.01 | <0.001 | 1.7 |
| NE Margaree | 6-May-03 | 4.7 | 13 | 0.08 | 0.009 | 0.03 | <0.01 | <0.001 | 1.4 |
| NE Margaree | 9-Jan-03 | 5 | 25 | 0.28 | 0.013 | 0.11 | <0.01 | <0.001 | <1.5 |
| NE Margaree | 22-Jun-06 | 6.6 | 25 | 0.14 | <0.005 | 0.05 | 0.02 | <0.005 | 1.2 |
| | | | | | | | | | |
| Shelburne River | 29-Nov-05 | 4.1 | <5 | 0.31 | 0.01 | 0.01 | 0.02 | <0.005 | 1 |
| Shelburne River | 3-Nov-05 | 4.2 | <2 | 0.39 | 0.01 | <0.01 | 0.02 | <0.005 | 1 |
| Shelburne River | 5-Jul-05 | 2 | <2 | 0.29 | 0.036 | <0.01 | 0.03 | <0.005 | 1.4 |
| Shelburne River | 27-Apr-05 | 3 | <2 | 0.2 | 0.019 | 0.01 | 0.02 | <0.005 | <0.6 |
| Shelburne River | 9-Dec-04 | 3.7 | <1 | 0.26 | 0.011 | <0.01 | 0.02 | 0.019 | <1.2 |
| Shelburne River | 9-Dec-04 | 3.7 | <1 | 0.27 | 0.017 | <0.01 | 0.02 | 0.019 | 1.6 |
| Shelburne River | 29-Sep-04 | 1.7 | <1 | 0.32 | 0.023 | <0.01 | 0.02 | <0.001 | 1.2 |
| Shelburne River | 22-Jun-04 | 1.7 | <1 | 0.26 | 0.025 | <0.01 | 0.01 | <0.001 | 2.4 |
| Shelburne River | 28-Nov-03 | 5.1 | <2 | 0.37 | 0.03 | 0.01 | 0.02 | <0.001 | <1.5 |

Table III-1, continued

| Sample Station | Date Sampled | Silica | Sulfate | Total Nitrogen | Total Phosphorus | Nitrate+Nitrite | Ammonia | Ortho Phosphorus | Suspended Solids |
|---|---|---|---|---|---|---|---|---|---|
| | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| Shelburne River | 29-Jul-03 | 0.8 | <2 | 0.25 | 0.024 | <0.01 | <0.01 | <0.001 | 1.6 |
| Shelburne River | 10-Jul-03 | 1.6 | <2 | 0.25 | 0.011 | 0.01 | <0.01 | <0.001 | <1 |
| Shelburne River | 5-Jul-06 | 3.1 | <5 | 0.34 | 0.007 | <0.01 | 0.03 | <0.005 | 2 |
| | | | | | | | | | |
| Kelley River | 13-Oct-05 | 2.7 | <2 | 0.3 | 0.012 | <0.01 | 0.02 | <0.005 | <0.6 |
| Kelley River | 21-Jun-05 | 2.7 | <2 | 0.23 | 0.02 | <0.01 | 0.02 | <0.005 | <0.6 |
| Kelley River | 17-Dec-04 | 3.3 | <1 | 0.17 | 0.032 | 0.04 | 0.01 | 0.007 | 0.8 |
| Kelley River | 26-Aug-04 | 3.1 | <1 | 0.39 | 0.036 | <0.01 | 0.03 | <0.001 | <1.5 |
| Kelley River | 27-Jul-06 | 3.4 | <5 | 0.28 | 0.01 | <0.01 | 0.02 | <0.005 | 1.2 |
| Kelley River | 18-May-06 | 2.2 | <5 | 0.24 | 0.006 | <0.01 | <0.01 | <0.005 | 0.8 |

## APPENDIX IV – LAND USE
## DETAILED BREAKDOWN OF LAND USE CATEGORIES

Table IV-1. Pockwock Lake Watershed land classification conditions.

| POCKWOCK WATERSHED LAND CLASSIFICATION CONDITIONS | | | | | |
|---|---|---|---|---|---|
| For/Non Description | Grouping | Area (km) | % of Group | % of Watershed | Group % of Watershed |
| Agriculture | Agriculture | 0.00 | 100.00 | 0.01 | 0.0 |
| Rock barren-<49%exposed rock>25%live tree cvr | Barren | 0.16 | 49.70 | 0.29 | 0.6 |
| Barren-<25%live tree cvr >50%rock/woody plants | Barren | 0.04 | 11.84 | 0.07 | |
| Gravel pit-activer/non used extract gravel | Barren | 0.12 | 38.47 | 0.22 | |
| Clear Cut-<25%residuals in crn closure | Clearcut | 6.89 | 98.83 | 12.77 | 12.9 |
| Partial depletion not verified | Clearcut | 0.08 | 1.17 | 0.15 | |
| Natural Forest Stand (not treated silviculturally) | Forest | 32.53 | 99.44 | 60.28 | 60.6 |
| Treated Forest Stand (treatment not classified) | Forest | 0.09 | 0.27 | 0.16 | |
| Dead-stand w<25%crn close live material | Forest | 0.09 | 0.27 | 0.17 | |
| Treated stand-silvicult treat identif | Forest | 0.00 | 0.01 | 0.01 | |
| Urban | Urban | 0.68 | 46.00 | 1.25 | 2.7 |
| Misc-nonforested misc (eg. old mill, rifle range) | Urban | 0.04 | 2.62 | 0.07 | |
| Powerline corridor | Urban | 0.22 | 14.98 | 0.41 | |
| Road Corridor | Urban | 0.54 | 36.41 | 0.99 | |
| Wetlands general-wet not lake/river/stream/bog | Wetland/Water | 0.73 | 5.85 | 1.35 | 23.1 |
| Open bogs-mostly ericaceous plnts<25%live tree | Wetland/Water | 0.48 | 3.82 | 0.88 | |
| Treed bogs-mostly ericaceous>25%stunt tree | Wetland/Water | 0.54 | 4.34 | 1.00 | |
| Lake wetland-wetland in freshwater | Wetland/Water | 0.09 | 0.70 | 0.16 | |
| Inland water-lks, rivers, reservoirs, canal, pond | Wetland/Water | 10.65 | 85.29 | 19.74 | |
| Totals: | | 53.97 | | 100.00 | 100.0 |

Table IV-2. North East Margaree River Watershed land classification conditions.

| NORTH EAST MARGAREE RIVER WATERSHED LAND CLASSIFICATION CONDITIONS | | | | | |
|---|---|---|---|---|---|
| For/Non Description | Grouping | Area (km) | % of Group | % of Watershed | Group % of Watershed |
| Agriculture | Agriculture | 2.8 | 100.0 | 0.8 | 0.8 |
| Rock barren-<49%exposed rock>25%live tree cvr | Barren | 0.0 | 0.4 | 0.0 | 2.6 |
| Barren-<25%live tree cvr >50%rock/woody plants | Barren | 9.4 | 98.0 | 2.6 | |
| Gravel pit-activer/non used extract gravel | Barren | 0.2 | 1.6 | 0.0 | |
| Clear Cut-<25%residuals in crn closure | Clearcut | 0.8 | 99.8 | 0.2 | 0.2 |
| Partial depletion not verified | Clearcut | 0.0 | 0.2 | 0.0 | |
| Natural Forest Stand (not treated silviculturally) | Forested | 239.3 | 74.1 | 65.3 | 88.1 |
| Treated Forest Stand (treatment not classified) | Forested | 29.5 | 9.1 | 8.0 | |
| Old field-<25% crn close and <1m height tree | Forested | 0.5 | 0.2 | 0.1 | |
| Dead-stand w<25%crn close live material | Forested | 1.2 | 0.4 | 0.3 | |
| Dead-1-stand w 25-50% crn close live material | Forested | 1.7 | 0.5 | 0.5 | |
| Dead-2-stand w51-100% crn close live mat. | Forested | 0.5 | 0.1 | 0.1 | |
| Treated stand-silvicult treat identif | Forested | 25.3 | 7.8 | 6.9 | |
| Dead-3-26-50%crn close/equiv dead mat | Forested | 0.9 | 0.3 | 0.2 | |
| Dead-4-51-75% crn close/equiv dead mat | Forested | 0.2 | 0.1 | 0.1 | |
| Plantation | Forested | 18.9 | 5.9 | 5.2 | |
| Brush-<25%merch.tree cov>24%woody plants | Forested | 2.4 | 0.7 | 0.7 | |
| Alders <75% cover | Forested | 1.5 | 0.5 | 0.4 | |
| Alders >75% cover | Forested | 1.0 | 0.3 | 0.3 | |
| Urban | Urban | 0.9 | 81.3 | 0.3 | 0.3 |
| Misc-nonforested misc (eg. old mill, rifle range) | Urban | 0.0 | 3.1 | 0.0 | |
| Road Corridor | Urban | 0.2 | 15.5 | 0.0 | |
| Wetlands general-wet not lake/river/stream/bog | Wetland/Water | 5.3 | 18.1 | 1.4 | 8.0 |
| Beaver flowage | Wetland/Water | 1.1 | 3.9 | 0.3 | |
| Open bogs-mostly ericaceous plants<25%live tree | Wetland/Water | 10.3 | 35.0 | 2.8 | |
| Treed bogs-mostly ericaceous>25%stunt tree | Wetland/Water | 11.2 | 38.0 | 3.0 | |
| Lake wetland-wetland in freshwater | Wetland/Water | 0.0 | 0.2 | 0.0 | |
| Inland water-lks, rivers, reservoirs, canal, pond | Wetland/Water | 1.4 | 4.8 | 0.4 | |
| Totals: | | 366.7 | 100.0 | 100.0 | 100.0 |

Table IV-3. Shelburne River Watershed land classification conditions.

| SHELBURNE RIVER WATERSHED LAND CLASSIFICATION CONDITIONS | | | | | |
|---|---|---|---|---|---|
| For/Non Description | Grouping | Area (km) | % of Group | % of Watershed | Group % of Watershed |
| Rock barren-<49%exposed rock>25%live tree cvr | Barren | 1.13 | 7.09 | 0.42 | 5.92 |
| Barren-<25%live tree cvr >50%rock/woody plants | Barren | 14.70 | 92.58 | 5.48 | 5.92 |
| Gravel pit-activer/non used extract gravel | Barren | 0.05 | 0.33 | 0.02 | 5.92 |
| Clear Cut-<25%residuals in crn closure | Clearcut | 0.80 | 76.48 | 0.30 | 0.39 |
| Partial depletion verified-cut hrdwd resid>24%crn | Clearcut | 0.25 | 23.52 | 0.09 | 0.39 |
| Natural Forest Stand (not treated silviculturally) | Forest | 200.78 | 99.25 | 74.83 | 75.40 |
| Treated Forest Stand (treatment not classified) | Forest | 0.28 | 0.14 | 0.11 | 75.40 |
| Dead-1-stand w 25-50% crn close live material | Forest | 0.05 | 0.03 | 0.02 | 75.40 |
| Brush-<25%merch.tree cov>24%woody plants | Forest | 1.19 | 0.59 | 0.44 | 75.40 |
| Brush-<25%merch.tree cov>24%woody plants | Forest | 0.00 | 0.00 | 0.00 | 75.40 |
| Misc-nonforested misc (eg. old mill, rifle range) | Urban | 0.66 | 100.00 | 0.25 | 0.25 |
| Wetlands general-wet not lake/river/stream/bog | Wetland/Water | 13.59 | 28.08 | 5.07 | 18.04 |
| Beaver flowage | Wetland/Water | 0.39 | 0.81 | 0.15 | 18.04 |
| Open bogs-mostly ericaceous plnts<25%live tree | Wetland/Water | 3.90 | 8.06 | 1.45 | 18.04 |
| Treed bogs-mostly ericaceous>25%stunt tree | Wetland/Water | 3.94 | 8.14 | 1.47 | 18.04 |
| Lake wetland-wetland in freshwater | Wetland/Water | 0.11 | 0.24 | 0.04 | 18.04 |
| Inland water-lks, rivers, reservoirs, canal, pond | Wetland/Water | 26.47 | 54.67 | 9.87 | 18.04 |
| Totals: | | 268.30 | | 100.00 | 100.00 |

Table IV-4. Kelley River Watershed land classification conditions.

| KELLEY RIVER WATERSHED LAND CLASSIFICATION CONDITIONS | | | | | |
|---|---|---|---|---|---|
| For/Non Description | Grouping | Area (km) | % of Group | % of Watershed | Group % of Watershed |
| Blueberries | Agriculture | 0.04 | 100 | 0.1 | 0.1 |
| Barren-<25%live tree cvr >50%rock/woody plants | Barren | 0.11 | 86.3 | 0.2 | 0.2 |
| Gravel pit-activer/non used extract gravel | Barren | 0.02 | 13.7 | 0.0 | |
| Clear Cut-<25%residuals in crn closure | Clearcut | 4.32 | 100.0 | 6.7 | 6.7 |
| Natural Forest Stand (not treated silviculturally) | Forest | 32.49 | 62.7 | 50.3 | 80.3 |
| Treated Forest Stand (treatment not classified) | Forest | 1.13 | 2.2 | 1.8 | |
| Dead-stand w<25%crn close live material | Forest | 5.05 | 9.7 | 7.8 | |
| Dead-1-stand w 25-50% crn close live material | Forest | 6.34 | 12.2 | 9.8 | |
| Dead-2-stand w51-100% crn close live mat. | Forest | 3.56 | 6.9 | 5.5 | |
| Plantation | Forest | 2.79 | 5.4 | 4.3 | |
| Brush-<25%merch.tree cov>24%woody plants | Forest | 0.33 | 0.6 | 0.5 | |
| Alders<75%cover | Forest | 0.13 | 0.3 | 0.2 | |
| Misc-nonforested misc (eg. old mill, rifle range) | Urban | 0.03 | 3.9 | 0.0 | 1.3 |
| Road Corridor | Urban | 0.78 | 96.1 | 1.2 | |
| Wetlands general-wet not lake/river/stream/bog | Wetland/Water | 2.93 | 39.5 | 4.5 | 11.5 |
| Beaver flowage | Wetland/Water | 0.10 | 1.4 | 0.2 | |
| Open bogs-mostly ericaceous plnts<25%live tree | Wetland/Water | 3.03 | 40.9 | 4.7 | |
| Treed bogs-mostly ericaceous>25%stunt tree | Wetland/Water | 1.22 | 16.5 | 1.9 | |
| Inland water-lks, rivers, reservoirs, canal, pond | Wetland/Water | 0.13 | 1.7 | 0.2 | |
| | Totals: | 64.54 | | 100.0 | 100.0 |

## APPENDIX V – EQUIPMENT, DEPLOYMENT, MAINTENANCE, AND CHEMICAL STANDARD SOLUTIONS

### EQUIPMENT

Data sondes used in the water quality monitoring network were manufactured by Hydrolab® and purchased through Campbell Scientific Ltd. from which instrument specifications are available. The following contact information is provided:

Campbell Scientific Canada Corp.
11564 - 149 Street NW
Edmonton, AB
Canada T5M 1W7

Phone 780-454-2505
Fax 780-454-2655
E-Mail David.Allan@campbellsci.ca
General E-Mail dataloggers@campbellsci.ca
Web Site http://www.campbellsci.ca

### DEPLOYMENT, AND MAINTENANCE

Deployment and maintenance documentation was provided by Mr. Dave Allan, Water Quality Specialist, Campbell Scientific Ltd. (see contact information above).

# REMOTE AND REAL-TIME DEPLOYMENT

## Shore Deployments

Figures 1 and 2 illustrate the structure and configuration presently used to deploy either real time or remote water quality instruments from shore. Many sites in southern Alberta and British Columbia use this type of deployment due to limited access and variable water level. The Datasonde or Minisonde is placed in the downstream end of a 3 to 6 meter length of 10 cm PVC pipe that has 1.5-meter of one end slotted. This pipe is oriented downstream such that water is able to pass through the slotted end and past the

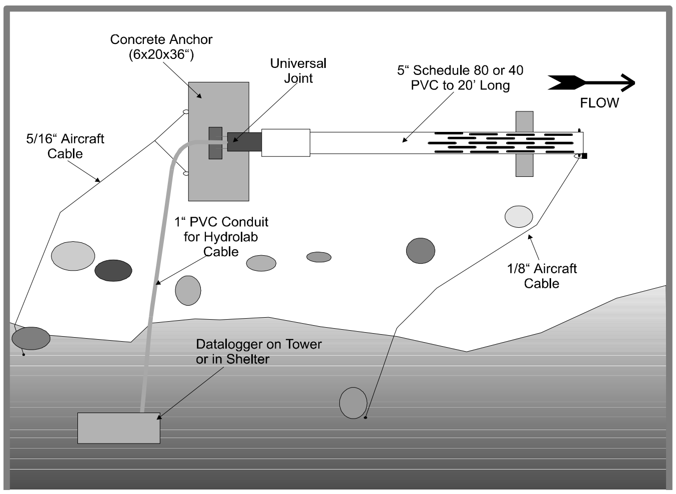


**Figure 1**

sensors. The pipe is connected by a heavy duty coupling to a universal joint that allows the pipe to swivel in any direction. This allows the field crew to easily raise and turn the pipe towards shore for inspection and to change instruments.

The pipe and universal joint are bolted directly to a large concrete anchor weighing approximately 70 kg. If high flows are expected any number of additional anchors can be attached along with a heavy aircraft cable to shore. This cable will also facilitate the removal of the structure at the end of the season. A length of light

**Figure 2**

aircraft cable is attached at the downstream end of the pipe
and runs to shore to aid the field crew in the pipe retrieval. This cable is locked to a large pin that passes through the end of the pipe and prevents the unauthorised removal of the instrument. A concrete curb or rock is placed on the bottom under the slotted end of the pipe to hold the pipe above the river bottom substrate and prevent it from becoming clogged with silt. The greatest advantage with this structure is its entirely submerged and any floating material passes over it without incident.

A second method used on small streams, shown in Figures 3 and 4, is to attach the slotted pipe to a 2x12 pressure treated board, which is

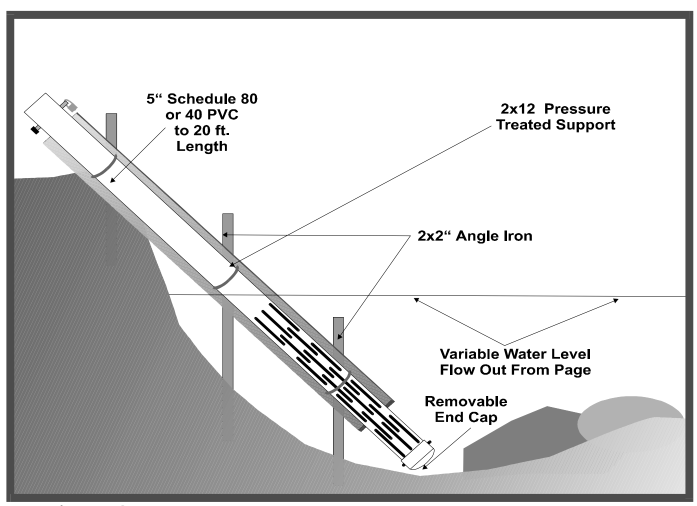


**Figure 3**

Figure 4

then bolted to stakes driven into the bank. The pipe and 2x12 are angled down into the water at about 45° and the Datasonde or Minisonde is loaded in from the top and slides down the pipe into place at the slotted end. The cables run up the pipe and into conduit at the top and then to the shelter housing the datalogger. The end cap is removable so that sand, silt and any build up of debris can be cleaned out.

### Bridge Deployment

The following figures (5 & 6) illustrate the deployment of a Hydrolab Datasonde or Minisonde from a bridge. The instrument is placed inside a PVC pipe 3 to 6 meters in length that has been slotted at one end. The slots allow water to freely pass through the pipe and past the sensors. The pipe is attached to the bridge pier with two heavy timbers (2x12 or larger) usually near the center of the river. The slotted end with removable cap is placed slightly above the river bottom but can be raised or lowered depending on the water level at the time. The pipe should be suspended behind the pier for protection as in Figure 6 or it may become snagged on floating debris. The advantage is mainly the ease of access. The following is a photo from the Salmon River in BC where this type of deployment is presently being used.

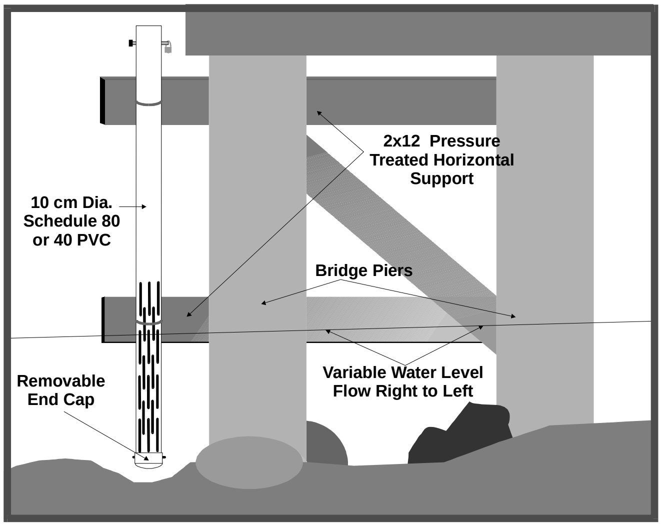


Figure 5

Figure 6

Methods of deployment can be complex but the theme is the same for all. The instrument must be protected, the information must represent the true conditions in the river and the field crews must be able to recover the instrument at any time with a minimum of effort. It is vital that field crews are skilled, trained and safety oriented. This is potentially dangerous work, with many hazards.

# GENERAL MAINTENANCE

## Background

Although individual Datasonde 4a's (DS4a) or Minisondes4a (MS4a) can be configured in a multitude of ways, the sonde itself will need to be cleaned and serviced on occasion. Great care needs to taken here, in that any damage to the sonde, housing or O-ring seals will have a catastrophic effect on the entire unit. It is preferable, and in some cases you will be required, to maintain a log of all the repairs, maintenance and calibration that is done on each unit. This log can take any form that is convenient to you but should include the unit serial number, date, who serviced the equipment and what was done.

## Equipment

- DS or MS4a calibration cup.
- Distilled water, methanol, cotton swabs and silicone grease.
- Table clamp or lab chain clamp to hold the sonde inverted and vertical.
- Hydrolab's Basic Maintenance Kit for DS or MS4a including small Allen wrenches and Philips screwdriver.
- Duct tape (the wider the better).
- Scrub pads and cleanser (lab grade Sparkleen works great).
- Soft bristle scrub brush or old toothbrush.

## Maintenance

The sonde, circulator and individual probes should be maintained on a regular basis (at least monthly during daily use) or prior to and after any long-term deployment.

1. If the sonde is covered with sediment, algae and other biological growth when it is recovered, try to clean as much off right away so it doesn't bake on while it is in the back of your truck.

2. After returning to your lab remove the duct tape (if you have used it to help keep the sonde clean) and with the scrub pads and Sparkleen get all the caked on sediment algae and other material off as best you can. You may need to let the whole thing soak in a sink of warm water and Sparkleen overnight to soften the gunk up and try scrubbing again the next day.

3. Use the toothbrush or other small nylon brush to gently remove sediment, algae, bugs, and any other debris around the sensors. It is important <u>not</u> to use soaps or solvents if any of the ion sensors are installed ($NH_4$ , Chloride & Nitrate).

4. On DS & MS4a's, remove the circulator's impeller and clean and remove any debris that may be wrapped around it. In some areas pyrite or other iron based materials can accumulate around the magnet of the circulator and in time can interfere with it's function and even cause premature wearing of the surfaces.

5. On H20's & DS3's, remove the circulator's impeller and clean and remove any debris that

may be wrapped around it. Put a very small amount of silicone grease on the impeller post.

6. Every other year or so the O-rings and internal memory battery in the sonde need to be checked. Great care is needed to open the sonde and if you are unsure check with Campbell Scientific (Canada) Corp. for assistance.

7. Check the pair of O-rings for any wear spots, tears or deterioration and replace as required. Thoroughly clean both the bulkhead and the inside of the tube and lightly grease the O rings with silicone.

8. Check the internal lithium battery in the DS or MS4a to ensure it is still at or above 3 volts DC. If not replace the battery. With DS3's the lithium battery is soldered to the CPU board and may need to be returned to CSCC for replacement. H20's and DS3's could have a pair of 3-volt lithium batteries installed to power the Dissolved Oxygen probe. Check to ensure they are still above 2.75 volts and replace if required. Replace the desiccant packets and carefully put the sonde back together.

9. With the sonde back together and the set screws in place tape the outside of the sonde at the O rings with the wide duct tape to help to keep sediment and debris out of there. If the sonde is to be out for long periods (especially in warm productive water) you can duct tape the whole thing to make cleaning easier next time (don't tape the storage cup).

### Cautions & Problems

Maintenance of the sonde and probes should become second nature. In other words too much maintenance is better than not enough. The amount or frequency of maintenance is directly related to the overall quality of data you will collect. On long term deployments if you are only able to get to the site to service the unit every 6 weeks, you may have to be satisfied with broader data acceptance criteria, especially towards the end of the deployment period. If you visit the site every other week you can expect to have the best data possible.

If the sample site has been chosen well, maintenance problems could be minimised but will not likely be eliminated. When choosing a site, especially for long term deployment look for sufficient flow without turbulence, depth without direct sunlight

Under certain conditions it may be advisable to make a mesh screen to protect the sensors from debris, slush, macrophytes, algae, bubbles and even sunlight. Screens as in the figure below can be easily made from Nitex mesh, window screening, shade cloth or any available mesh material that will let water pass through but help to keep the other junk out.

## CHEMICAL STANDARD SOLUTIONS

As mentioned in an earlier section, Hydrolab and Quanta P sensors are routinely calibrated to guarantee the best possible the accuracy of data being gathered. pH, conductivity and turbidity sensors are calibrated using commercially manufactured liquid calibration standards as specified below.

***pH*** **–** HACH buffer solutions pH 7.00 (Cat.# 22835-56) and 4.01 (Cat.# 22834-56) available from Atlantic Purification Systems Ltd., Dartmouth, Nova Scotia.

***Conductivity*** **–** Ricca Chemical Company Conductivity/TDS standards - 100 umhos/cm (Cat.# 2237-1) and 500 umhos/cm (Cat.# 2241-1).

***Turbidity*** **–** AMCO Clear Turbidity standards 50NTU (HACH Cat.# 013710HY) and 100 NTU (HACH Cat.# 013720HY) available from Campbell Scientific Limited.

***Dissolved Oxygen*** **–** calibrated using air saturation method.