Baseline Water Quality Survey of the Annapolis, Cornwallis and Habitant River Watersheds

Prepared for
Nova Scotia Environment

by

M. Brylinsky
Acadia Center for Estuarine Research
Acadia University
Wolfville Nova Scotia

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SUMMARY

For a number of reasons there is currently a growing interest among mink farmers to expand their operations into the Annapolis Valley region of Nova Scotia. Owing to the impacts this activity has had on water quality in other regions of Nova Scotia, Nova Scotia Environment commissioned a water quality survey of streams within the major watersheds of the Annapolis Valley to define current conditions and to provide a basis for subsequent assessment if needed in future. The primary objective of the survey was to establish a database on baseline water quality conditions within the major watersheds of the Annapolis Valley using a suite of water quality parameters most likely to be influenced by mink farming operations.

The watersheds selected for the survey included those associated with the Annapolis, Cornwallis and Habitant Rivers. The parameters selected included conductivity, alkalinity, pH, water colour, total phosphorus, ortho-phosphorus, total nitrogen, nitrite+nitrate, ammonia, dissolved oxygen, percent dissolved oxygen saturation, water temperature and fecal coliform numbers. Estimates of daily nutrient loadings for nitrogen and phosphorus were also made.

The data collected was evaluated using guidelines established by the Canadian Council of Ministers of Environment for the Protection of Freshwater Aquatic Life and Protection of Agriculture Water Use, Health Canada guidelines for recreational water use and Environment Canada nutrient guidelines for the prevention of nutrient over-enrichment.

The results of the survey indicate that all three watersheds currently exhibit characteristics that indicate water quality within these watersheds to be impacted to some degree. In particular, nutrient levels and fecal coliform bacteria numbers are high. The most likely cause of the current degradation in water quality is the high level of agricultural activity present within all three of the watersheds surveyed.

Table of Contents

List of Figures

Page

List of Tables

Baseline Water Quality Survey of the Annapolis, Cornwallis and Habitant River Watersheds

1. Background

Mink farming operations within the Carleton River watershed in southwestern Nova Scotia have been implicated as the major cause of serious degradation of water quality in a number of lakes as a result of nutrient over-enrichment by mink farm runoff (Brylinsky 2011). This has led to the development and implementation of mink farming regulations by the Nova Scotia Department of Agriculture (NSDA) designed to reduce the impacts of mink farming activities on water quality.

For a number of reasons, partly related to problems associated with the presence of Aleutian disease in the southwestern Nova Scotia area, as well as concern as to whether some of the older existing mink farms will be able to meet the new NSDA regulations, there is interest among mink farmers in establishing new operations within the Annapolis Valley. As a result, to facilitate any further assessment as may be needed in future to ensure water quality protection and effectiveness of current regulations, Nova Scotia Environment (NSE) commissioned a survey of current baseline water quality conditions within areas of the Annapolis Valley where new mink farming operations would most likely be established

2. Approach

Although there are five secondary watersheds located within the Annapolis Valley, limitations on the resources available constrained the surveys primarily to the non-tidal portions of the Annapolis, Cornwallis, and Habitant River watersheds. Surveys were not carried out within the watersheds of the Pereaux and Canard Rivers, both of which are relatively small. In order to maximize the watershed area covered by the surveys, water quality samples were collected, when possible, at the mouths of tributaries (i.e., tertiary watersheds) entering the main river of each watershed. In some cases this was not possible because of the difficulty of accessing the tributary at its mouth. In those instances water samples were collected as close to the mouth of the tributary as possible.

In addition to the samples collected at the mouth of the tertiary watershed tributaries, water quality samples were also collected within the main river of the Annapolis and Cornwallis watersheds at a number of river sites easily accessed by overhead roadways.[1]

Surveys of water quality within areas of existing mink farms were also carried out using the same procedures and survey parameters as those used for the tributary sites. The water

[1] This was not done for the Habitant watershed due to the difficulty of accessing most of the main river as a result of the limited number of roadways crossing the river.

samples were collected at one or more locations from nearby watercourses considered most likely to receive any run-off from existing mink farm activities.
Evaluations of water quality were based, when possible, on the Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life and Protection of Agriculture Water Use developed by the Canadian Council of Ministers of the Environment (CCME 2013), Health Canada guidelines for recreational water use (Health Canada 2010) and Environment Canada guidelines to prevent eutrophication of streams located within agricultural areas of Canada (Chambers *et. al*. 2012).

3. Methodologies

The water quality parameters measured at each tributary included conductivity, alkalinity, pH, water colour, total phosphorus, ortho-phosphorus, total nitrogen, nitrite+nitrate, ammonia, dissolved oxygen, percent dissolved oxygen saturation, water temperature and fecal coliform (*E. coli*). Numbers. Estimates of daily nutrient loadings for nitrogen and phosphorus at each tributary were also made based on measurements of current velocities, tributary cross section areas and nutrient concentrations at the time of sample collections. Water samples collected at the mouths of tributaries were taken far enough above where they entered the river to ensure they did not also contain main river water. Measurements of water temperature and dissolved oxygen concentration were made using a YSI Model 55 Dissolved Oxygen Meter. Mean current velocities were determined using a Global Flow Model FP101 probe. Cross sectional areas of tributaries were determined based on estimates of average water depth and width.

All samples collected for chemical analyses were sent to the Environmental Services Laboratory of the QE II Health Science Centre within 24 hrs of collection. Samples collected for fecal coliform (*E. coli*) numbers were delivered to the Annapolis Valley Regional Hospital Laboratory on the same day as collected.

Of the 12 water quality parameters surveyed, four (pH, dissolved oxygen, nitrate, and ammonia) have guidelines for the Protection of Freshwater Aquatic Life established by the Canadian Council of Ministers of the Environment (CCME). These are as follows:

pH - 6.5 to 9.0

Dissolved oxygen – The lowest acceptable concentration depends of the life stage and species:
Warm water biota – early life stages - 6.0 mg/L
Warm water biota – other life stages - 5.5 mg/L
Cold water biota – early life stages - 9.5 mg/L
Cold water biota – other life stages - 6.5mg/L

Nitrate - 3.0 mg NO_3-N/L for long term exposure and 124 mg NO_3-N/L for short term exposure

Ammonia – The value of this guideline depends on water temperature and pH, an increase in either resulting in lower guideline values. Since there was a wide variation in both parameters for the surveyed sites, it is not possible to stipulate a single guideline value for this parameter.

The CCME table providing the upper guideline limit for ammonia, as mg/L NH_3, for different temperature and pH values, is as follows[2]:

Temp. (°C)	pH							
	6.0	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**10.0**
0	231	73.0	23.1	7.32	2.33	0.749	0.25	0.042
5	153	48.3	15.3	4.84	1.54	0.502	0.172	0.034
10	102	32.4	10.3	3.26	1.04	0.343	0.121	0.029
15	69.7	22.0	6.98	2.22	0.715	0.239	0.089	0.026
20	48.0	15.2	4.82	1.54	0.499	0.171	0.067	0.024
25	33.5	10.6	3.37	1.08	0.354	0.125	0.053	0.022
30	23.7	7.50	2.39	0.767	0.256	0.094	0.043	0.021

There are also CCME guidelines of 100 mg/L nitrite+nitrate-N for livestock drinking water and 100/100 ml for fecal coliform numbers for the use of agricultural water for irrigation. In addition, Health Canada has established a fecal coliform guideline, based on a single sample, of 400/100 ml for recreational use involving body contact[3].

The guidelines for total nitrogen and total phosphorus developed by Environment Canada to prevent eutrophication of streams located within agricultural areas of Canada vary within different ecoregions of Canada and, although none have been developed for Nova Scotia due to the lack of baseline information, there are guidelines for Prince Edward Island which has a similar topology (low profile, slow moving rivers) and geology (mainly sandy soils) to Annapolis Valley rivers. The value of these guidelines for total nitrogen and total phosphorus are 1.21 and 0.032 mg/L, respectively.

4. Results

The surveys were carried out between 4 September and 13 October 2013. A table listing the complete database of results for each sample location within each watershed is contained in Appendix I. Appendix II contains a series of maps showing the location of each water quality sample site and Appendix III lists the tertiary watersheds sampled in each watershed. In the following section the results of the surveys are summarized graphically as a series of bar graphs which show the value of each water quality parameter within each tributary. For each bar graph, the order of the data from left to right represents the location of the tributary from headwaters to downstream, respectively. In addition, the location of the tributary with respect to its discharge into the north or south side of the river is denoted by the colour of the bar, blue representing tributaries located on the north side of the river and green representing tributaries located on the south side of the river. The bar graphs also contain information as to whether or not a particular value exceeds the CCME, Health Canada or Environment Canada guidelines

[2] Note: The CCME guidelines for ammonia are in mg/L NH_3, whereas the values reported by the QEII laboratory and used in the database and bar graphs are mg/L Ammonia-N. To convert the CCME values to mg/L Ammonia –N, multiply by 0.82.
[3] For multiple samples there is an alternative guideline of 200 /100ml for the geometric mean concentration (based on a minimum of five samples).

described in Section 3 above. The limit(s) of each guideline are shown as dashed lines on the relevant bar graphs.

4.1 Annapolis River Watershed

The Annapolis River watershed is the largest of the three watersheds surveyed. Its main river originates within Caribou Bog west of Berwick and flows westward where it discharges into the Annapolis Basin. Its total area is 158,233.5 hectares and contains 90 tertiary watersheds ranging in size from 6.9 to 29,458.5 hectares. Of the 90 tertiary watersheds, water quality samples were collected from 33 tributaries which collectively represent an area of 136,279.2 hectares (86.2%) of the total watershed area. The remaining watershed areas are either located within the tidal portion of the river or within small watersheds which contain about 10.7 and 3.2 % of the total watershed area, respectively.

4.1.1 Tributaries

4.1.1.1 Conductivity, Alkalinity and pH

The levels of conductivity and alkalinity varied greatly among the tributaries sampled (Fig 4.1). These parameters do not appear to vary with respect to distance from the headwaters of the river. Tributaries flowing from the north side of the river, however, tended to have lower values than tributaries flowing from the south side of the river, this difference being most likely related to differences in geology within the watersheds on either side of the river.

The levels of pH varied from a low of 5.2 to a high of 8.2. Of the 33 tributaries sampled, only one (3M – Daniels Brook – pH of 5.2) had a pH value that was significantly outside of the range of the CCME guidelines for the Protection of Freshwater Aquatic Life.

4.1.1.2 Nutrients

All forms of nitrogen (Fig 4.2) showed similar trends in spatial variation among the tributaries. The highest values generally occurred within tributaries located in the upper area of the river's watershed. This was especially true of nitrite+nitrate levels which were often below the limit of detection within the lower half of the river. There was also a general trend for tributaries on the south side of the river to have higher values than those on the north, most likely a result of the greater degree of agricultural land use on the south side of the river. Nitrate levels, however, never exceeded the CCME long-term guideline of 3.0 mg NO_3-N/L for the Protection of Freshwater Aquatic Life. The ratio of inorganic nitrogen to total nitrogen was often high, in some case more than 0.5 which suggests that most of the nitrogen present originates from commercial inorganic agricultural fertilizers, sewage treatment plants or faulty septic systems.

One particularly high value of 0.26 mg/L ammonia-N was found in tributary 3WWW (Oak Hollow Brook). Water temperature and pH at the time of collection were 16.6 and 8.0 respectively. The CCME guideline for ammonia at these values is about 0.7 mg/L ammonia, which is well above the level measured, and it is unlikely that any of the ammonia levels observed at any of the other tributaries are above the CCME guidelines.

The Environment Canada guideline of 1.21 mg/L for total nitrogen was exceeded at six (18%) sites.

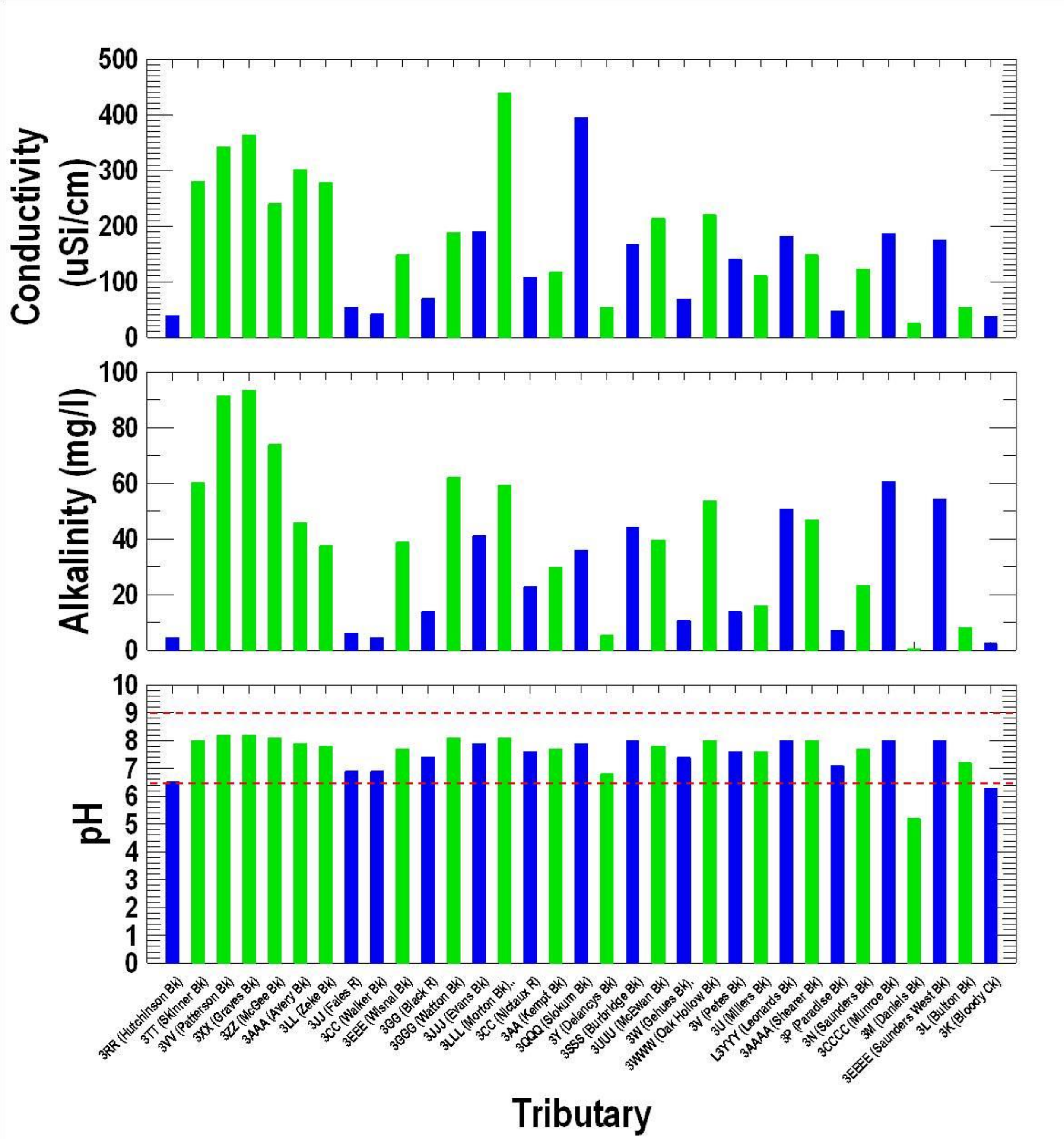

Fig. 4.1. Levels of conductivity, alkalinity and pH in Annapolis watershed tributaries (red dashed lines indicate upper and lower CCME limits of pH for protection of freshwater aquatic life).

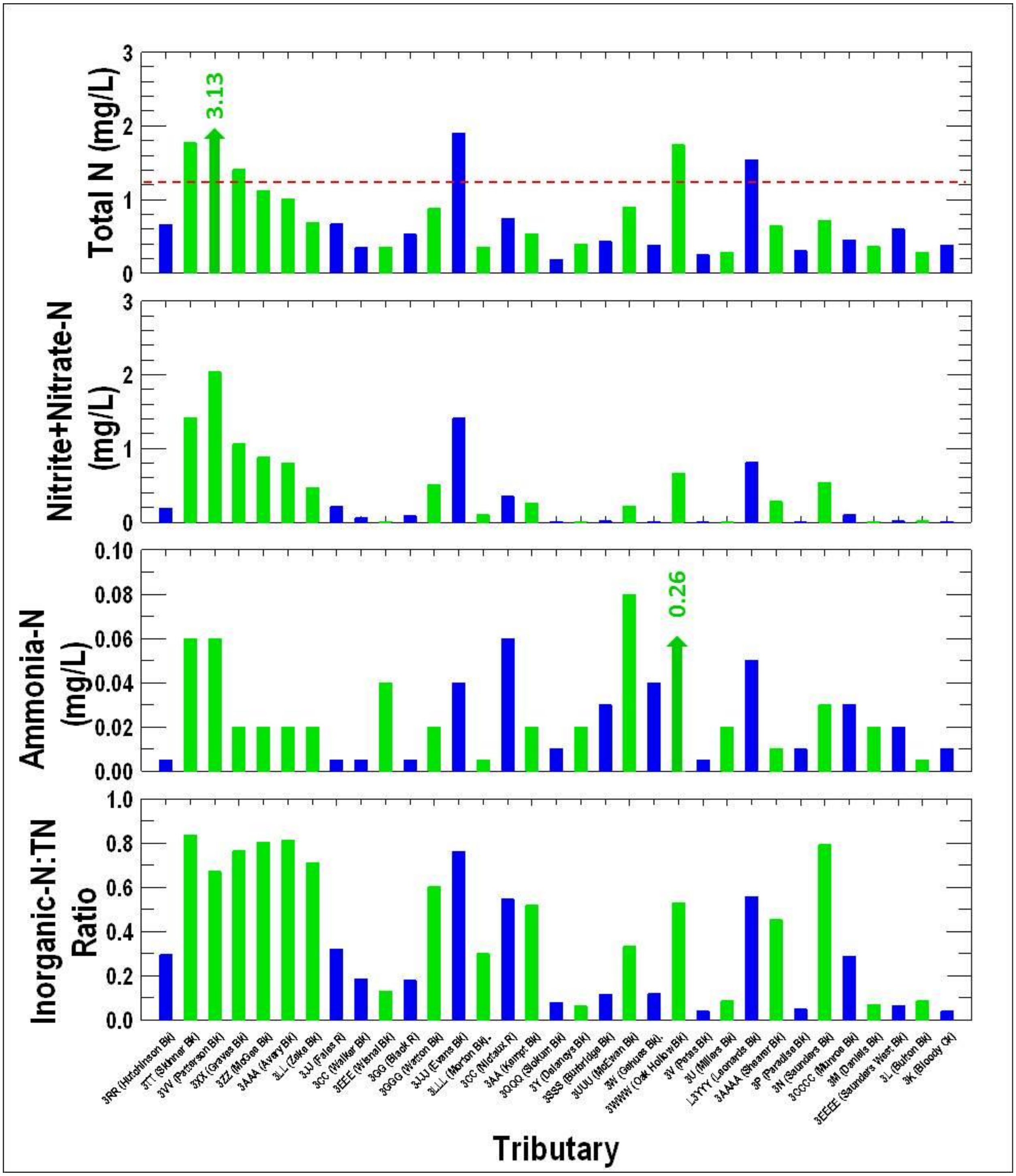

Fig. 4.2. Levels of total nitrogen, nitrite+nitrate and ammonia in Annapolis River watershed tributaries (red dashed line indicates Environment Canada guideline for total nitrogen).

Total phosphorus and phosphate values were very high (Fig 4.3). Twelve sites (36%) exceeded the Environment Canada guideline for total phosphorus. Much of the total phosphorus present was in the inorganic phosphate form, the ratio of phosphate to total phosphorus in many of the tributaries often being greater than 0.5. This is also most likely a result of run-off of inorganic phosphate contained in inorganic fertilizers used in agriculture or point source inputs from sewage treatment plants or faulty septic systems.

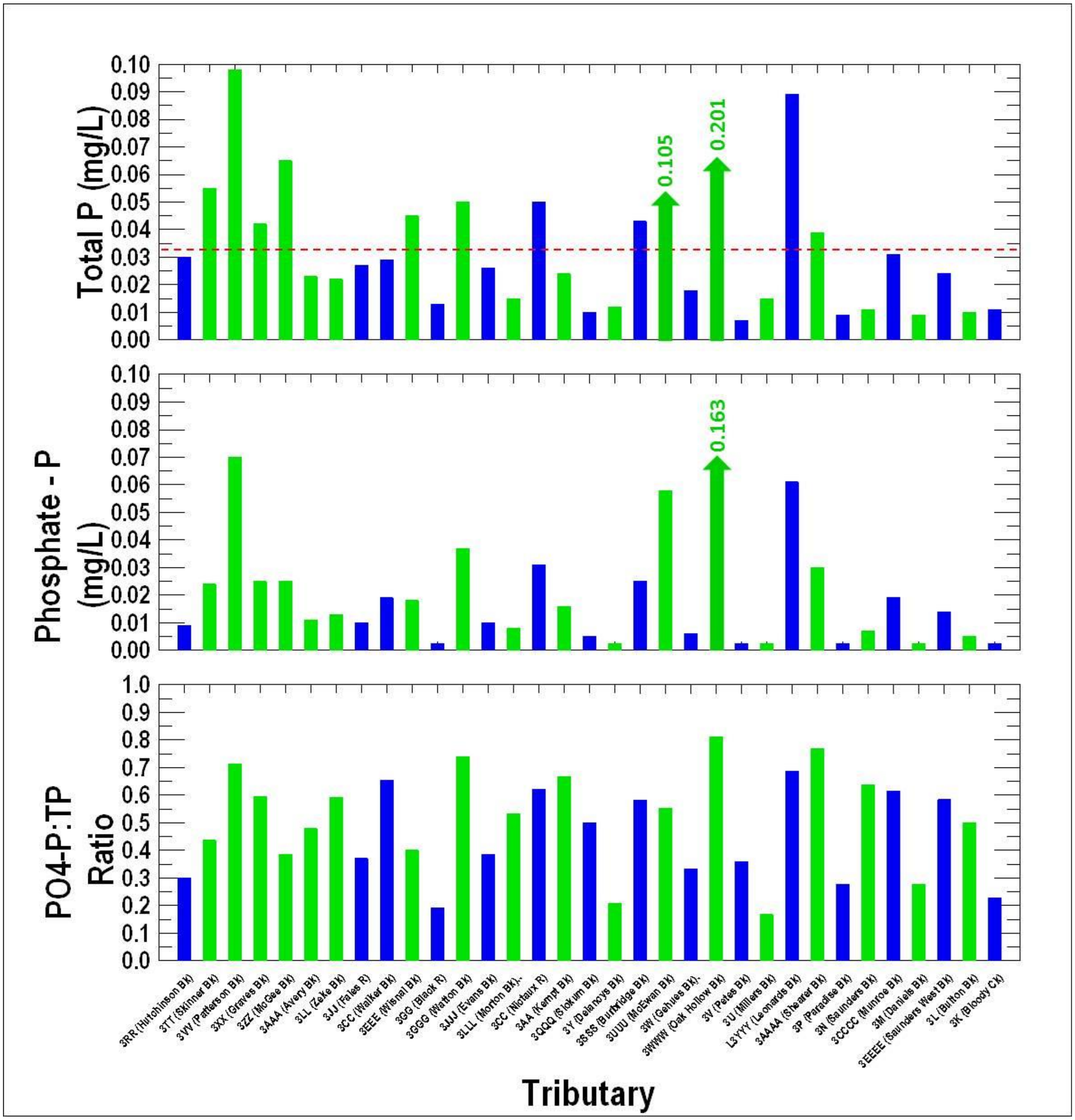

Fig. 4.3. Levels of total phosphorus and phosphate in Annapolis River watershed tributaries (red dashed line indicates Environment Canada guideline for total phosphorus).

4.1.1.3 Nutrient Loadings

Nutrient loadings for total nitrogen and total phosphorus varied greatly (Fig 4.4) and were largely dependent of the volume of water flowing into the river, the highest values being exhibited mostly by the larger tributaries.

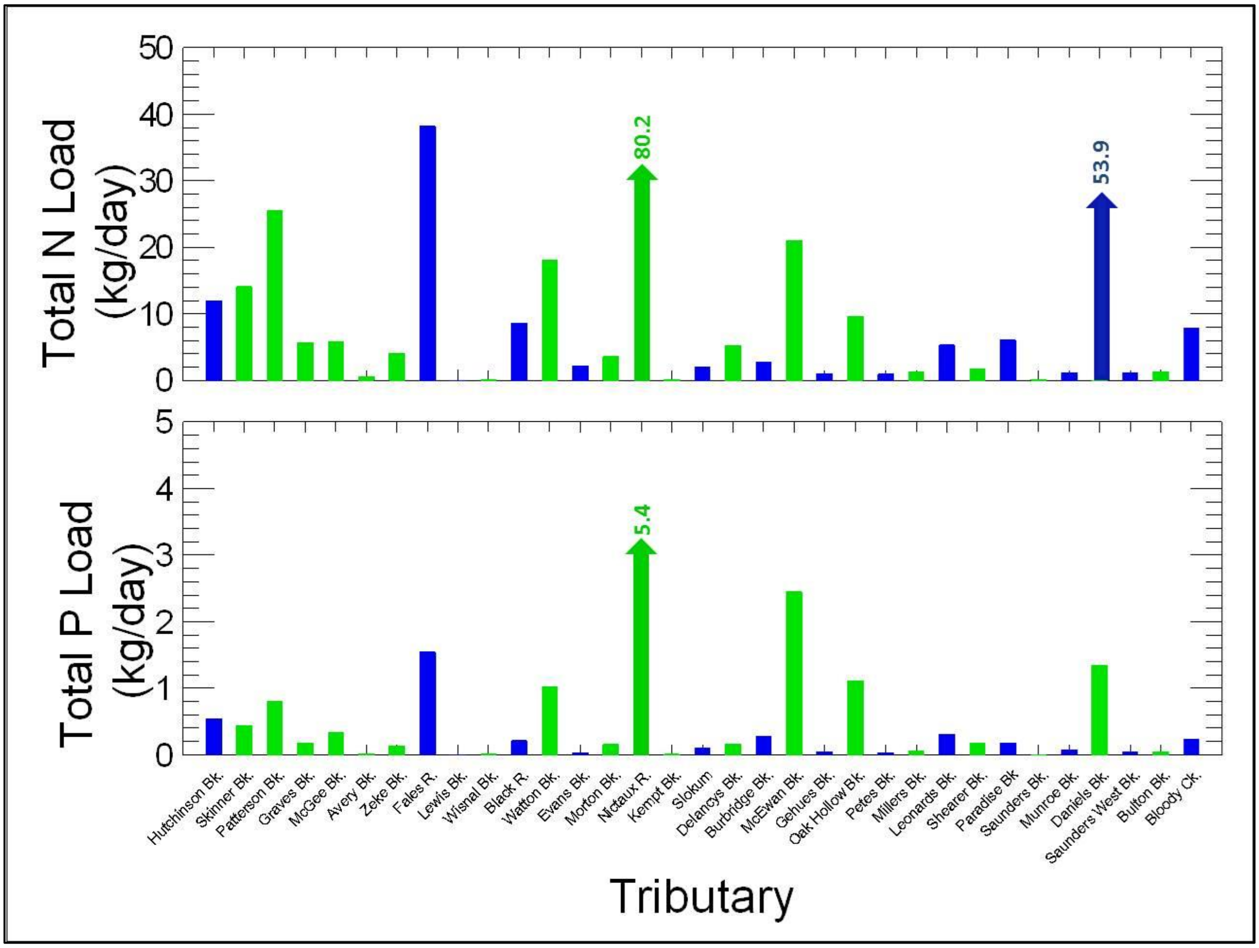

Fig 4.4 Daily total nitrogen and phosphorus loadings in Annapolis River watershed tributaries.

4.1.1.4 Water Temperature and Dissolved Oxygen

Water temperatures ranged from a low of 10.7 to a high of 21.0 °C. The lower temperatures occurred mainly within tributaries located in the upper reaches of the river and the higher temperatures mainly within the mid-river area (Fig. 4.5).

Dissolved oxygen concentrations (Fig. 4.5) showed a trend opposite to that of water temperature, with higher values in the tributaries located within the upper reaches of the river and lower values in tributaries located within the mid-river area. This is to be expected as a result of the capacity of water to hold more dissolved oxygen at lower temperatures.

With one exception, all values of dissolved oxygen fell within the CCME guidelines for warm water biota (5.5 to 6.0 mg/L). The one exception was Wisnal Brook (3EEE) which had a value of 5.2 mg/L. The CCME guidelines for cold water biota are 9.5 mg/L for early life stages and 6.5 mg/L for other life stages. Most tributaries were near to the lower limit for the latter, but many others were well below the lower limit for early life stages. This, however, is likely to be a problem only during warmer periods of the year when early life stages are not likely to be present.

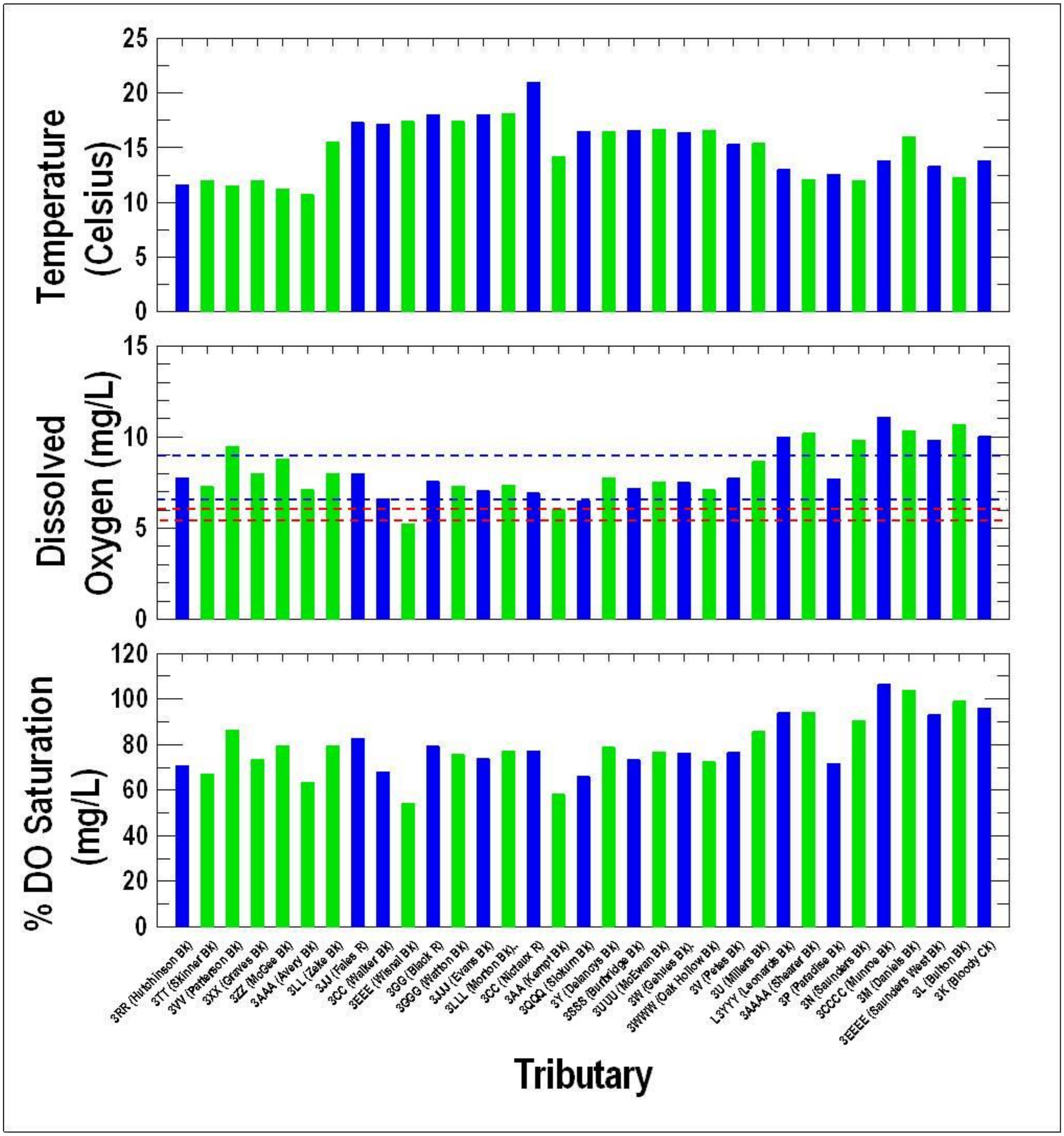

Fig 4.5 Water temperature, dissolved oxygen and percent dissolved oxygen saturation in Annapolis River watershed tributaries (upper red line indicates CCME guideline boundary for early life stages of warm water species; lower red line indicates CCME guideline boundary for other life stages of warm water species; upper blue line indicates CCME guideline boundary for early life stages of cold water species; lower blue line indicates CCME guideline boundary for other life stages of cold water species).

4.1.1.5 Fecal Coliform Numbers

Fecal coliform numbers ranged from a low of 20 to >2419/100 ml (Fig 4.6). Of the 33 tributaries sampled, 30 (91%) had levels above 100/100 ml, the CCME guideline for protection of agricultural water use. Health Canada's guideline for recreation activities involving body contact for a single sample is ≤ 400 /100 ml. Of the 33 tributaries sampled, 14 (44%) had levels above this value.

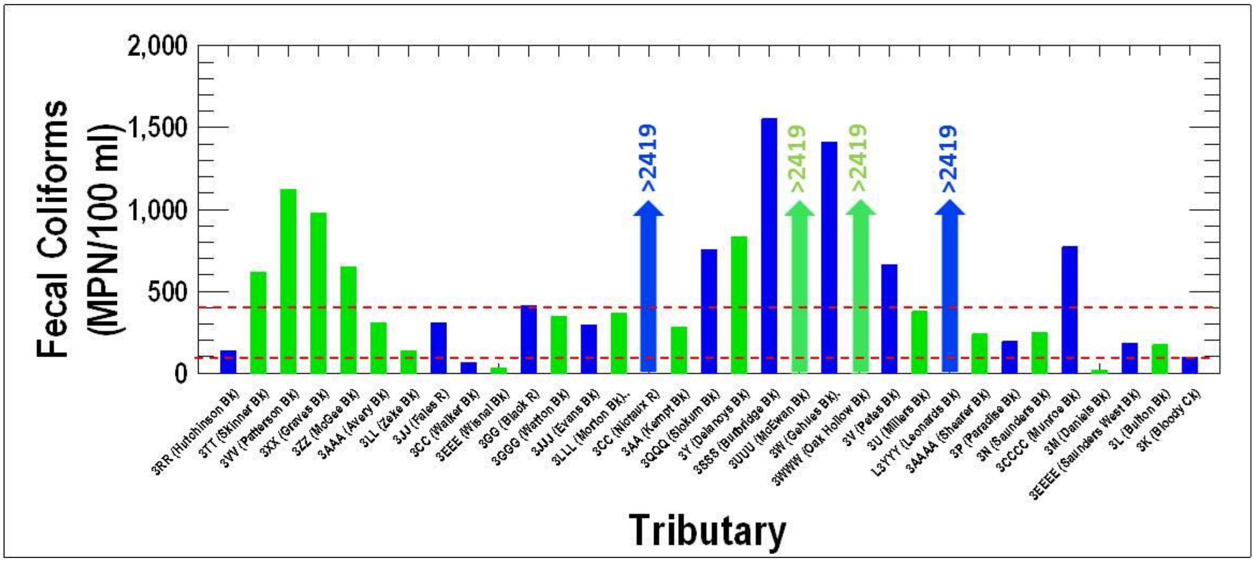

Fig 4.6 Fecal coliform numbers for Annapolis River watershed tributaries (lower red line indicates the upper boundary of the CCME guideline for protection of agriculture water use and upper red line indicates the Health Canada guideline for contact recreation).

4.1.1.6 Water Colour

Water colour (Fig. 4.7) varied from a low of 20.2 to a high of 229.1 TCUs. There are no obvious trends in water colour with respect to either distance from headwaters or origin on north or south side of the river.

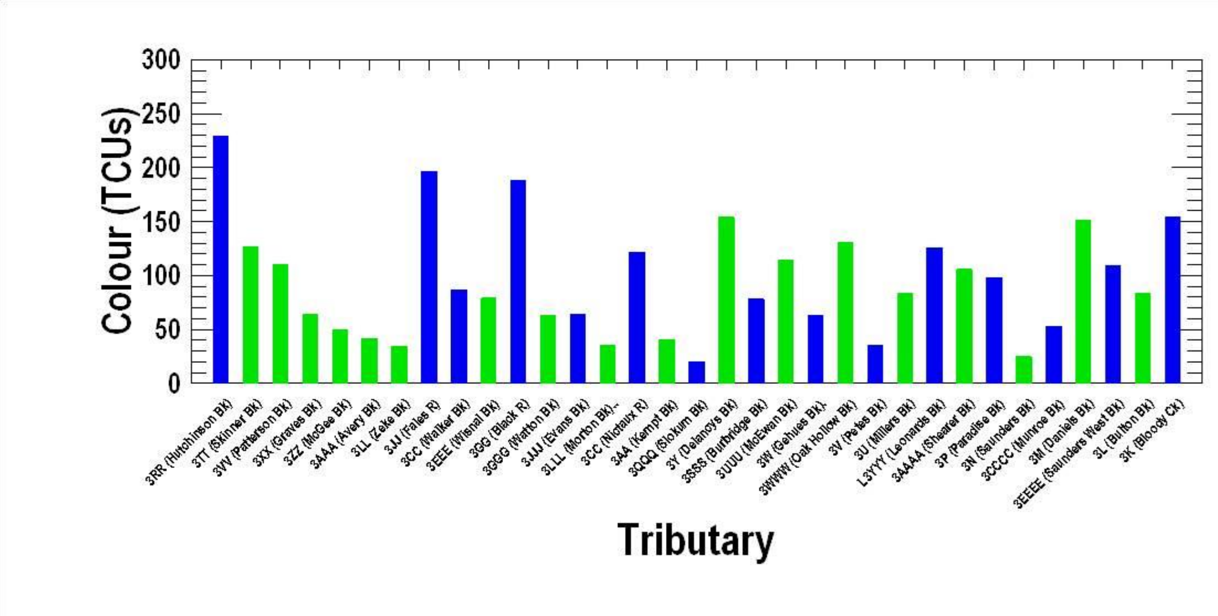

Fig 4.7 Water colour in Annapolis River watershed tributaries.

4.1.2 Main River

A total of eight sites were sampled from within the main river on 9 October 2013, the locations of which are shown in Appendix IIC.

4.1.2.1 Conductivity, Alkalinity and pH

Conductivity, alkalinity and pH (Fig. 4.8) varied relatively little compared to the degree of variation observed within the river tributaries. In particular there was little variation in pH which was relatively constant at about 7.5 and well within the CCME boundaries for the Protection of Freshwater Aquatic Life, and indicative of a well buffered system with little evidence of being impacted by acid precipitation.

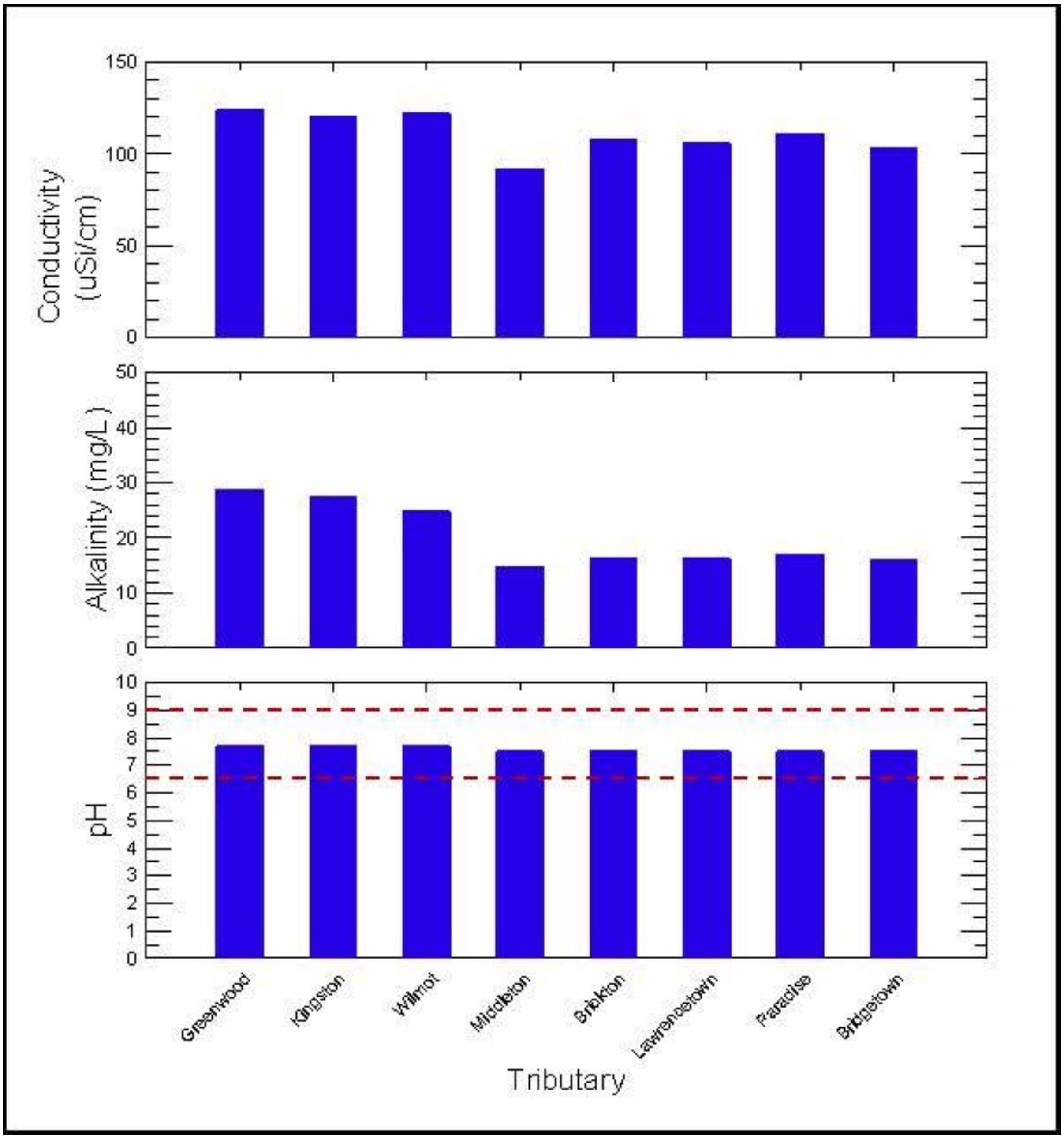

Fig. 4.8. Levels of conductivity, alkalinity and pH at main sites of the Annapolis River (red dashed lines indicate upper and lower CCME limits of pH for protection of aquatic life).

4.1.2.2 Nutrients

Total nitrogen, nitrite+ nitrate and ammonia levels (Fig. 4.9) all exhibited a trend of decreasing levels downstream from the headwater region. Ammonia did not exhibit any consistent trend. The Environment Canada guideline for total nitrogen (1.21 mg/L) was not exceeded at any of the sites, nor were the CCME guidelines for ammonia (1.3 mg Ammonia-N for the pH and temperature at time of collection) and nitrate-N (3.0 mg/L) ever exceeded. Inorganic nitrogen often comprised more than 50% of the total nitrogen.

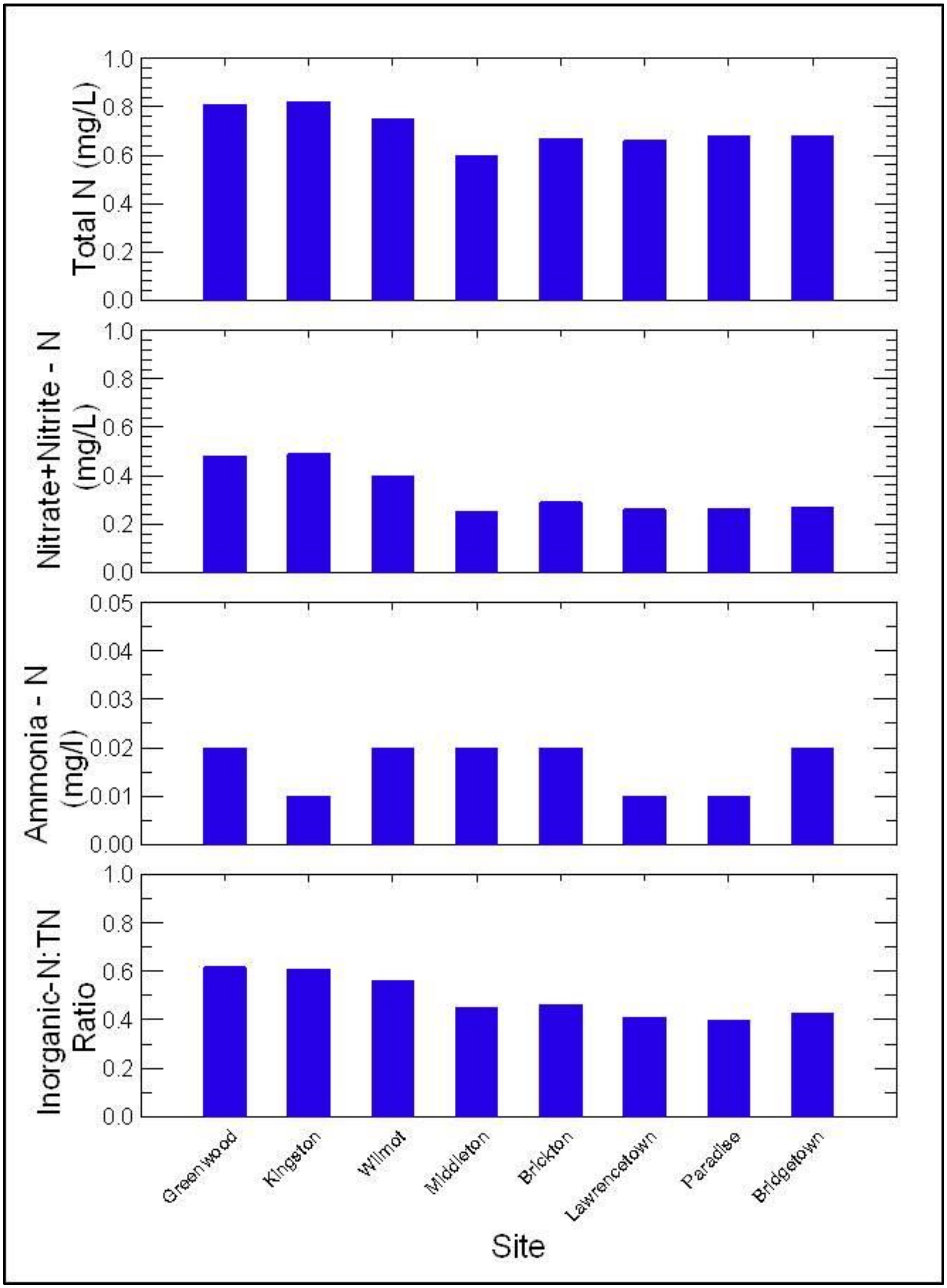

Fig. 4.9. Levels of total nitrogen, nitrite+nitrate and ammonia at main sites of the Annapolis River.

Total phosphorus and phosphate concentrations (Fig. 4.10) were high at all of the main river sites but, unlike nitrogen, exhibited a trend of slightly increasing levels downstream from the headwater region. Total phosphorus levels at all but one site were above the Environment Canada guideline of 0.032 mg/L. Phosphate typically comprised more than 50% of the total phosphorus.

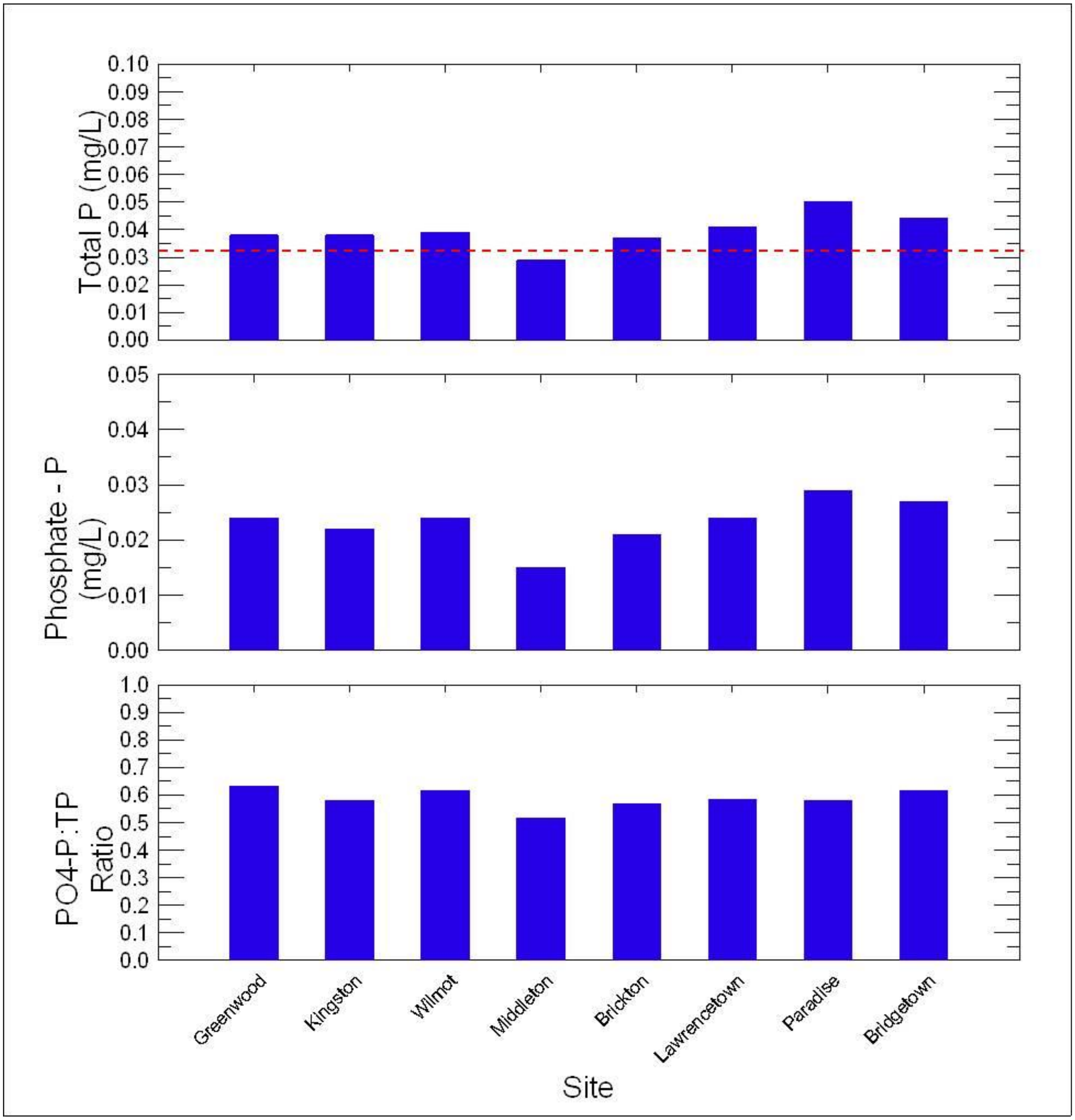

Fig. 4.10. Levels of total phosphorus and phosphate at main sites of the Annapolis River (red dashed line indicates Environment Canada guideline for total phosphorus).

4.1.2.3 Water Temperature and Dissolved Oxygen

Water temperature and dissolved oxygen generally exhibited a slight increase at the downstream sites (Fig 4.11). Dissolved oxygen levels met the warm water aquatic life guidelines for all life stages at all sites. The guideline for coldwater life early stages was not met at any of the sites, but the guideline for other coldwater life stages was met at all but the upper two sites. Percent dissolved oxygen saturation levels ranged from a low of about 55% in the headwater region to a high of about 80% at the most downstream site surveyed.

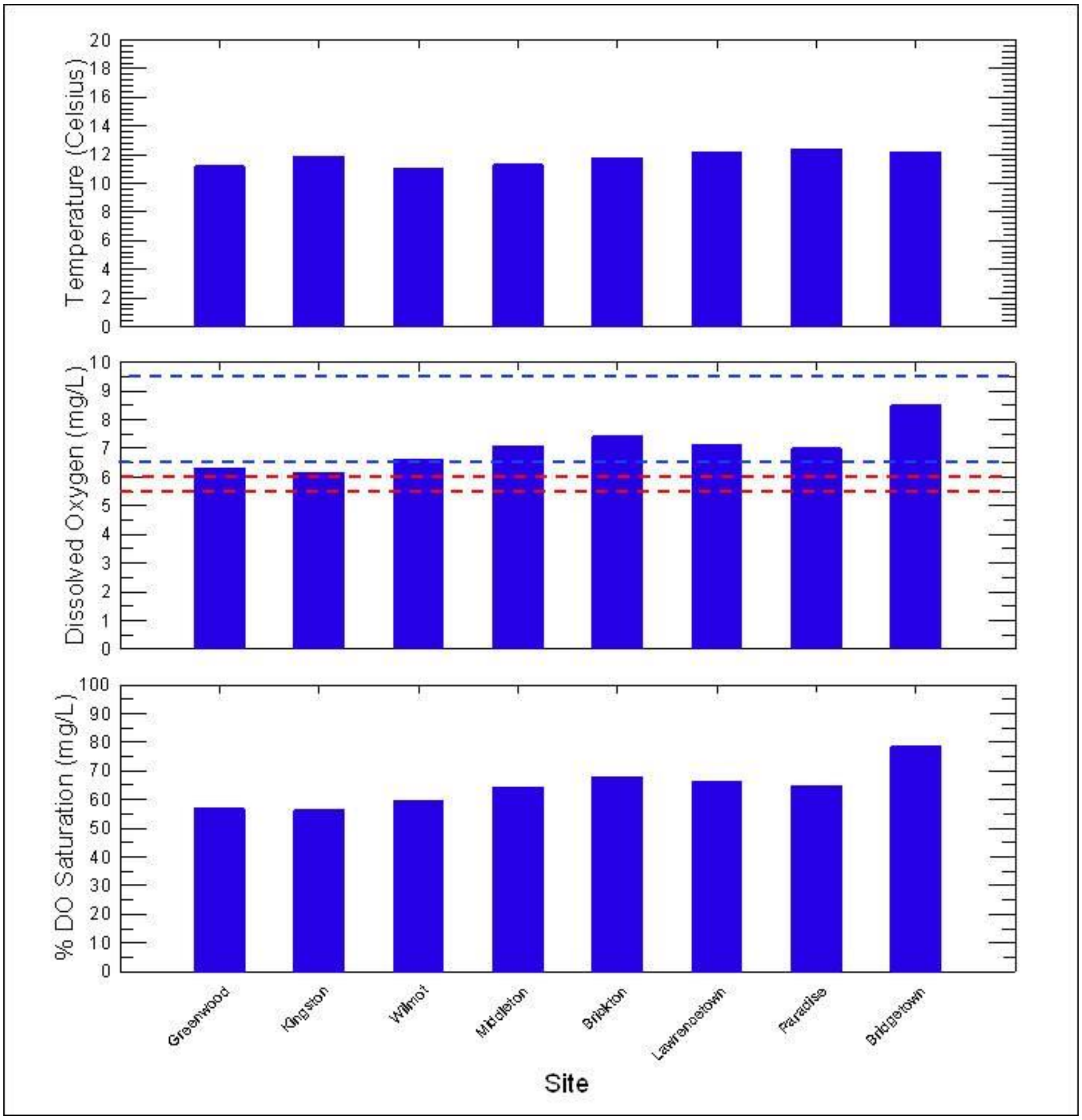

Fig 4.11 Water temperature, dissolved oxygen and percent dissolved oxygen saturation at main sites of the Annapolis River (upper red line indicates CCME guideline boundary for early life stages of warm water species; lower red line indicates CCME guideline boundary for other life stages of warm water species; upper blue line indicates CCME guideline boundary for early life stages of cold water species; lower blue line indicates CCME guideline boundary for other life stages of cold water species

4.1.2.4 Fecal Coliform Numbers

Fecal coliform numbers showed a distinct trend of increasing levels from headwaters to downstream regions. Of the eight sites surveyed none were below the CCME guideline of 100/100 ml for Protection of Agricultural Water Use and four of the sites were above the Health Canada guideline of 400/100 ml for contact recreation (Fig 4.12).

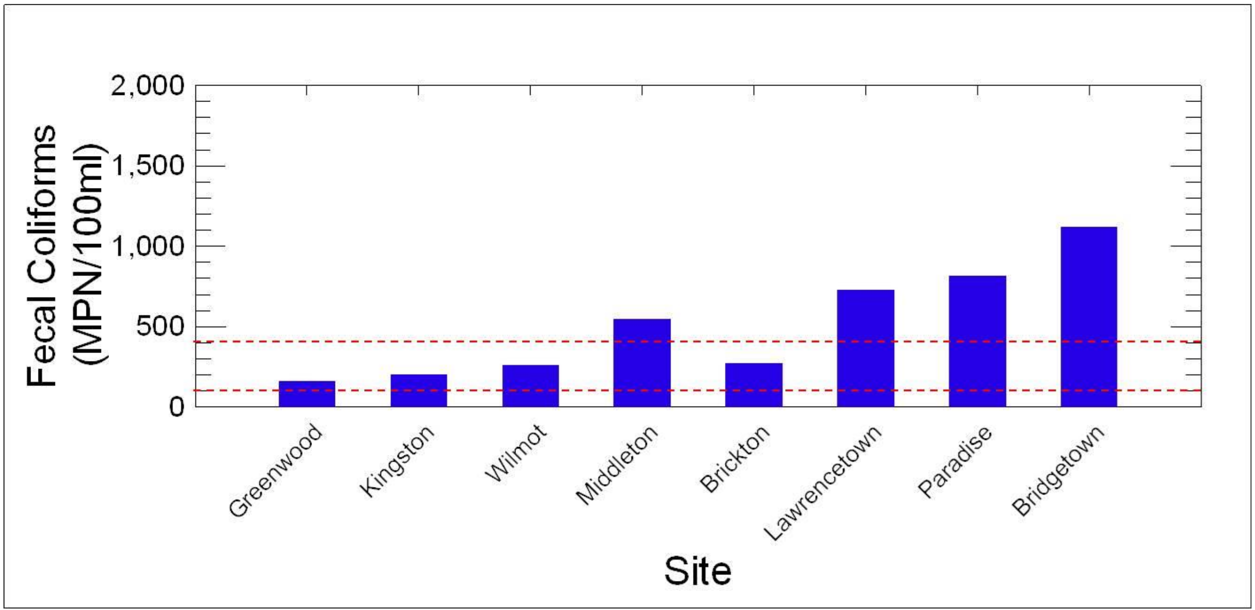

Fig 4.12 Fecal coliform numbers for main sites of the Annapolis River (lower red line indicates the upper boundary of the CCME guideline for protection of agriculture water and upper red line indicates the Health Canada guideline for contact recreation).

4.1.2.5 Water Colour

Water colour averaged about 100 TCUs and exhibited relatively little variation among the main river sites (Fig 13).

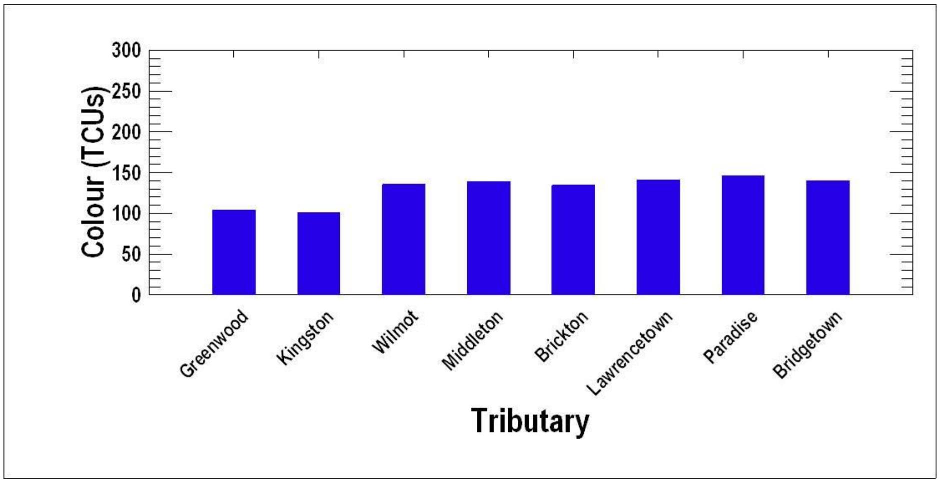

Fig 4.13 Water colour for main sites of the Annapolis River

4.2 **Cornwallis River Watershed**

The Cornwallis River originates within the Caribou Bog just west of Berwick and flows eastward where it discharges into the Minas Basin. Its total watershed area is 35,276.7 hectares and it contains 23 tertiary watersheds ranging in size from 16.5 to 8,563.7 hectares. Of the 23 tertiary watersheds, water quality samples were collected from 13 tributaries which collectively represent an area of 31,289 hectares (88.7%) of the total watershed area. The remaining watershed areas are located either within commercial or residential areas, or within the tidal portion of the river. Within the 13 tertiary watersheds surveyed, a total of 15 sites were sampled. Two of the larger watersheds, Brandywine Brook and Fisher Brook, were sampled at more than one location.

4.2.1 Tributaries

4.2.1.1 Conductivity, Alkalinity and pH

Conductivity and alkalinity (Fig 4.14) varied greatly among the tributaries. Tributaries entering on the north side of the river tended to have higher values than tributaries entering on the south side of the river. Levels of pH in contrast varied little and were all well within the CCME guidelines for the Protection of Freshwater Aquatic Life.

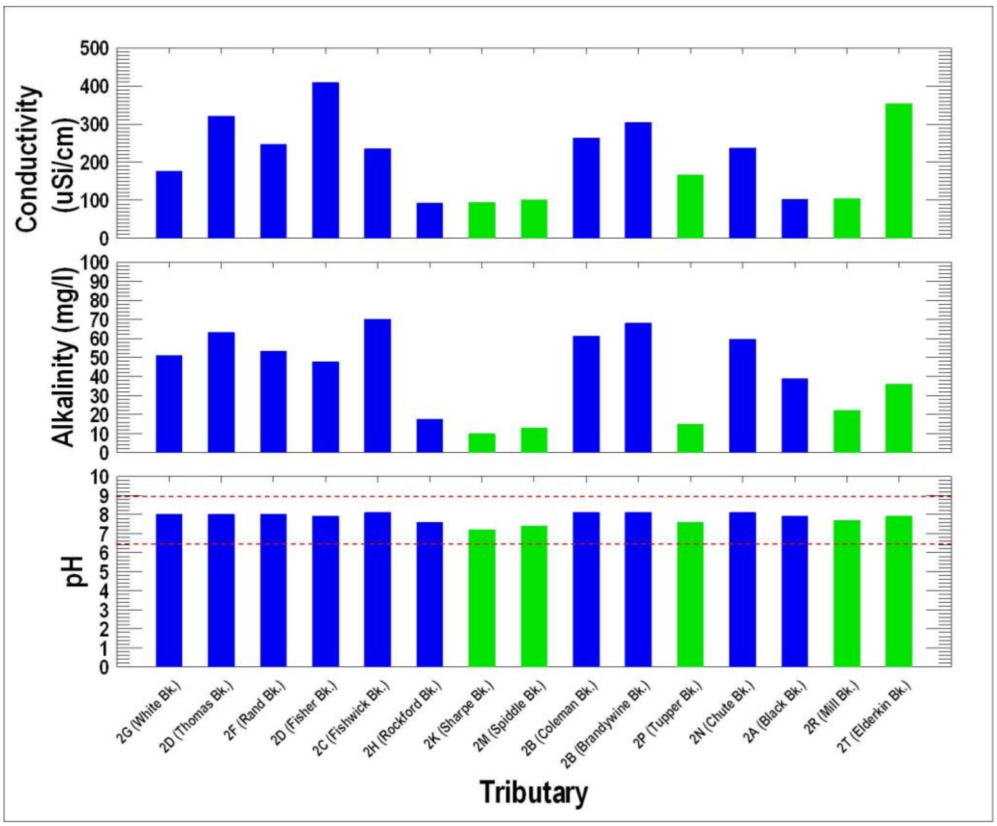

Fig. 4.14. Levels of conductivity, alkalinity and pH in Cornwallis watershed tributaries (red dashed lines indicate upper and lower CCME limits of pH for protection of freshwater aquatic life).

4.2.1.2. Nutrients

Levels of total nitrogen, nitite+nitrate and ammonia (Fig. 4.15) were highest mostly within tributaries entering from the north side of the river. Much of this nitrogen is in the inorganic form, the ratio of inorganic nitrogen to total nitrogen often exceeding 70%. The Environment Canada guideline for total nitrogen was exceeded at eight (53%) of the 15 sites sampled. The CCME guideline for ammonia (which would be about 0.7 mg/L for the water temperature and pH at the time of the survey) was never exceeded, nor was the CCME guideline for nitrate (3.0 mg/l NO_3-N) ever exceeded.

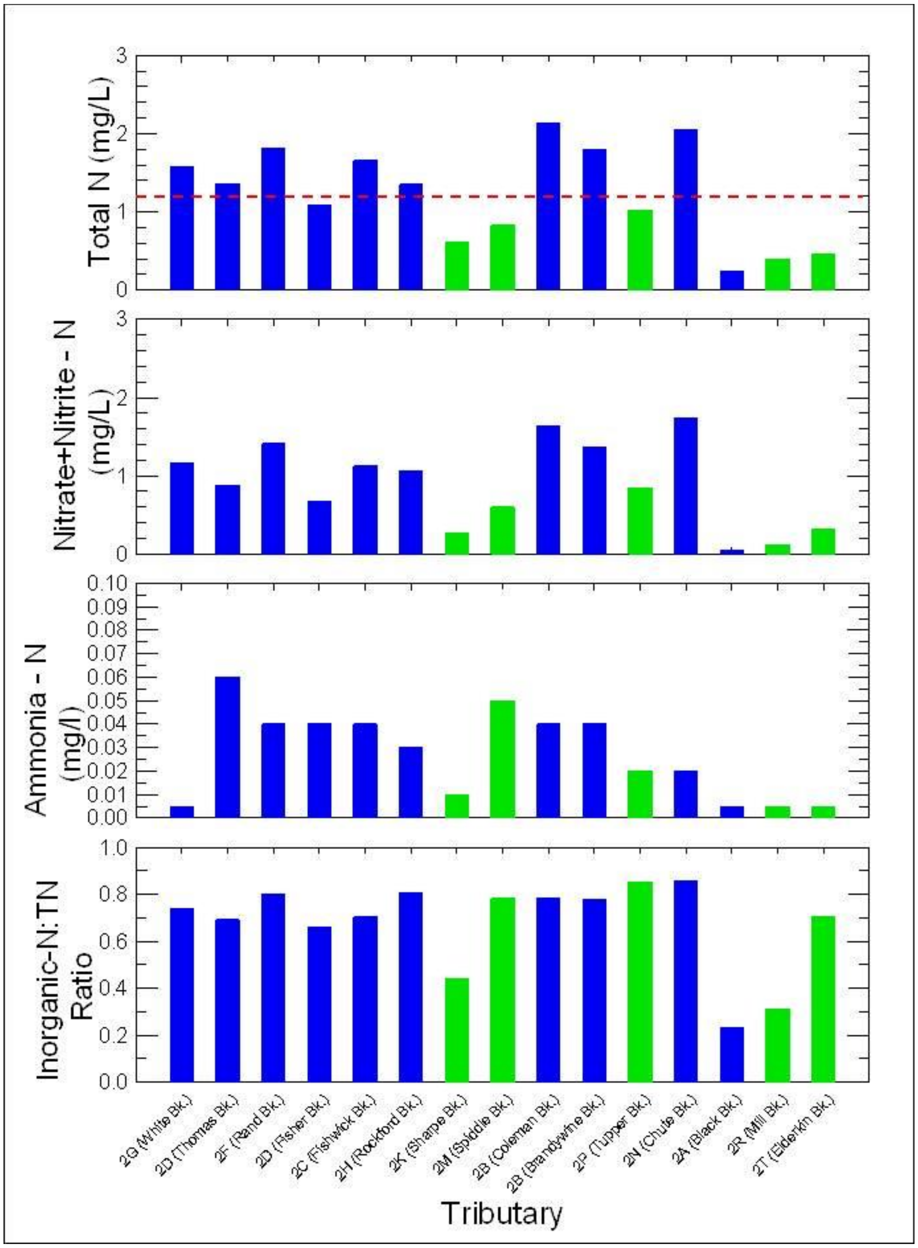

Fig. 4.15. Levels of total nitrogen, nitrite+nitrate and ammonia in tributaries of the Cornwallis Rive (red dashed line indicates Environment Canada guideline for total nitrogen).

Phosphorus levels are also very high (Fig. 4.16) and exhibited the same general trends as nitrogen. The highest values are exhibited by tributaries entering from the north side of the river and much of the phosphorus was often in the inorganic form. Twelve (80%) of the 15 sites had total phosphorus levels greater than the Environment Canada guideline of 0.032 mg/L.

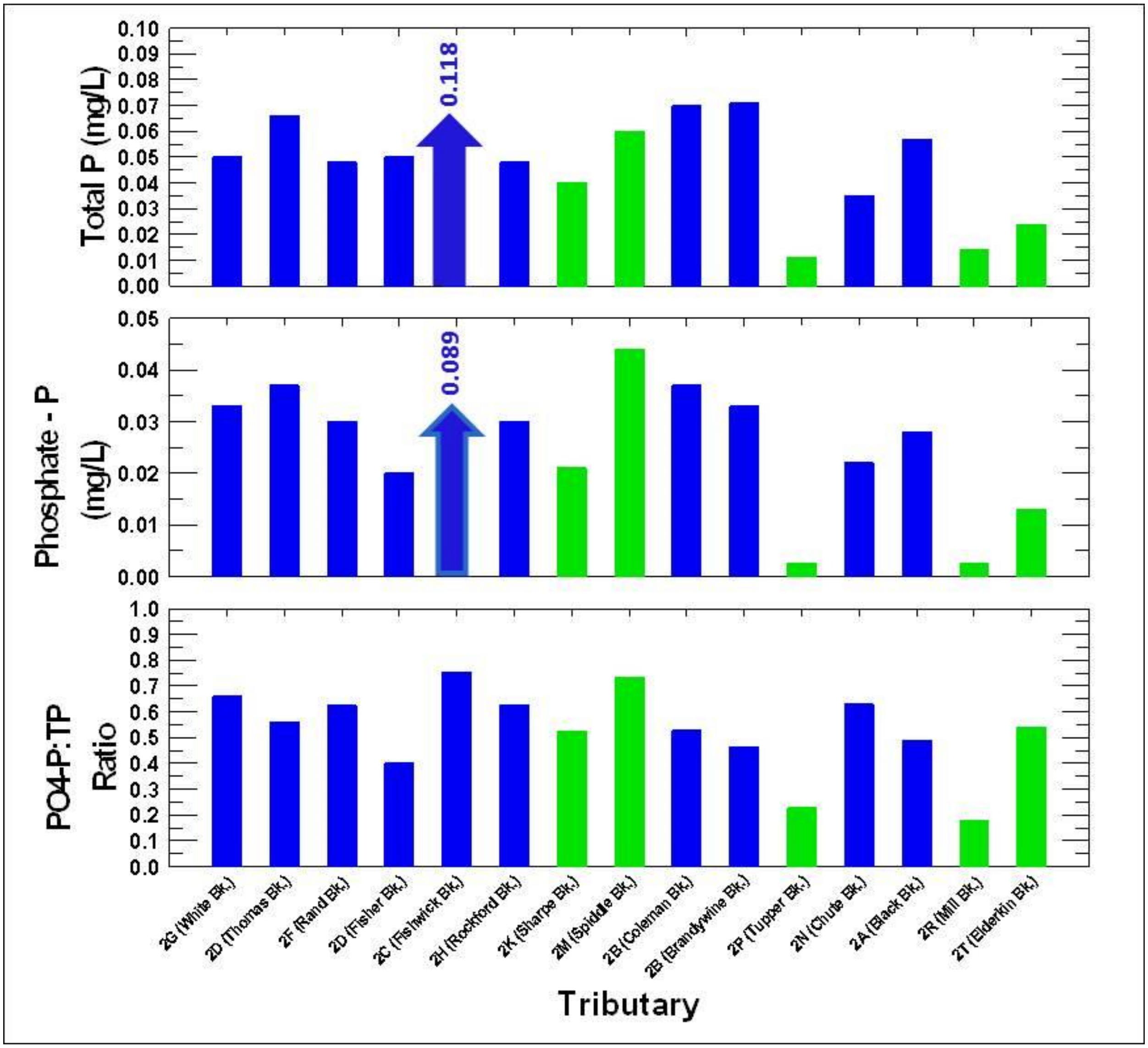

Fig. 4.16. Levels of total phosphorus and phosphate in tributaries of the Cornwallis River (red dashed line indicates the Environment Canada guideline for total phosphorus).

4.2.1.3 Nutrient Loadings

Daily total phosphorus and nutrient loadings (Fig. 4.17) varied greatly, mainly as a result of large differences in water flow at the time of the survey. Mid-river sites tended to have the highest loadings. The highest loadings were at Coleman and Brandywine Brooks.

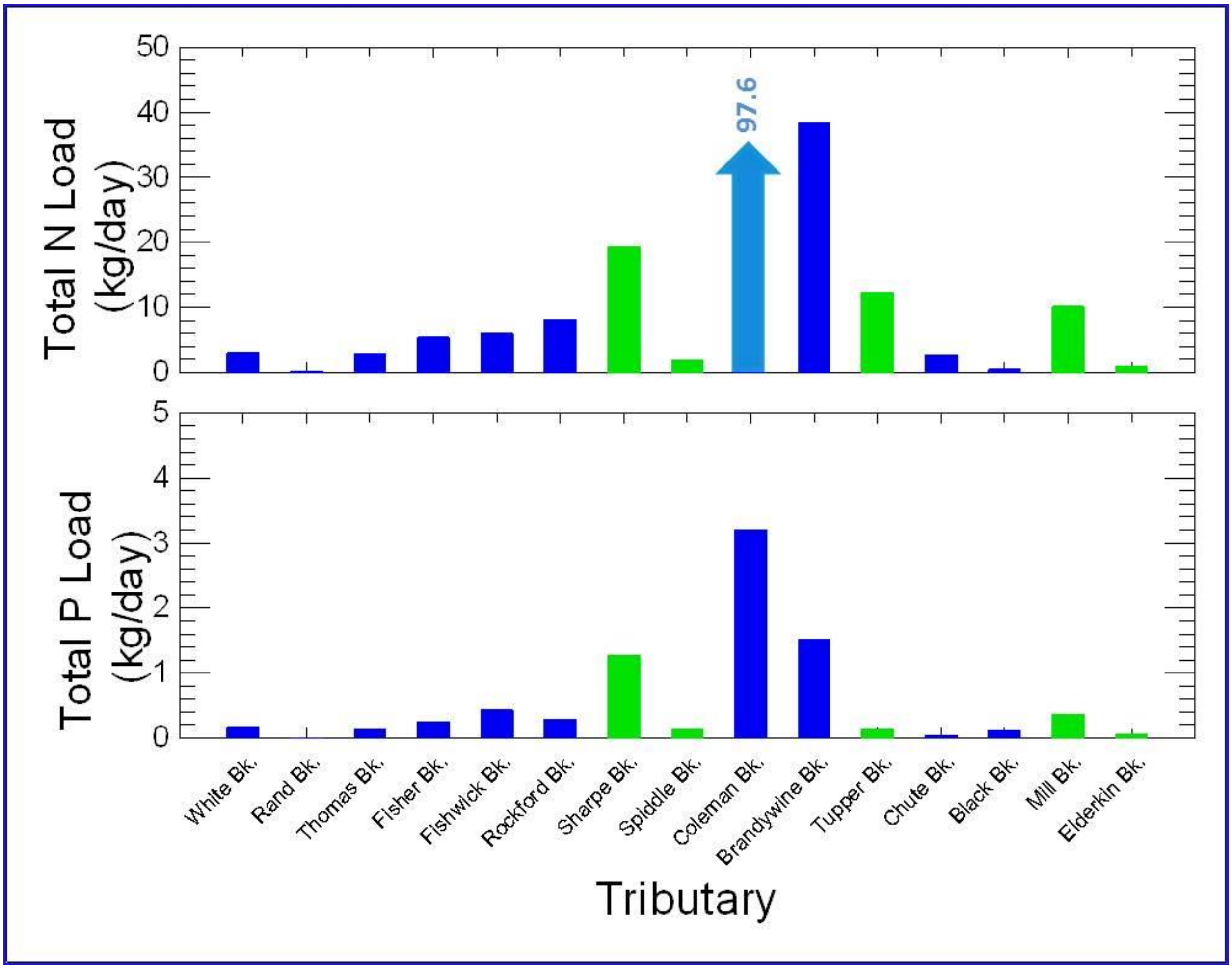

Fig 4.17 Daily total nitrogen and phosphorus loadings in Cornwallis River watershed tributaries.

4.2.1.4 Water **Temperature and Dissolved Oxygen**

Water temperatures ranged between about 15 and 18 °C (Fig.4.18). Dissolved oxygen levels ranged from about 6.5 to 9.0 mg/L. All values of dissolved oxygen fell within the CCME guidelines for warm water biota (5.5 to 6.0 mg/L) and the general cold water biota guideline (6.5 mg/L), but none met the guideline for early stages of cold water biota (9.5 mg/L).

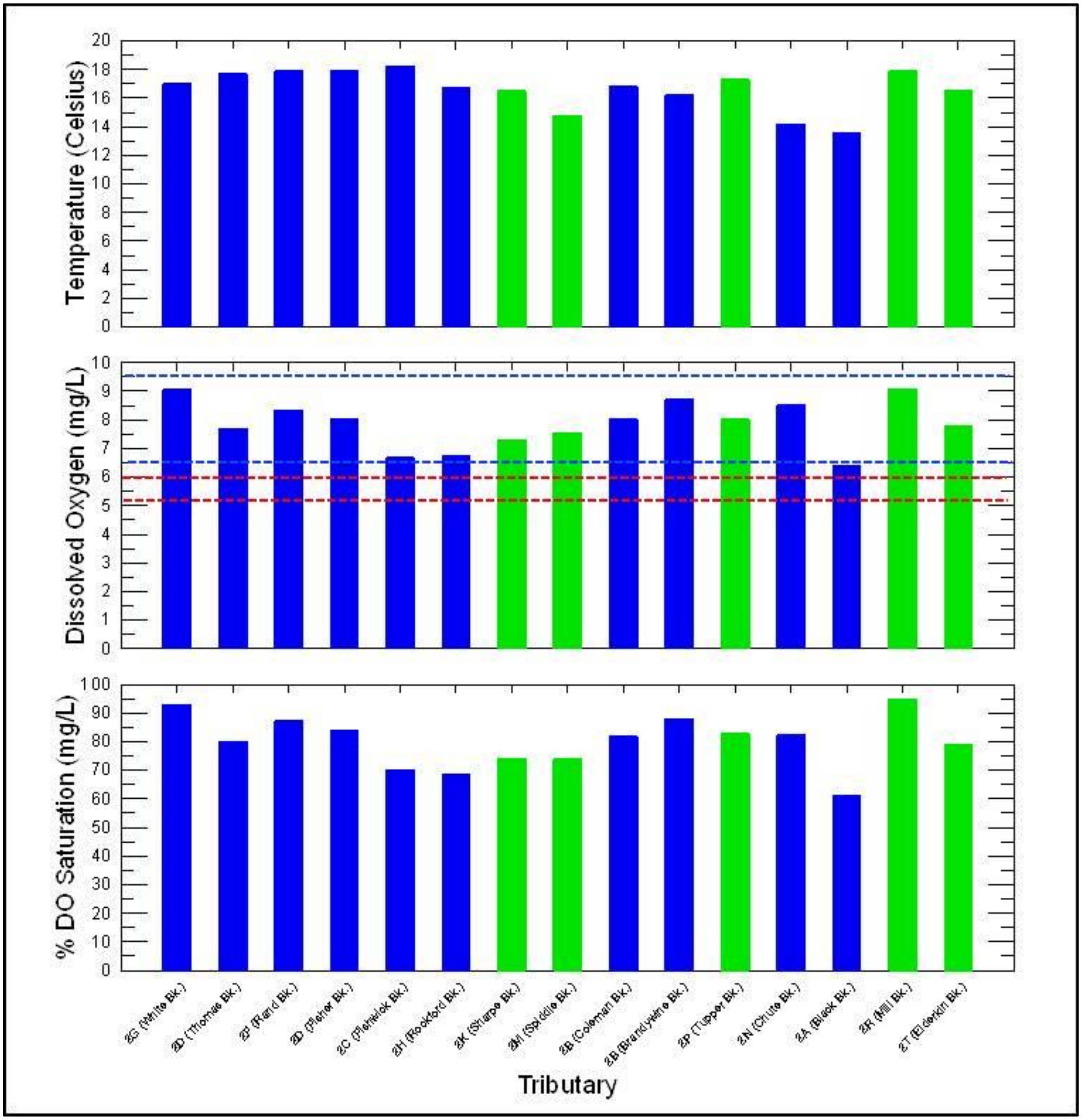

Fig 4.18 Water temperature, dissolved oxygen and percent dissolved oxygen saturation at tributaries of the Cornwallis River (upper red line indicates CCME guideline boundary for early life stages of warm water species; lower red line indicates CCME guideline boundary for other life stages of warm water species; upper blue line indicates CCME guideline boundary for early life stages of cold water species; lower blue line indicates CCME guideline boundary for other life stages of cold water species.

4.2.1.5 Fecal Coliform Numbers

Fecal coliform numbers (Fig. 4.19) within all but the most downstream sites were very high. All exceeded the CCME guidelines for Protection of Agricultural Water Use and 11 (73%) exceeded the Health Canada guideline for contact recreational activities.

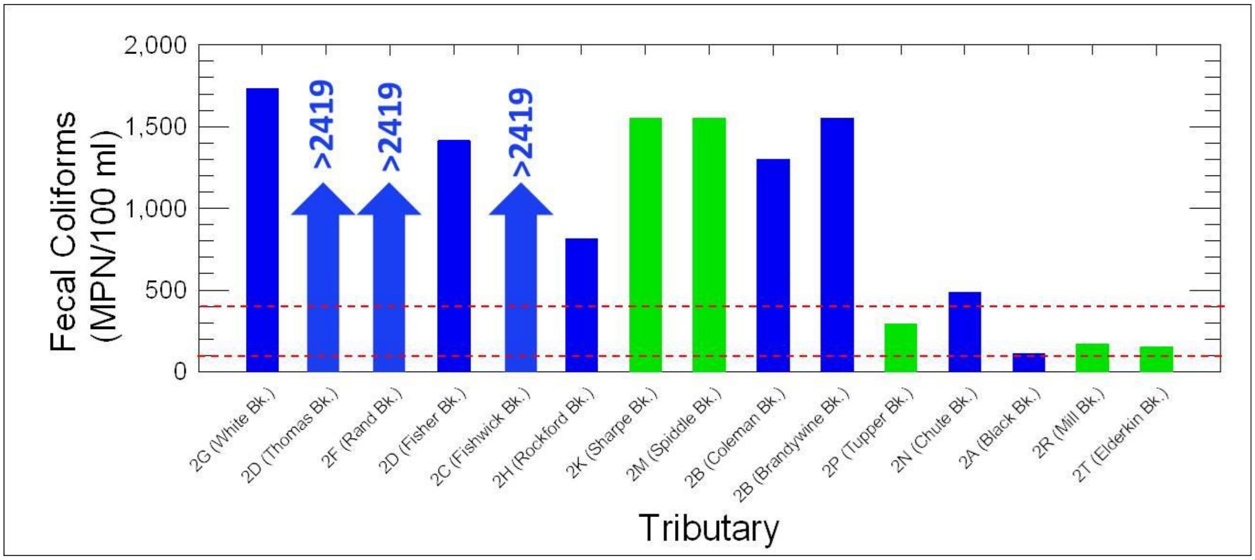

Fig 4.19 Fecal coliform numbers for tributary sites of the Cornwallis River (lower red line indicates the upper boundary of the CCME guideline for protection of agriculture water use and upper red line indicates the Health Canada guideline for contact recreation).

4.2.1.6 Water Colour

Water colour (Fig. 4.20) was relatively low within most of the tributaries ranging from a low of 16.2 to a high of 80.0 TCUs.

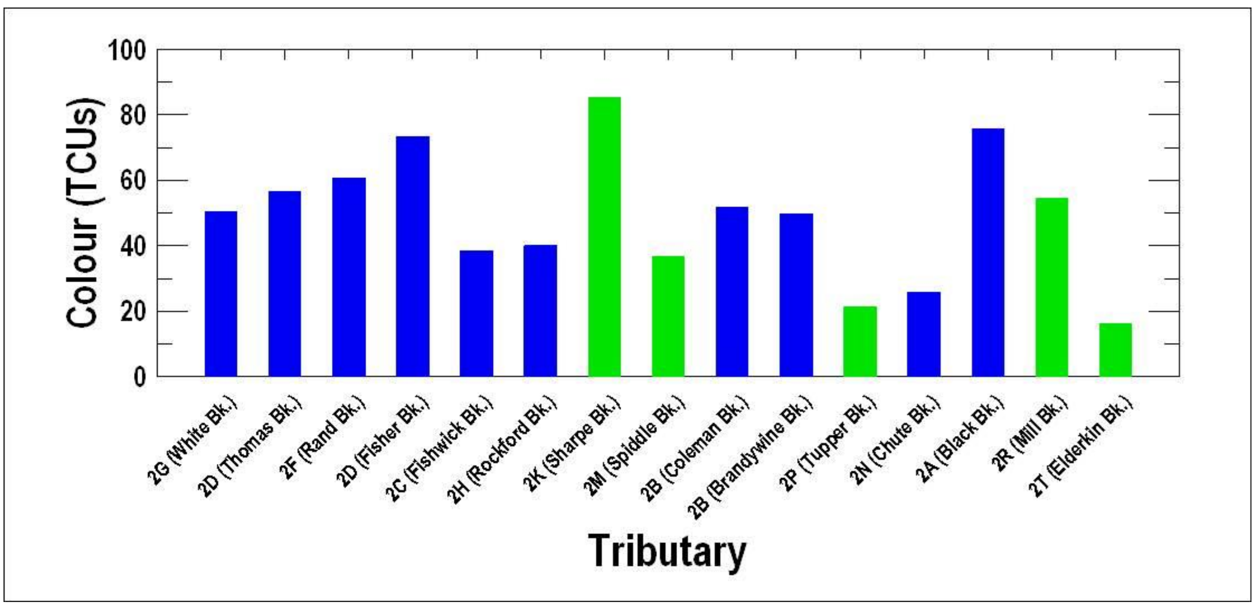

Fig 4.20 Water colour for tributary sites of the Cornwallis River.

4.2.2 **Main River**

A total of five sites were sampled from within the main river on 9 October 2013, the locations of which are shown on a map contained in Appendix IIE.

4.2.2.1 Conductivity, Alkalinity and pH

Conductivity and alkalinity (Fig. 4.21) were considerably higher within the upper headwater region of the watershed. In contrast, pH showed little variation among the main river sites surveyed and was well within the CCME guidelines for the Protection of Freshwater Aquatic Life.

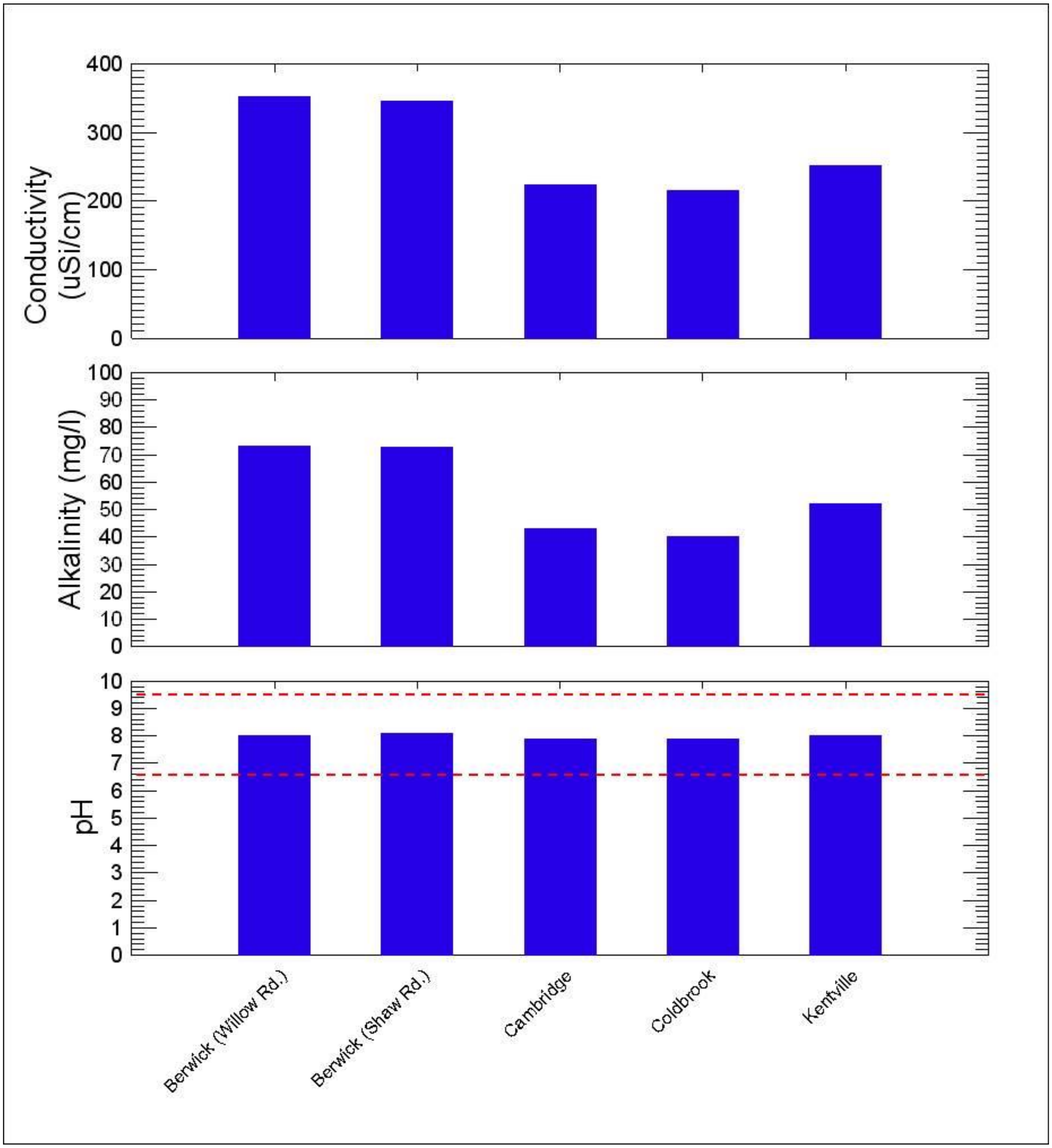

Fig. 4.21. Levels of conductivity, alkalinity and pH at Cornwallis River main sites (red dashed lines indicate upper and lower CCME limits of pH for protection of aquatic life).

4.2.2.2 Nutrients

Total nitrogen and nitite+nitrate (Fig. 4.22) are very high at all the main river sites. There is an obvious trend of increasing concentrations of total nitrogen and nitrite+nitrate from the headwater region to the downstream region. The Environment Canada guideline for total nitrogen was exceeded at all sites, but ammonia and nitrate levels were well below the CCME guidelines for the Protection of Freshwater Aquatic Life. Between 60 and 80% of the total nitrogen was in the inorganic form.

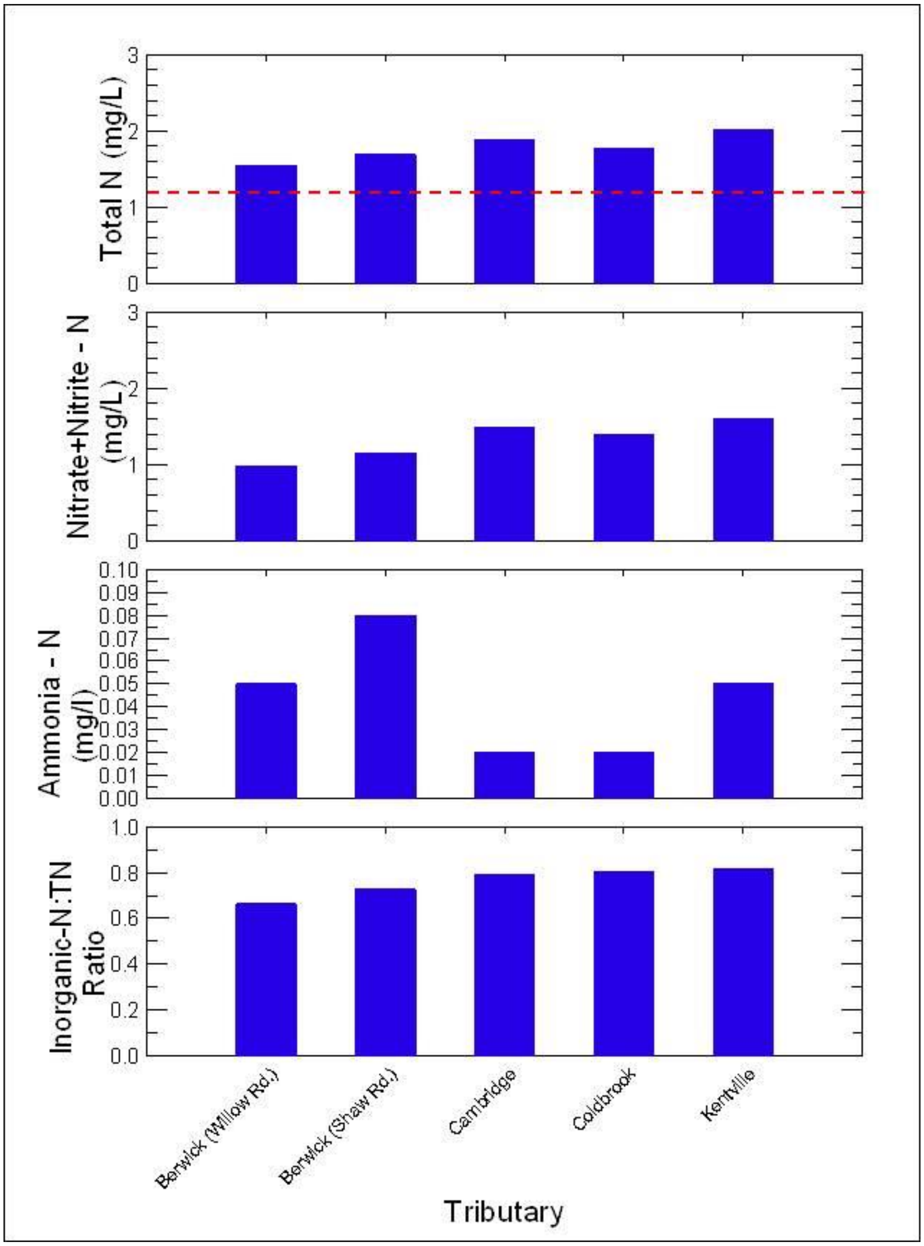

Fig. 4.22. Levels of total nitrogen, nitrite+nitrate and ammonia at main river sites of the Cornwallis River (red dashed line indicates the Environment Canada guideline for total nitrogen).

Phosphorus concentrations are also high at the main river sites (Fig 4.23). Both total phosphorus and phosphate showed a trend of highest levels within the mid-river sites, but the ratio of phosphate to total phosphorus tended to be lower within the headwater region. All sites are well above the Environment Canada guideline of 0.032 mg/L for total phosphorus.

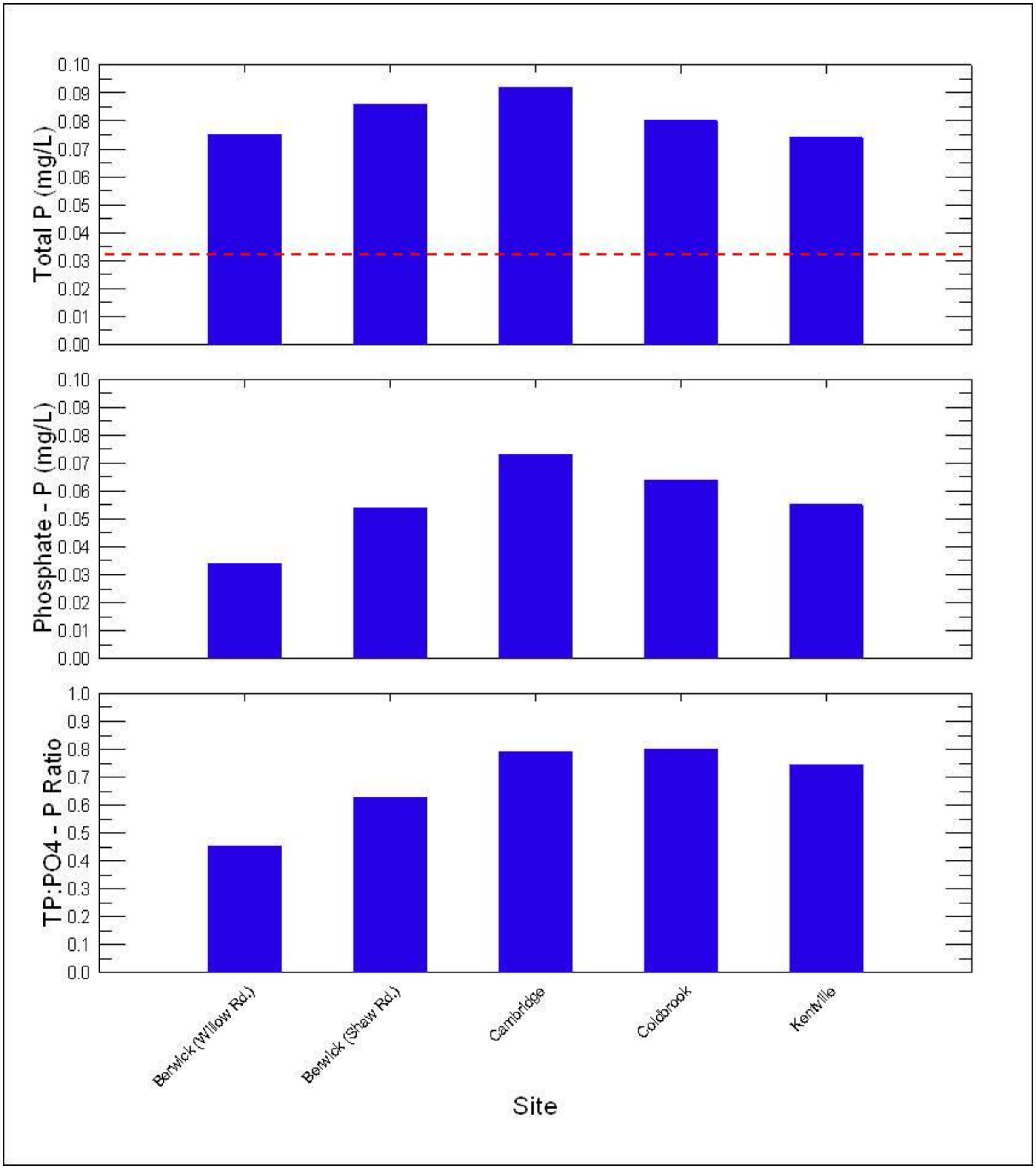

Fig. 4.23. Levels of total phosphorus and phosphate at main River sites of the Cornwallis River (red dashed line indicates the Environment Canada guideline for total phosphorus).

4.2.2.3 Water **Temperature and Dissolved Oxygen**

Water temperature exhibited little variation among the main river sites surveyed (Fig 4.24). Dissolved oxygen concentrations also exhibited relatively little variation, but were quite low and although within the CCME guidelines for warm water species, were well below the upper CCME guideline for cold water species.

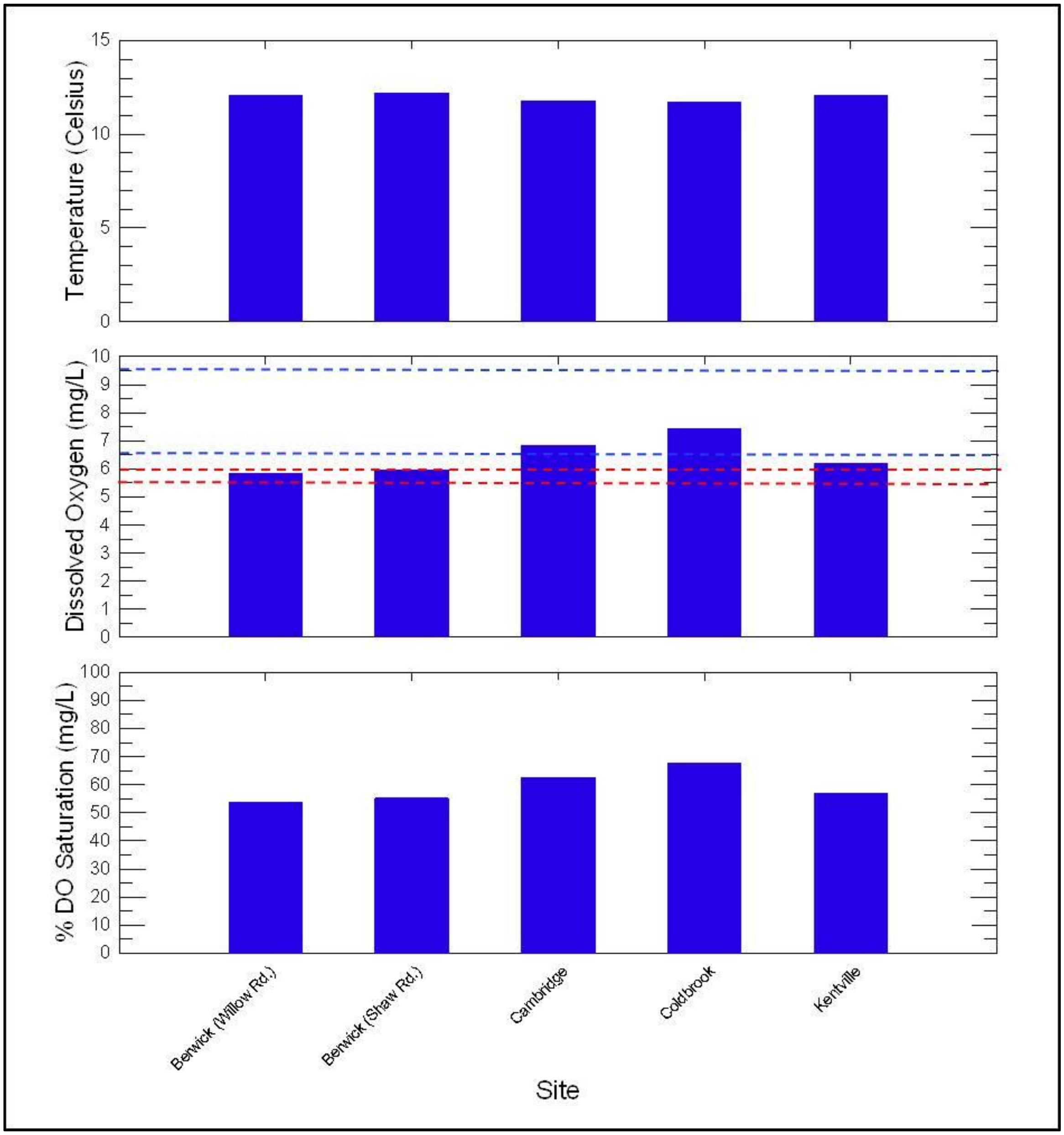

Fig 4.24 Water temperature, dissolved oxygen and percent dissolved oxygen saturation at main river sites of the Cornwallis River (upper red line indicates CCME guideline boundary for early life stages of warm water species; lower red line indicates CCME guideline boundary for other life stages of warm water species; upper blue line indicates CCME guideline boundary for early life stages of cold water species; lower blue line indicates CCME guideline boundary for other life stages of cold water species).

4.2.2.4 Fecal Coliform Numbers

Despite the high fecal coliform numbers observed within many of the Cornwallis tributaries, with one exception the levels observed within the main river were relatively low (Fig. 4.25). The high number observed at Willow Road may be related to the operation of the Berwick sewage treatment plant. However, of the five sites surveyed, four exceeded the CCME guideline for Protection of Agricultural Water Use. Only one site exceeded the Health Canada guideline for contact recreational activities.

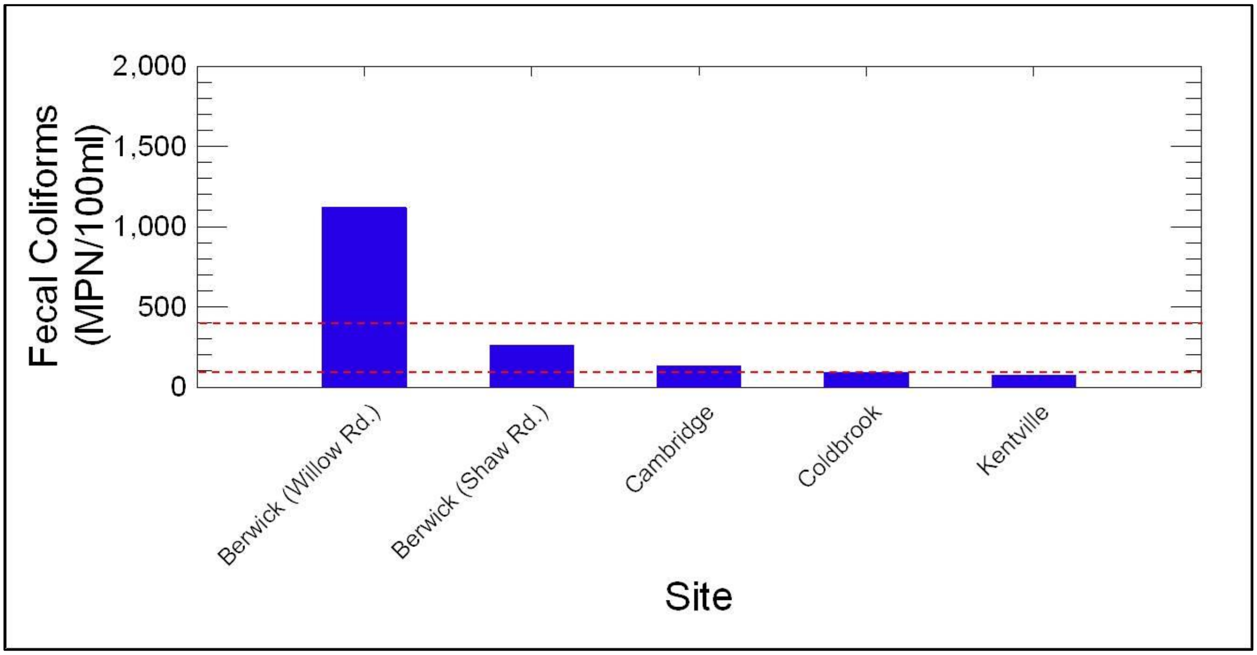

Fig 4.25 Fecal coliform numbers for main river sites of the Cornwallis River (lower red line indicates the upper boundary of the CCME guideline for protection of agriculture and upper red line indicates the Health Canada guideline for contact recreation).

4.2.2.5 Water Colour

Water colour at the main river sites is relatively low and shows a distinct decrease from the headwater to downstream region (Fig. 4.26).

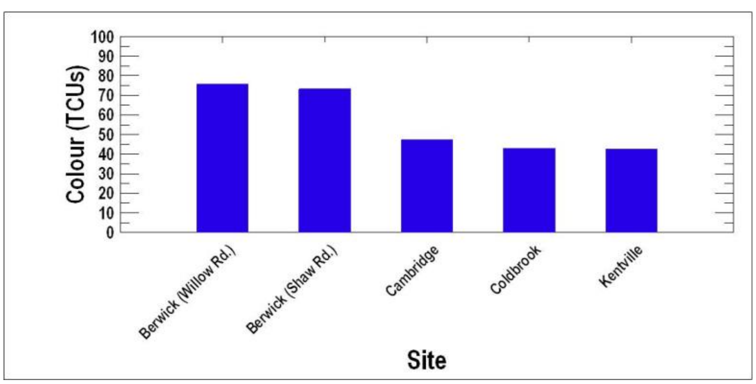

Fig 4.26 Water colour for main river sites of the Cornwallis River.

4.3. Habitant River Watershed

4.3.1 Tributaries

The Habitant River watershed is the smallest of the three watersheds surveyed. The Habitant River originates north of Centreville and flows eastward where it discharges into the Minas Basin. Its total watershed area is 5,592.6 hectares and it contains five tertiary watersheds ranging in size from 9.1 to 1,994.0 hectares. Of the five tertiary watersheds, water quality samples were collected from four which collectively represent an area of 3,598.6 hectares (64.3%) of the total watershed area. The remaining watershed area is located within the eastern region of the watershed and consists mostly of dyked farmland drained mainly by small constructed ditches and contains no well-defined natural streams. No sampling was conducted on the lower main river due to the lack of access and bridges crossing over the river.

4.3.1.1 Conductivity, Alkalinity and pH

The levels of conductivity, alkalinity and pH are all relatively high (Fig 4.27). At all sites pH levels were just slightly above eight and well within the CCME guidelines for the Protection of Freshwater Aquatic Life. The cause of the high conductivity and pH levels relative to those observed within the Annapolis and Cornwallis watersheds is difficult to explain without further chemical analyses, but may be related to agricultural liming activities.

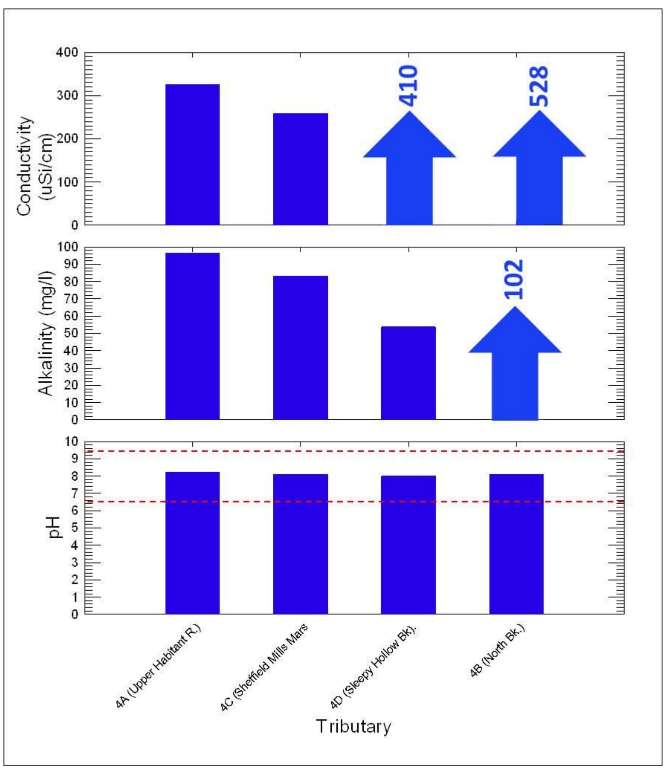

Fig. 4.27. Levels of conductivity, alkalinity and pH in Habitant watershed tributaries (red dashed lines indicate upper and lower CCME limits of pH for protection of aquatic freshwater life).

4.3.1.2 Nutrients

Total nitrogen and nitite+nitrate levels (Fig. 4.28) are high at all sites sampled. Most of the nitrogen is in the inorganic nitrite+nitrate form and is most likely a result of agricultural fertilizer use as this area is not heavily populated and has no nearby sewage treatment facilities. Ammonia levels were also high but well below the CCME guideline for the Protection of Freshwater Aquatic Life which would be about 0.8 mg/L for the levels of water temperature and pH at the time of the survey.

The Upper Habitant River site flows into the Sheffield Mills Marsh which was sampled at the marsh outflow. Comparison of the levels of total and nitrite+nitrate nitrogen indicates that the marsh has some capacity to sequester these forms of nitrogen. Ammonia levels, however, were much higher at the marsh outflow.

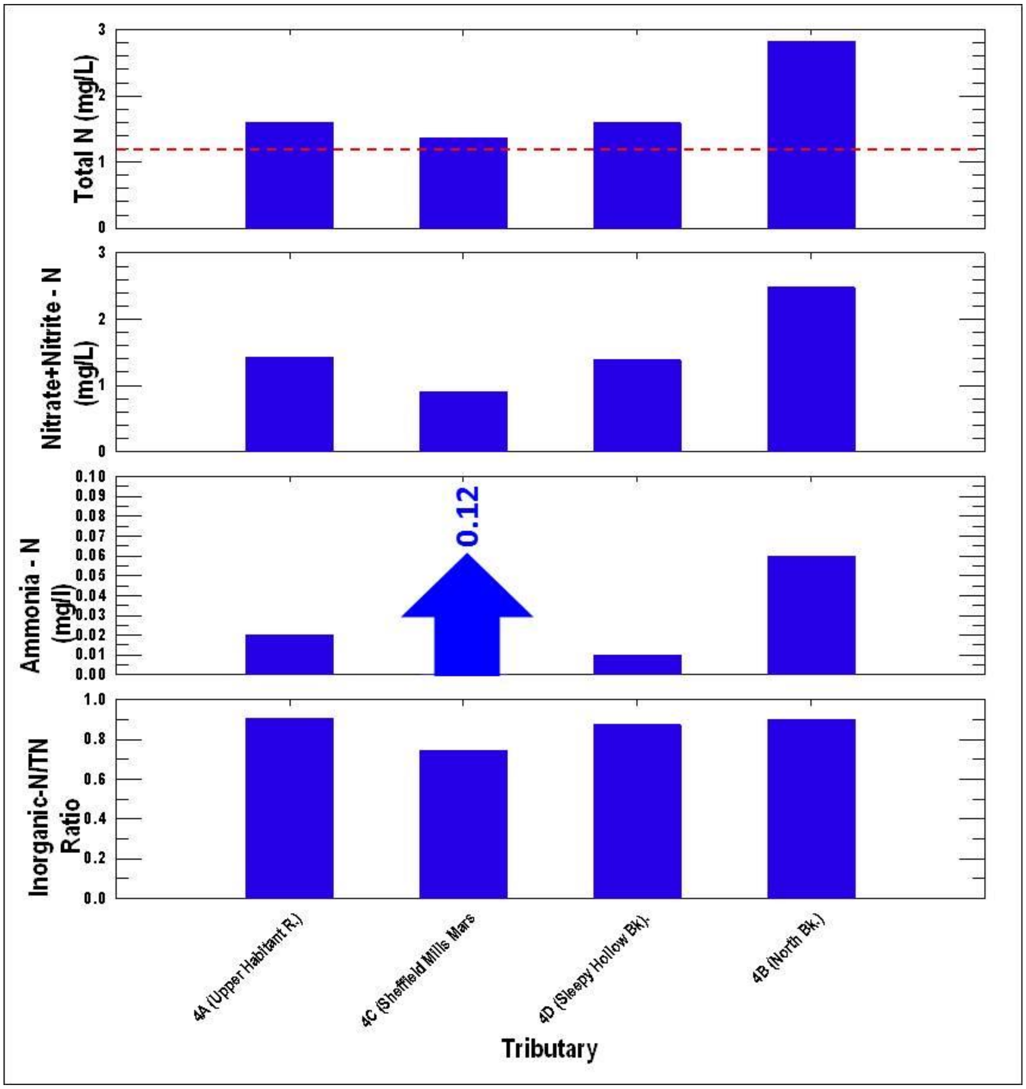

Fig. 4.28. Levels of total nitrogen, nitrite+nitrate and ammonia in tributaries of the Habitant River (red dashed line indicates the Environment Canada guideline for total nitrogen).

Phosphorus levels are also very high at most of the sites sampled (Fig. 4.29). At the North Brook site, more than 80% of the phosphorus is in the inorganic form. The Environment Canada guideline of 0.032 mg/L total phosphorus was exceeded at all of the sites. Unlike nitrogen, the level of phosphorus at the outflow of the marsh was significantly higher than the Upper Habitant River site suggesting that the marsh has reached its capacity to sequester phosphorus.

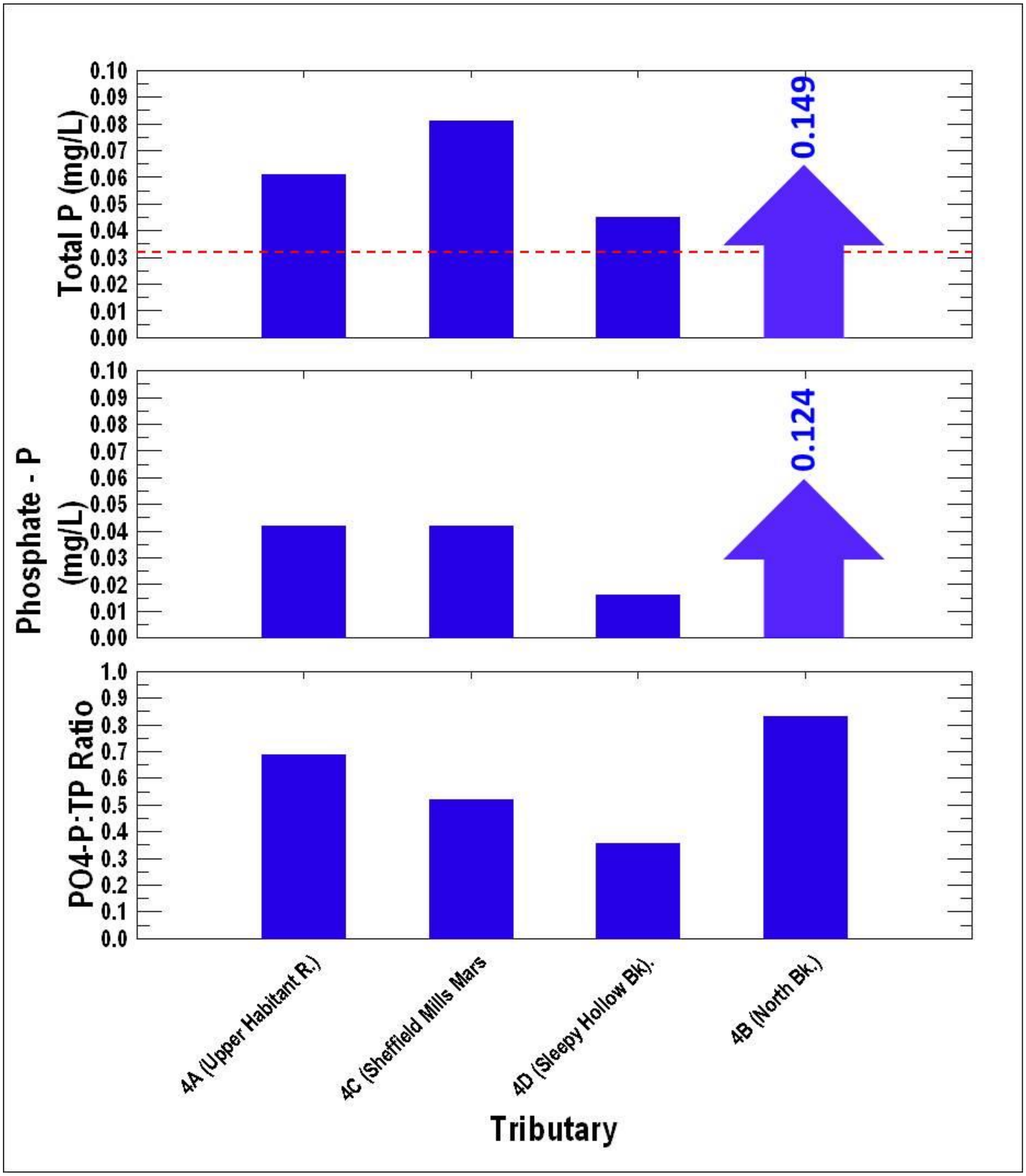

Fig. 4.29. Levels of total phosphorus and phosphate in tributaries of the Habitant River (red dashed line indicates the Environment Canada guideline for total phosphorus)..

4.3.1.3 Nutrient Loadings

Nutrient loadings (Fig 4.30) varied greatly between sites. The zero loadings for the Upper Habitant River site are a result of zero current flow at the time of the survey. The high loading values for the North Brook site are a result of its large flow.

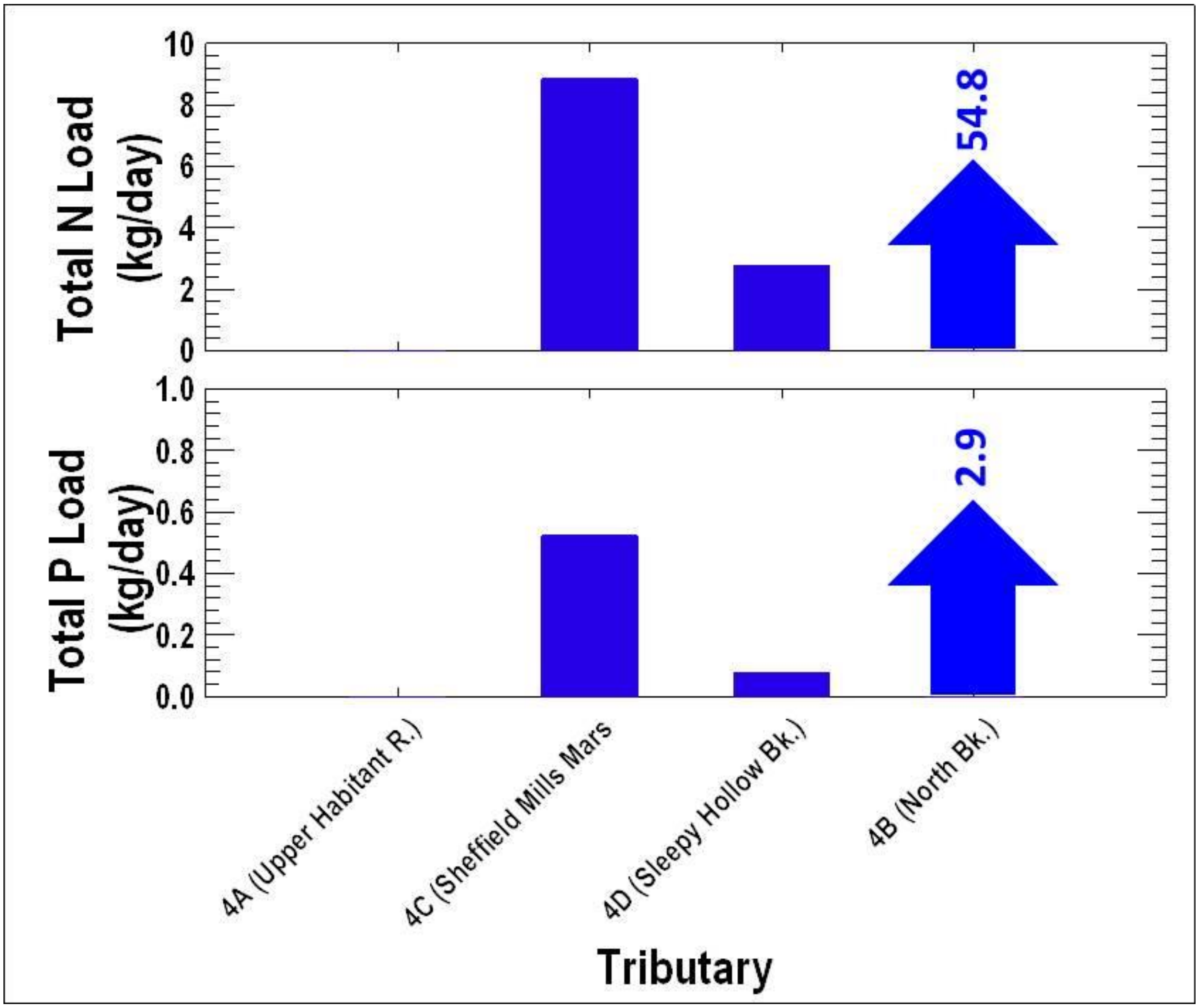

Fig 4.30 Daily total nitrogen and phosphorus loadings in Habitant River watershed tributaries.

4.3.1.4 Water Temperature and Dissolved Oxygen

Water temperatures among the sites varied from a low of 13.5 to a high of 17.7 (Fig 4.31). With one exception (North Brook) dissolved oxygen concentrations were low bordering on the CCME guideline for warm water species and well below the guideline for cold water species.

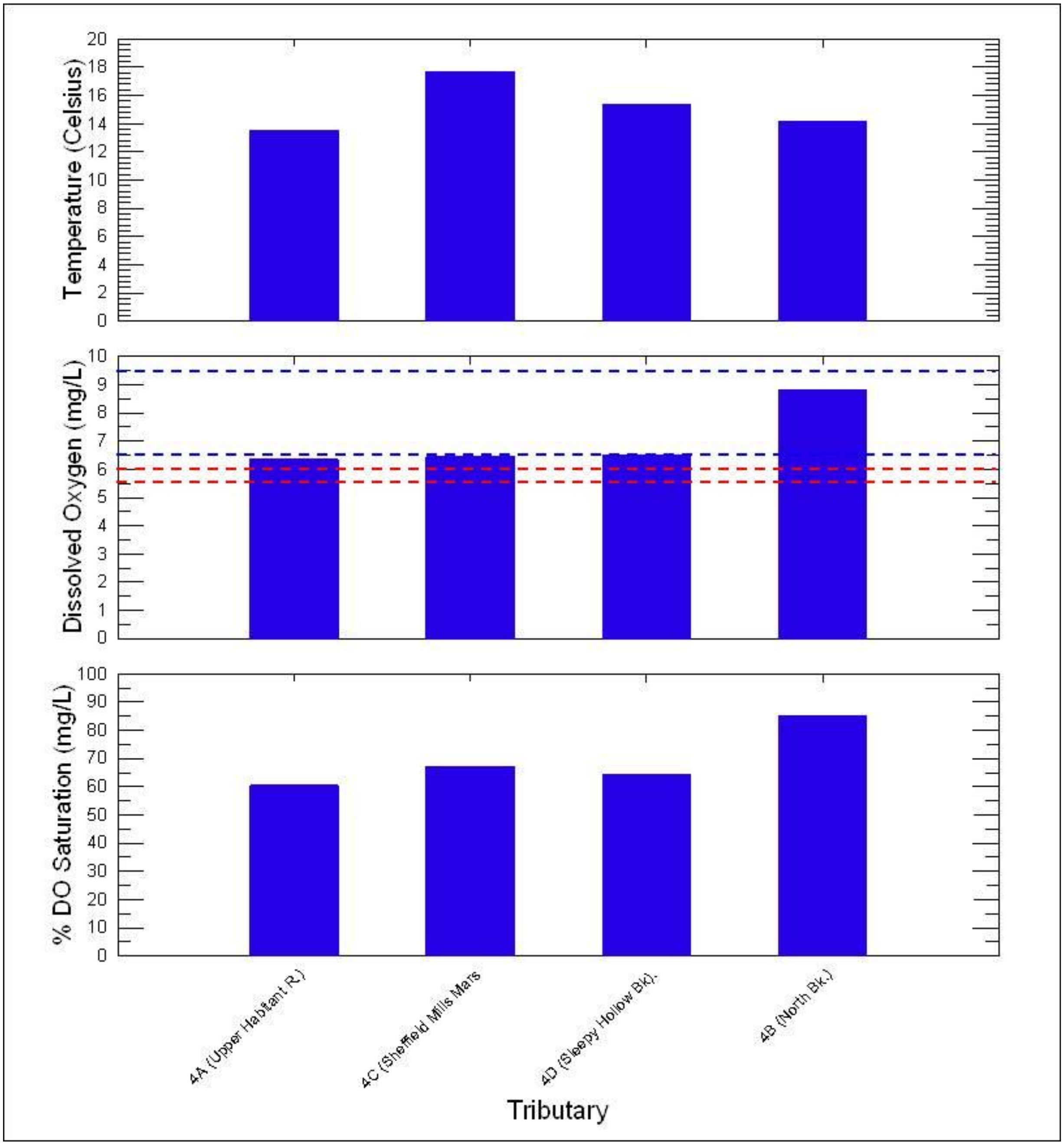

Fig 4.31 Water temperature, dissolved oxygen and percent dissolved oxygen saturation at tributaries of the Habitant River (upper red line indicates CCME guideline boundary for early life stages of warm water species; lower red line indicates CCME guideline boundary for other life stages of warm water species; upper blue line indicates CCME guideline boundary for early life stages of cold water species; lower blue line indicates CCME guideline boundary for other life stages of cold water species).

4.3.1.5 Fecal Coliform Numbers

With the exception of the Sheffield Mills Marsh site, all sites had fecal coliform levels above the CCME guideline for Protection of Agricultural Water Use (Fig 4.32). Two of the four sites had levels near or well above the Health Canada guideline for contact recreational activities.

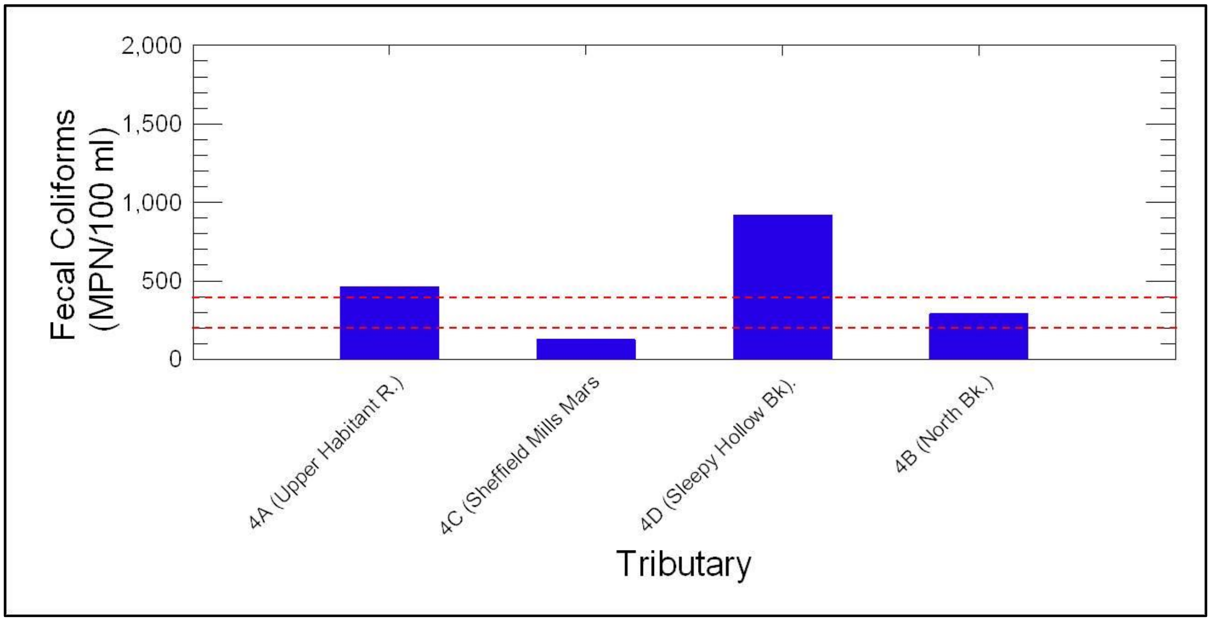

Fig 4.32 Fecal coliform numbers for tributary sites of the Habitant River (lower red line indicates the upper boundary of the CCME guideline for protection of agriculture and upper red line indicates the Health Canada guideline for contact recreation).

4.3.1.6 Water Colour

Water colour was quite low at all of the surveyed sites ranging between 22.7 and 43.7 TCUs (Fig.4.33).

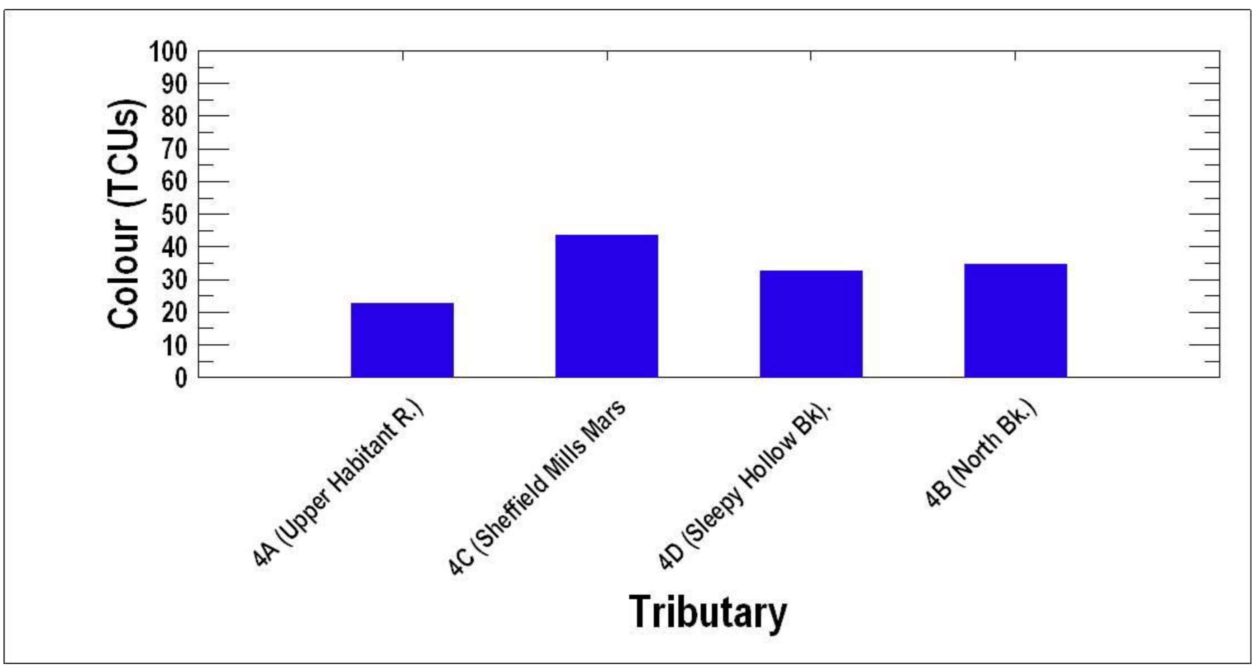

Fig 4.33 Water colour for tributary sites of the Habitant River

4.4 Mink Farm Surveys

There are a total of 13 existing mink farms located within the watersheds surveyed, five of which are located within the Annapolis River watershed, and eight of which are located within the Cornwallis River watershed. There are also two sites, one in the Annapolis River watershed and one within the Cornwallis River watershed, for which applications have been submitted for approval to establish new mink farms. In addition, there is one newly approved and operational mink farm located within the Habitant River watershed. Appendices IIG to III contain maps showing the location of these sites.

Water quality surveys within areas of existing mink farms were carried out using the same parameters and procedures as those used for the tributary sites. Samples were collected at one or more locations from nearby watercourses considered most likely to receive any run-off from existing mink farm activities. In some cases, it was either not possible to identify a nearby waterway specific to the farm site, or the site was not easily accessible. In these cases the sample site location of the nearest river tributary was referenced. Table 4.1 lists the sites sampled and the name of the nearest watercourse or tributary. The water quality data specific to each site is presented in the main database contained in Appendix I.

Table 4.1 Nearest watercourse sampled for existing, new and proposed mink farm sites.

Watershed	Site Name	Nearest Watercourse	Sample Name
Annapolis	MF1	Leonard Brook.	1DC-3YYY
Annapolis	MF8	Burbridge Brook	1DC-3SSS
Annapolis	MF21	South River	21SS
Annapolis	MF20	Gould Brook	20SS
Annapolis	MF22	Hutchinson Brook	22SS
Cornwallis	MF11	Keddy/Armstrong Brook	MF11-SS1/MF11-SS2
Cornwallis	MF12	White Brook	1DD-2G
Cornwallis	MF14	Black River	1DD-3GG
Cornwallis	MF15	Fishwick Brook	1DD-2C
Cornwallis	MF17	Fishwick Brook	1DD-2C
Cornwallis	MF18	Fisher Brook	1DD-2D1
Cornwallis	MF19	Coleman Brook	1DD-2B2
Cornwallis	MF23	Rand Brook	1DD-2F
Cornwallis	ProposedMF1	Bear Brook	1DC-3SS
Annapolis	ProposedMF2	South River	MF21-SS
Habitant	NewMF3	Sleepy Hollow Brook	1DD-4D

4.5 Statistical Comparisons Among Watersheds

Table 4.2 provides a comparative statistical summary of the survey data collected for each individual watershed. These statistics are also illustrated graphically as bar plots (Fig.4.34a and b).

Table 4.2 Statistical comparison of water quality parameters among watersheds**.**

Parameter	Site	N	Min	Max	Median	Arithmetic Mean
Conductivity (µSi/cm)	Annapolis Main River	8	91.8	124.0	109.5	110.7
	Cornwallis Main River	5	215.0	352.0	252.0	277.8
	Annapolis Tributaries	33	25.2	439.0	148.0	168.0
	Cornwallis Tributaries	15	93.1	409.0	235.0	214.0
	Habitant Tributaries	4	259.0	528.0	368.0	380.8
Alkalinity (mg/L)	Annapolis Main River	8	14.8	28.8	16.7	20.2
	Cornwallis Main River	5	40.3	73.0	52.2	56.3
	Annapolis Tributaries	33	0.5	93.3	37.5	35.1
	Cornwallis Tributaries	15	9.8	70.0	47.6	41.7
	Habitant Tributaries	4	53.7	102.0	89.9	83.6
pH	Annapolis Main River	8	7.5	7.7	7.5	7.6
	Cornwallis Main River	5	7.9	8.1	8.0	8.0
	Annapolis Tributaries	33	5.2	8.2	7.8	7.6
	Cornwallis Tributaries	15	7.2	8.1	7.9	7.8
	Habitant Tributaries	4	8.0	8.2	8.1	8.1
Colour (TCUs)	Annapolis Main River	8	100.6	146.3	137.3	130.2
	Cornwallis Main River	5	42,2	75.8	47.4	56.4
	Annapolis Tributaries	33	20.2	229.1	83.1	94.3
	Cornwallis Tributaries	15	16.2	85.3	50.5	49.1
	Habitant Tributaries	4	22.7	43.7	33.7	33.5
Total N (mg/L)	Annapolis Main River	8	0.60	0.82	0.68	0.70
	Cornwallis Main River	5	1.55	2.02	1.77	1.78
	Annapolis Tributaries	33	0.19	3.13	0.60	0.79
	Cornwallis Tributaries	15	0.24	2.14	1.35	1.22
	Habitant Tributaries	4	1.37	2.82	1.60	1.85
Nitrite+Nitrate – N (mg/L)	Annapolis Main River	8	0.25	0.49	0.28	0.34
	Cornwallis Main River	5	0.98	1.60	1.40	1.32
	Annapolis Tributaries	33	<0.01	2.04	0.19	0.38
	Annapolis Tributaries	15	0.05	1.74	0.88	0.88
	Habitant Tributaries	4	0.90	2.48	1.41	1.55
Ammonia - N (mg/L)	Annapolis Main River	8	<0.01	0.02	0.02	0.01
	Cornwallis Main River	5	<0.01	0.02	0.08	0.04
	Annapolis Tributaries	33	<0.01	0.26	0.02	0.03
	Cornwallis Tributaries	15	<0.01	0.06	0.03	0.02
	Habitant Tributaries	4	0.01	0.12	0’04	0.52
Inorganic-N:TN Ratio	Annapolis Main River	8	0.52	0.63	0.58	0.49
	Cornwallis Main River	5	0.67	0.82	0.80	0.76
	Annapolis Tributaries	33	0.04	0.84	0.30	0.37
	Cornwallis Tributaries	15	0.23	0.86	0.74	0.68
	Habitant Tributaries	4	0.75	0.91	0.90	0.86

Table 4.2 (Con't.)

Parameter	Site	N	Min	Max	Median	Arithmetic Mean
Total N Loading Kg N/Day	Annapolis Tributaries	33	0.01	80.19	4.05	10.33
	Cornwallis Tributaries	15	0.117	97.63	5.39	13.94
	Habitant Tributaries	4	0.01	54.82	5.80	16.61
Total P (mg/L)	Annapolis Main River	8	0.029	0.050	0.039	0.039
	Cornwallis Main River	5	0.074	0.092	0.080	0.081
	Annapolis Tributaries	33	0.007	0.210	0.026	0.038
	Cornwallis Tributaries	15	0.011	0.118	0.050	0.051
	Habitant Tributaries	4	0.045	0.149	0.071	0.084
Phosphate - P (mg/L)	Annapolis Main River	8	0.015	0.029	0.024	0.023
	Cornwallis Main River	5	0.034	0.073	0.055	0.056
	Annapolis Tributaries	33	0.003	0.163	0.013	0.027
	Cornwallis Tributaries	15	0.003	0.089	0.030	0.029
	Habitant Tributaries	4	0.016	0.124	0.042	0.056
Inorganic P:TP Ratio	Annapolis Main River	8	0.51	0.63	0.58	0.58
	Cornwallis Main River	5	0.45	0.80	0.74	0.68
	Annapolis Tributaries	33	0.17	0.81	0.50	0.49
	Cornwallis Tributaries	15	0.18	0.75	0.54	0.53
	Habitant Tributaries	4	0.36	0.83	0.60	0.60
Total P Loading Kg P/Day	Annapolis Tributaries	33	0.01	5.35	0.17	0.53
	Cornwallis Tributaries	15	0.01	3.19	0.17	0.54
	Habitant Tributaries	4	0.00	2.90	0.30	0.87
Water Temperature (°C)	Annapolis Main River	8	11.0	12.4	11.9	11.8
	Cornwallis Main River	5	11.7	12.2	12.1	12.0
	Annapolis Tributaries	33	10.7	21.0	15.4	14.9
	Cornwallis Tributaries	15	13.6	18.2	16.8	16.6
	Habitant Tributaries	4	13.5	17.7	14.6	15.2
Dissolved Oxygen (mg/L)	Annapolis Main River	8	6.15	8.50	7.05	7.03
	Cornwallis Main River	5	5.84	7.42	6.18	6.45
	Annapolis Tributaries	33	5.24	11.1	7.73	8.13
	Cornwallis Tributaries	15	6.40	9.07	8.01	7.86
	Habitant Tributaries	4	6.35	8.80	6.48	7.03
% DO Saturation (mg/L)	Annapolis Main River	8	56.5	78.5	64.6	64.3
	Cornwallis Main River	5	53.8	67.8	57.0	59.3
	Annapolis Tributaries	33	54.2	106.3	77.22	79.4
	Cornwallis Tributaries	15	61.0	94.8	81.8	80.1
	Habitant Tributaries	4	60.4	85.0	65.8	69.3
Fecal Coliforms (MPN/100ml)	Annapolis Main River	8	161	1120	410	411
	Cornwallis Main River	5	75	1120	130	336
	Annapolis Tributaries	33	20	>2419	365	703
	Cornwallis Tributaries	15	109	>2419	1414	1226
	Habitant Tributaries	4	126	921	376	450

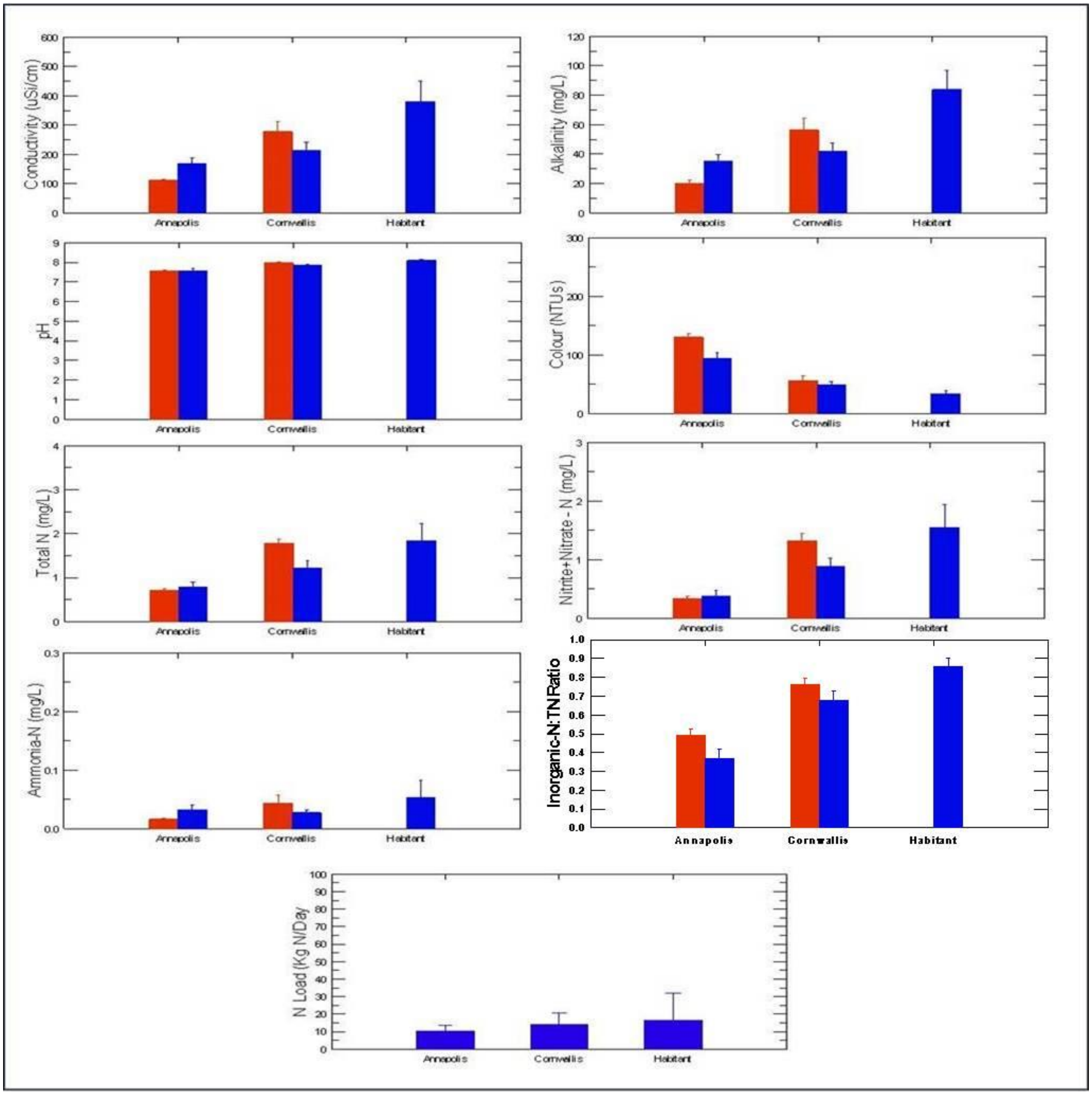

Fig 4.34a. Mean value of each survey parameter for main river (■) and tributary (■) sites in each watershed (error bars are one standard error of the mean).

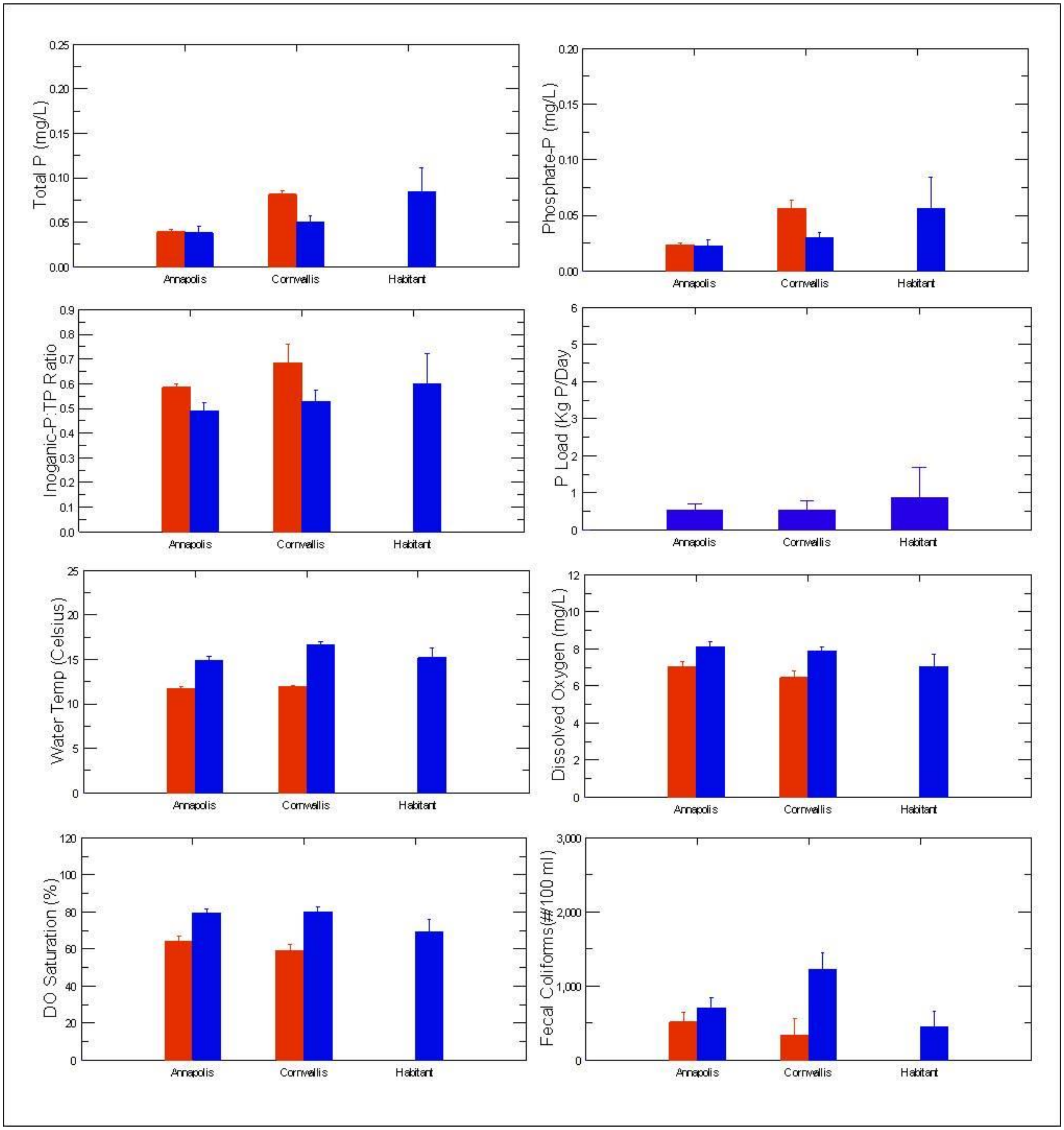

Fig 4.34b. Mean value of each survey parameter for main river (■) and tributary (■) sites in each watershed (error bars are one standard error of the mean).

Although there are significant differences between the surveyed watersheds in conductivity and, alkalinity, the highest levels being observed in the Habitant and the lowest levels in the Annapolis, pH within all of the watersheds was quite similar. The differences among watersheds in conductivity and alkalinity are most likely due to differences in the geological characteristcs of each waterhshed.

There are also signicficant differences in water colour among watersheds, the highest values being observed in the Annapolis watershed and the lowest in the Habitant. Water colour in these watersheds is determined largely by the levels of dissolved humic substances which originate from lechates of coniferous vegetation.

Nutrient levels also vary significantly among watersheds. All forms of both nitrogen and phosphorus, as well as nitrogen and phosphorous loadings, are highest in the Habitant and lowest in the Annapolis. This trend is also true for the proportion of inorganic forms of nitrogen and phosphorus present.

Water temperature, dissolved oxygen and percent dissolved oxygen levels show relatively little variation among watersheds.

Fecal coliform numbers in tributaries are highest in the Cornwallis watershed and lowest in the Habitant.

For the most part, the trends exhibited for the Annapolis and Cornwallis main river sites were similar to that exhibited for the tributary sites. Comparisons between the tributary and main river mean levels of the surveyed parameters within each watershed show a general trend for the main river to have higher water colour and nutrient levels and tributaries to have higher levels of water temperature, dissolved oxygen and fecal coliform bacteria.

5. Discussion

The results of this survey suggest that all of the watersheds surveyed exhibit some degree of degradation in water quality. Of particular concern are the high nutrient levels and fecal coliform numbers.

The level and form of nutrients present in all of the surveyed watersheds are not typical of what would be expected in a watershed not degraded to any significant extent. In particular, the fact that a large proportion of the nitrogen and phosphorus is in the inorganic form is indicative of anthropogenic nutrient over-enrichment, and is likely a result of the high level of agricultural activity present in all three of the watersheds surveyed. The fact that mean levels of the inorganic nutrients are higher within the main river than the tributaries suggests that either much of this enters the river through direct surface run-off, or that a considerable portion of the nutrient load to the river settles and accumulates within the bottom of the river and at the time of the surveys had become resuspended. It could also be a result of point sources of nutrient inputs from sewage treatment plants and/or septic systems.

Fecal coliform bacteria levels are also high. Potential sources of fecal coliform bacteria include agricultural livestock activities, sewage treatment plant outflows and faulty septic systems. A large proportion of the tributaries and main river sites surveyed exceeded the CCME guideline for agricultural water use and a significant proportion exceeded the Health Canada guideline for recreational water use. In contrast to the trends exhibited by nutrient levels, fecal coliform numbers tended to be higher within the tributaries than within the main river sites and were surprising low in the lower portion of the Cornwallis River.

The levels of pH varied very little among sites and were very good, all but one site falling within the CCME guidelines for protection of aquatic life. This indicates that all three watersheds have good buffering capacity and are not being impacted by acid precipitation.

6. References

Brylinsky, M**.** 2011. Water quality survey of ten lakes in the Carleton River watershed area of Digby and Yarmouth Counties, Nova Scotia. Report prepared for the Nova Scotia Department of Environment. 78p.

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APPENDIX I

Database Tables

Appendix 1A Sample Site Names and Locations

Watershed	Secondary Watershed Code	Tertiary Watershed Code	Tributary Name	Sample Station ID	Northing	Easting
Annapolis	1DC	3RR	Hutchinson Bk.	A3RR	4985777	360778
Annapolis	1DC	3TT	Skinner Bk.	A3TT	4987828	357227
Annapolis	1DC	3VV	Patterson Bk.	A3VV	4987724	356389
Annapolis	1DC	3XX	Graves Bk.	A3XX	4987394	355049
Annapolis	1DC	3ZZ	McGee Bk.	A3ZZ	4986195	353717
Annapolis	1DC	3AAA	Avery Bk.	A3AAA	4985866	353219
Annapolis	1DC	3LL	Zeke Bk.	A3LL	4982305	346610
Annapolis	1DC	3JJ	Fales R.	A3JJ	4981392	345239
Annapolis	1DC	3CC	Lewis Bk.	A3CC	4981105	344479
Annapolis	1DC	3EEE	Wisnal Bk.	A3EEE	4980734	343129
Annapolis	1DC	3GG	Black R.	A3GG	4979662	342036
Annapolis	1DC	3GGG	Watton Bk.	A3GGG	4979518	340298
Annapolis	1DC	3JJJ	Evans Bk.	A3JJJ	4979372	339360
Annapolis	1DC	3LLL	Morton Bk.	A3LLL	4979095	337836
Annapolis	1DC	3CCC	Nictaux R.	A3CCC	4978204	337218
Annapolis	1DC	3AA	Kempt Bk.	A3AA	4976203	334934
Annapolis	1DC	3QQQ	Slokum	A3QQQ	4976740	334797
Annapolis	1DC	3Y	Delancys Bk.	A3Y	4975371	334080
Annapolis	1DC	3SSS	Burbridge Bk.	A3SSS	4974808	332607
Annapolis	1DC	3UUU	McEwan Bk.	A3UUU	4974450	331928
Annapolis	1DC	3W	Gehues Bk.	A3W	4973193	330826
Annapolis	1DC	3WWW	Oak Hollow Bk.	A3WWW	4972944	330504

Appendix 1A (Con't.)

Watershed	Secondary Watershed Code	Tertiary Watershed Code	Tributary Name	Sample Station ID	Northing	Easting
Annapolis	1DC	3V	Petes Bk.	A3V	4972906	330528
Annapolis	1DC	3U	Millers Bk.	A3U	4972463	330200
Annapolis	1DC	3YYY	Leonards Bk.	A3YYY	4970888	326218
Annapolis	1DC	3AAAA	Shearer Bk.	A3AAAA	4970509	324887
Annapolis	1DC	3P	Paradise Bk	A3P	4970310	324910
Annapolis	1DC	3N	Saunders Bk.	A3N	4969283	323097
Annapolis	!DC	3CCCC	Munroe Bk.	A3CCCC	4968980	322404
Annapolis	1DC	3M	Daniels Bk.	A3M	4968642	321697
Annapolis	1DC	3EEEE	Saunders West Bk.	A3EEEE	4968625	321458
Annapolis	1DC	3L	Bulton Bk.	A3L	4967226	320117
Annapolis	1DC	3K	Bloody Ck.	A3K	4965805	317372
Cornwallis	1DD	2G	White Bk.	C2G	4991131	359714
Cornwallis	1DD	2F	Rand Bk.	C2F	4990755	361529
Cornwallis	1DD	2D-TB	Thomas Bk.	C2D-TB	4990904	362211
Cornwallis	1DD	2D-FB	Fisher Bk.	C2D-FB	4992884	363111
Cornwallis	1DD	2C	Fishwick Bk.	C2C	4990848	367489
Cornwallis	1DD	2H	Rockford Bk.	C2H	4990534	368235
Cornwallis	1DD	2K	Sharpe Bk.	C2K	4990650	371390
Cornwallis	1DD	2M	Spiddle Bk.	C2M	4991144	373973
Cornwallis	1DD	2B-CB	Coleman Bk.	C2B-CB	4993613	374113
Cornwallis	1DD	2BBB	Brandywine Bk.	C2BBB	4993944	374702
Cornwallis	1DD	2P	Tupper Bk.	C2P	4991629	375988
Cornwallis	1DD	2N	Chute Bk.	C2N	4994310	376741
Cornwallis	1DD	2A	Black Bk.	C2A	4994123	377286

Appendix 1A (Con't.)						
Watershed	**Secondary Watershed Code**	**Tertiary Watershed Code**	**Tributary Name**	**Sample Station ID**	**Northing**	**Easting**
Cornwallis	1DD	2R	Mill Bk.	C2R	4992391	382582
Cornwallis	1DD	2T	Elderkin Bk.	C2T	4991964	383707
Habitant	1DD	4A	Upper Habitant River	H4A	4999935	380759
Habitant	1DD	4C	Sheffield Mills Marsh Outflow	H4C	5000861	383292
Habitant	1DD	4B	North Bk.	H4B	5000660	384106
Habitant	1DD	4D	Sleepy Hollow Bk.	H4D	5001758	383267

Appendix 1B Annapolis Watershed (Secondary Watershed Code 1DC) Tributary Survey Data

Tributary	Tertiary Watershed Code	Date	Conductivity (uSi/cm)	pH	Alkalinity (mg/L)	True Colour (TCUs)	Total N (mg/L)	Nitratre+nitrite - N (mg/L)	Ammonia - N (mg/L)	T0tal P (mg/L)	Phosphate - P (mg/L)	Fecal Coliforms (MPN/100ml)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	% DO Saturation
Hutchinson Bk.	3RR	9-Sep-13	38.9	6.5	4.5	229.1	0.66	0.19	<0.01	0.030	0.009	135	11.6	11.07	56.9
Skinner Bk.	3TT	9-Sep-13	280.0	8.0	60.3	126.7	1.77	1.42	0.06	0.055	0.024	613	12.0	10.90	56.4
Patterson Bk.	3VV	9-Sep-13	342.0	8.2	91.4	109.8	3.13	2.04	0.06	0.098	0.070	1120	11.5	11.12	59.5
Graves Bk.	3XX	9-Sep-13	364.0	8.2	93.3	64.1	1.41	1.06	0.02	0.042	0.025	980	12.0	11.05	64.2
McGee Bk.	3ZZ	9-Sep-13	240.0	8.1	73.9	49.3	1.12	0.88	0.02	0.065	0.025	649	11.2	10.92	67.9
Avery Bk.	3AAA	9-Sep-13	301.0	7.9	45.8	41.7	1.01	0.80	0.02	0.023	0.011	308	10.7	10.82	66.1
Zeke Bk.	3LL	12-Sep-13	278.0	7.8	37.5	34.5	0.69	0.47	0.02	0.022	0.013	135	15.5	10.77	65.0
Fales R.	3JJ	12-Sep-13	53.3	6.9	6.2	196.4	0.67	0.21	<0.01	0.027	0.010	308	17.3	10.82	78.5
Lewis Bk.	3CCC	12-Sep-13	41.3	6.9	4.5	86.6	0.35	0.06	<0.01	0.029	0.019	63	17.2	10.97	70.5
Wisnal Bk.	3EEE	12-Sep-13	148.0	7.7	38.8	78.8	0.35	<0.01	0.04	0.045	0.018	32	17.4	10.87	66.9
Black R.	3GG	12-Sep-13	69.6	7.4	13.9	187.9	0.53	0.09	<0.01	0.013	<0.005	411	18.0	11.00	86.4
Watton Bk.	3GGG	12-Sep-13	188.0	8.1	62.1	63.1	0.88	0.51	0.02	0.050	0.037	345	17.4	10.87	73.6
Evans Bk.	3JJJ	12-Sep-13	190.0	7.9	41.1	63.6	1.90	1.41	0.04	0.026	0.010	291	18.0	11.07	79.3
Morton Bk.	3LLL	12-Sep-13	439.0	8.1	59.3	35.0	0.35	0.10	<0.01	0.015	0.008	365	18.1	11.20	63.4
Nictaux R.	3CC	12-Sep-13	108.0	7.6	22.8	121.6	0.75	0.35	0.06	0.050	0.031	>2419	21.0	10.06	79.5
Kempt Bk.	3AA	23-Sep-13	117.0	7.7	29.8	40.8	0.54	0.26	0.02	0.024	0.016	281	14.2	9.68	82.6
Slokum Bk.	3QQQ	23-Sep-13	395.0	7.9	36.1	20.2	0.19	<0.01	0.01	0.010	0.005	756	16.5	9.70	68.0
Delancys Bk.	3Y	23-Sep-13	53.9	6.8	5.4	154.0	0.40	<0.01	0.02	0.012	<0.005	830	16.5	9.66	54.2
Burbridge Bk.	3SSS	24-Sep-13	167.0	8.0	44.1	78.0	0.43	0.02	0.03	0.043	0.025	1553	16.6	9.55	79.2
McEwan Bk.	3UUU	23-Sep-13	214.0	7.8	39.6	114.0	0.90	0.22	0.08	0.105	0.058	>2419	16.7	9.66	75.5
Gehues Bk.	3W	23-Sep-13	68.5	7.4	10.6	63.3	0.38	<0.01	0.04	0.018	0.006	1414	16.4	9.55	73.8
Oak Hollow Bk.	3WWW	23-Sep-13	220.0	8.0	53.8	130.6	1.74	0.66	0.26	0.201	0.163	>2419	16.6	9.53	77.3
Petes Bk.	3V	23-Sep-13	140.0	7.6	13.9	35.4	0.25	<0.01	<0.01	0.007	<0.005	659	15.3	8.99	77.2
Millers Bk.	3U	23-Sep-13	110.0	7.6	16.0	83.1	0.29	<0.01	0.02	0.015	<0.005	376	15.4	10.35	58.1
Leonards Bk.	3YYY	24-Sep-13	182.0	8.0	50.7	125.5	1.54	0.81	0.05	0.089	0.061	>2419	13.0	9.85	65.9
Shearer Bk.	3AAAA	24-Sep-13	148.0	8.0	46.8	105.6	0.64	0.28	0.01	0.039	0.030	238	12.1	9.85	78.8
Saunders Bk.	3N	24-Sep-13	123.0	7.7	23.3	24.7	0.72	0.54	0.03	0.011	0.007	245	12.6	9.83	73.3
Paradise Bk	3P	24-Sep-13	47.1	7.1	7.0	97.9	0.31	<0.01	0.01	0.009	<0.005	192	12.0	9.81	76.8
Munroe Bk.	3CCCC	24-Sep-13	186.0	8.0	60.6	53.0	0.45	0.10	0.03	0.031	0.019	770	13.8	9.87	76.2
Daniels Bk.	3M	24-Sep-13	25.2	5.2	<1.0	151.0	0.36	<0.01	0.02	0.009	<0.005	20	16.0	9.83	72.4
Saunders West Bk.	3EEEE	24-Sep-13	175.0	8.0	54.3	109.0	0.60	0.02	0.02	0.024	0.014	184	13.3	10.10	76.6
Bulton Bk.	3L	24-Sep-13	54.2	7.2	8.2	83.1	0.29	0.02	<0.01	0.010	<0.010	172	12.3	10.08	85.8
Bloody Ck.	3K	23-Sep-13	37.3	6.3	2.4	154.4	0.38	<0.01	0.01	0.011	<0.005	99	13.8	10.63	94.1

Appendix 1C Annapolis Watershed Main River Survey Data														
Site	**Date**	**Conductivity (uSi/cm)**	**pH**	**Alkalinity (mg/L)**	**True Colour (TCUs)**	**Total N (mg/L)**	**Ammonia - N (mg/L)**	**Nitrite+Nitrate (mg/L)**	**T0tal P (mg/L)**	**Phosphate -P (mg/L)**	**Fecal Coliforms (MPN/100ml)**	**Water Temperature (°C)**	**Dissolved Oxygen (mg/L)**	**% DO Saturation**
Greenwood	9-Oct-13	124.0	7.7	28.8	104.4	0.81	0.48	<0.01	0.038	0.024	161	11.20	6.30	56.9
Kingston	9-Oct-13	120.0	7.7	27.6	100.6	0.82	0.49	0.01	0.038	0.022	199	11.90	6.15	56.4
Wilmot	9-Oct-13	122.0	7.7	24.8	135.3	0.75	0.40	<0.01	0.039	0.024	260	11.00	6.62	59.5
Middleton	9-Oct-13	91.8	7.5	14.8	139.2	0.60	0.25	<0.01	0.029	0.015	548	11.30	7.09	64.2
Brickton	9-Oct-13	108.0	7.5	16.3	134.6	0.67	0.29	<0.01	0.037	0.021	272	11.80	7.42	67.9
Lawrencetown	9-Oct-13	106.0	7.5	16.2	141.2	0.66	0.26	0.01	0.041	0.024	727	12.20	7.15	66.1
Paradise	9-Oct-13	111.0	7.5	17.0	146.3	0.68	0.26	0.01	0.050	0.029	816	12.40	7.00	65.0
Bridgetown	9-Oct-13	103.0	7.5	16.0	140.0	0.68	0.27	0.02	0.044	0.027	1120	12.20	8.50	78.5

Appendix 1D Annapolis Watershed Tributary Nutrient Loadings.									
Tributary	**Date**	**Current Velocity (m/sec)**	**Width (m)**	**Depth (m)**	**Surface Area (m^2)**	**Total N (mg/L)**	**Total P (mg/L)**	**Nitrogen Load (kg/day)**	**Phosphorus Load (kg/day)**
Hutchinson Bk.	9-Sep-13	0.14	2.0	0.75	1.50	0.66	0.030	11.98	0.54
Skinner Bk.	9-Sep-13	0.10	2.0	0.46	0.92	1.77	0.055	14.07	0.44
Patterson Bk.	9-Sep-13	0.11	2.0	0.43	0.86	3.13	0.098	25.58	0.80
Graves Bk.	9-Sep-13	0.17	2.5	0.11	0.28	1.41	0.042	5.70	0.17
McGee Bk.	9-Sep-13	0.13	1.0	0.46	0.46	1.12	0.065	5.79	0.34
Avery Bk.	9-Sep-13	0.01	3.0	0.23	0.69	1.01	0.023	0.60	0.01
Zeke Bk.	12-Sep-13	0.20	2.0	0.34	0.34	0.69	0.022	4.05	0.13
Fales R.	12-Sep-13	0.66	2.0	1.00	1.00	0.67	0.027	38.21	1.54
Lewis Bk.	16-Sep-13	0.01	0.5	0.10	0.03	0.35	0.029	0.01	0.00
Wisnal Bk.	12-Sep-13	0.01	1.0	0.36	0.18	0.35	0.045	0.05	0.01
Black R.	9-Sep-13	0.52	4.0	0.18	0.36	0.53	0.013	8.57	0.21
Watton Bk.	12-Sep-13	1.00	2.5	0.19	0.24	0.88	0.050	18.06	1.03
Evans Bk.	12-Sep-13	0.09	1.0	0.15	0.15	1.90	0.026	2.22	0.03
Morton Bk.	12-Sep-13	0.07	2.0	0.84	1.68	0.35	0.015	3.56	0.15
Nictaux R.	12-Sep-13	0.15	15.0	0.55	8.25	0.75	0.050	80.19	5.35
Kempt Bk.	9-Sep-13	0.20	0.3	0.13	0.02	0.54	0.024	0.15	0.01
Slokum	23-Sep-13	0.06	2.0	1.00	2.00	0.19	0.010	1.97	0.10
Delancys Bk.	23-Sep-13	0.15	4.0	0.50	1.00	0.40	0.012	5.18	0.16
Burbridge Bk.	24-Sep-13	0.09	2.5	0.33	0.83	0.43	0.043	2.76	0.28
McEwan Bk.	23-Sep-13	0.19	2.0	0.71	1.42	0.90	0.105	20.98	2.45
Gehues Bk.	23-Sep-13	0.05	2.0	0.60	0.60	0.38	0.018	0.98	0.05
Oak Hollow Bk.	23-Sep-13	0.04	4.0	0.40	1.60	1.74	0.201	9.62	1.11
Petes Bk.	23-Sep-13	0.05	2.0	0.43	0.86	0.25	0.007	0.93	0.03
Millers Bk.	23-Sep-13	0.05	4.0	0.48	0.96	0.29	0.015	1.20	0.06
Leonards Bk.	24-Sep-13	0.07	3.0	0.38	0.57	1.54	0.089	5.31	0.31
Shearer Bk.	24-Sep-13	0.06	2.0	0.42	0.84	0.40	0.039	1.74	0.17
Paradise Bk	24-Sep-13	0.36	2.5	0.25	0.63	0.31	0.009	6.03	0.17
Saunders Bk.	24-Sep-13	0.01	1.0	0.32	0.16	0.72	0.011	0.10	0.00
Munroe Bk.	24-Sep-13	0.08	2.0	0.18	0.36	0.45	0.031	1.12	0.08
Daniels Bk.	24-Sep-13	1.05	5.0	0.33	1.65	0.36	0.009	53.89	1.35
Saunders West Bk.	24-Sep-13	0.35	0.9	0.07	0.06	0.60	0.024	1.14	0.05
Bulton Bk.	24-Sep-13	0.08	3.0	0.22	0.66	0.29	0.010	1.32	0.05
Bloody Ck.	23-Sep-13	0.99	2.0	0.12	0.24	0.38	0.011	7.80	0.23

Appendix 1E Cornwallis Watershed Tributary (Secondary Watershed Code 1DD) Survey Data

Tributary	Tertiary Watershed Code	Date	Conductivity (uSi/cm)	pH	Alkalinity (mg/L)	True Colour (TCUs)	Total N (mg/L)	Nitratre+nitrite - N (mg/L)	Ammonia - N (mg/L)	T0tal P (mg/L)	Phosphate - P (mg/L)	T0tal P (mg/L)	Fecal Coliforms (MPN/100ml)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	% DO Saturation
White Bk.	2G	4-Sep-13	176.0	8.0	51.1	50.5	1.58	1.16	<0.01	0.050	0.033	0.050	1733	17.0	9.05	53.8
Rand Bk.	2F	4-Sep-13	247.0	8.0	53.4	60.7	1.81	1.41	0.04	0.048	0.030	0.048	>2419	17.7	7.70	55.2
Thomas Bk.	2D	4-Sep-13	321.0	8.0	63.0	56.6	1.36	0.88	0.06	0.066	0.037	0.066	>2419	17.9	8.35	62.5
Fisher Bk.	2D	4-Sep-13	409.0	7.9	47.6	73.4	1.08	0.67	0.04	0.050	0.020	0.050	1414	17.9	8.05	67.8
Fishwick Bk.	2C	4-Sep-13	235.0	8.1	70.0	38.4	1.66	1.13	0.04	0.118	0.089	0.118	>2419	18.2	6.68	57.0
Rockford Bk.	2H	4-Sep-13	93.1	7.6	17.5	40.1	1.35	1.06	0.03	0.048	0.030	0.048	816	16.7	6.73	92.9
Sharpe Bk.	2K	4-Sep-13	94.6	7.2	9.8	85.3	0.61	0.26	0.01	0.040	0.021	0.040	1553	16.5	7.29	80.2
Spiddle Bk.	2M	4-Sep-13	101.0	7.4	12.9	36.8	0.83	0.60	0.05	0.060	0.044	0.060	1553	14.8	7.56	87.3
Coleman Bk.	2B	5-Sep-13	264.0	8.1	61.3	51.6	2.14	1.64	0.04	0.070	0.037	0.070	1300	16.8	8.01	84.2
Brandywine Bk.	2B	5-Sep-13	305.0	8.1	68.0	49.8	1.80	1.36	0.04	0.071	0.033	0.071	1553	16.2	8.71	70.3
Tupper Bk.	2P	4-Sep-13	166.0	7.6	14.8	21.4	1.02	0.85	0.02	0.011	<0.005	0.011	291	17.3	8.03	68.6
Chute Bk.	2N	5-Sep-13	237.0	8.1	59.6	25.8	2.05	1.74	0.02	0.035	0.022	0.035	488	14.2	8.52	74.0
Black Bk.	2A	5-Sep-13	103.0	7.9	38.8	75.6	0.24	0.05	<0.01	0.057	0.028	0.057	109	13.6	6.40	74.0
Mill Bk.	2R	4-Sep-13	104.0	7.7	22.1	54.5	0.40	0.12	<0.01	0.014	<0.005	0.014	172	17.9	9.07	81.8
Elderkin Bk.	2T	4-Sep-13	354.0	7.9	35.8	16.2	0.46	0.32	<0.01	0.024	0.013	0.024	152	16.5	7.79	87.9

Appendix 1F Cornwallis Watershed Main River Survey Data														
Site	**Date**	**Conductivity (uSi/cm)**	**pH**	**Alkalinity (mg/L)**	**True Colour (TCUs)**	**Total N (mg/L)**	**Ammonia - N (mg/L)**	**Nitrite+Nitrate (mg/L)**	**T0tal P (mg/L)**	**Phosphate -P (mg/L)**	**Fecal Coliforms (MPN/100ml)**	**Water Temperature (°C)**	**Dissolved Oxygen (mg/L)**	**% DO Saturation**
Berwick (Willow Rd.)	9-Oct-13	352.0	8.0	73.0	75.8	1.55	0.05	0.98	0.075	0.034	1120	12.10	5.84	57.0
Berwick (Shaw Rd.)	9-Oct-13	346.0	8.1	72.7	73.3	1.69	0.08	1.15	0.086	0.054	260	12.20	5.97	67.8
Cambridge	9-Oct-13	224.0	7.9	43.1	47.4	1.89	<0.01	1.48	0.092	0.073	130	11.80	6.83	62.5
Coldbrook	9-Oct-13	215.0	7.9	40.3	42.9	1.77	<0.01	1.40	0.080	0.064	93	11.70	7.42	55.2
Kentville	9-Oct-13	252.0	8.0	52.2	42.4	2.02	0.05	1.60	0.074	0.055	75	12.10	6.18	53.8

Appendix 1G. Cornwallis River Watershed Tributary Nutrient Loadings.

Tributary	Date	Current Velocity (m/sec)	Width (m)	Depth (m)	Surface Area (m^2)	Total N (mg/L)	Total P (mg/L)	Nitrogen Load (kg/day)	Phosphorus Load (kg/day)
White Bk.	4-Sep-13	0.27	1.0	0.08	0.08	1.58	0.090	2.95	0.17
Rand Bk.	4-Sep-13	0.01	1.0	0.15	0.08	1.81	0.048	0.12	0.00
Thomas Bk.	4-Sep-13	0.13	1.0	0.36	0.18	1.36	0.066	2.75	0.13
Fisher Bk.	4-Sep-13	0.55	1.0	0.21	0.11	1.08	0.050	5.39	0.25
Fishwick Bk.	4-Sep-13	0.22	1.0	0.19	0.19	1.66	0.118	6.00	0.43
Rockford Bk.	4-Sep-13	0.07	1.0	1.00	1.00	1.35	0.048	8.16	0.29
Sharpe Bk.	4-Sep-13	0.25	3.0	0.49	1.47	0.61	0.040	19.37	1.27
Spiddle Bk.	4-Sep-13	0.17	2.0	0.16	0.16	0.83	0.060	1.95	0.14
Coleman Bk.	5-Sep-13	0.33	8.0	0.20	1.60	2.14	0.070	97.63	3.19
Brandywine Bk.	5-Sep-13	0.17	5.0	0.29	1.45	1.80	0.071	38.34	1.51
Tupper Bk.	4-Sep-13	0.12	2.0	0.58	1.16	1.02	0.011	12.27	0.13
Chute Bk.	5-Sep-13	0.25	0.8	0.16	0.06	2.05	0.035	2.66	0.05
Black Bk.	5-Sep-13	0.30	1.0	0.16	0.08	0.24	0.057	0.50	0.12
Mill Bk.	4-Sep-13	0.38	7.0	0.22	0.77	0.40	0.014	10.11	0.35
Elderkin Bk.	4-Sep-13	0.14	1.5	0.23	0.17	0.46	0.024	0.96	0.05

Appendix 1H. Habitant Watershed Tributary (Secondary Watershed Code 1DD) Survey Data

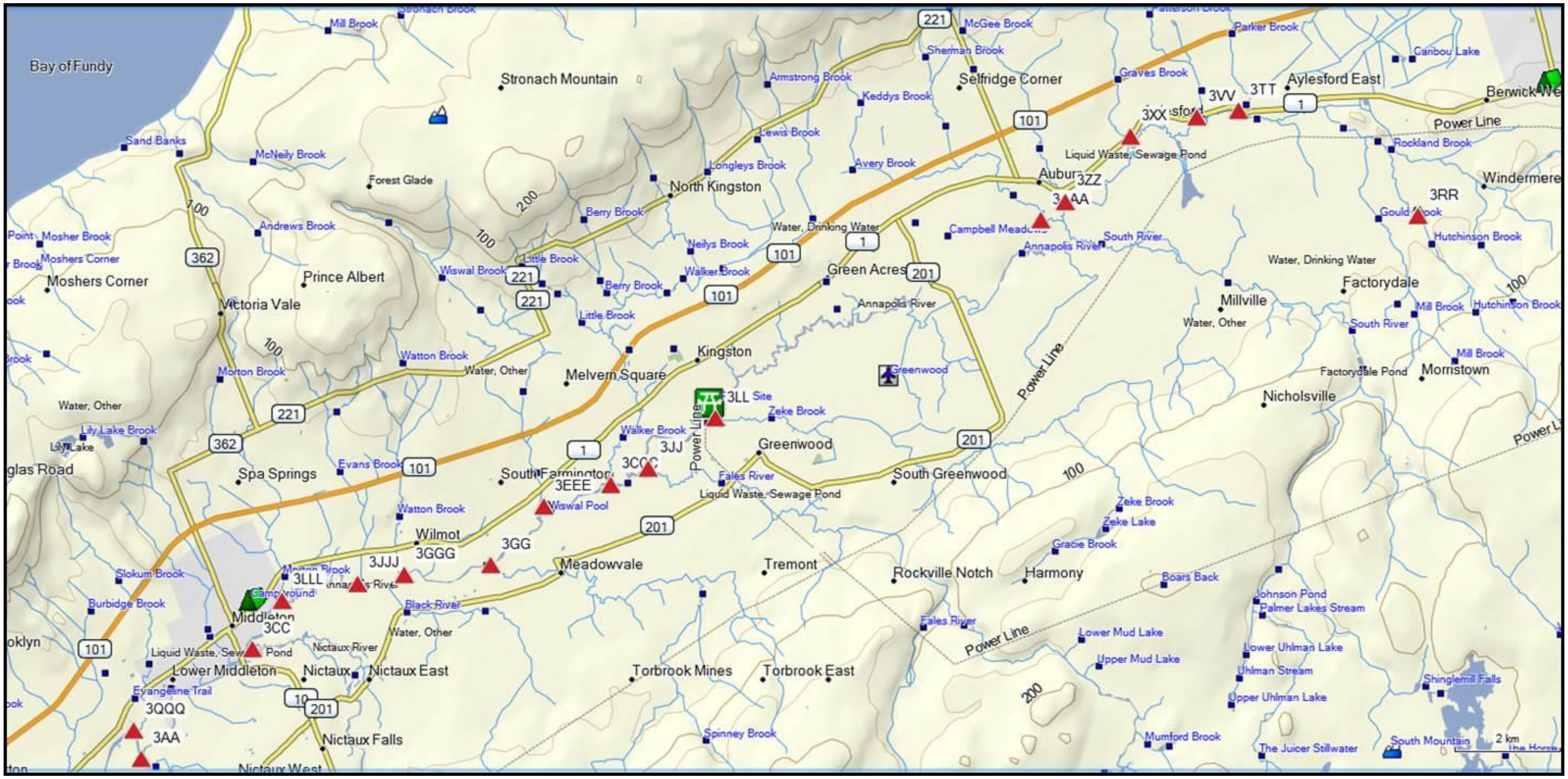
Site	Date	Conductivity (uSi/cm)	pH	Alkalinity (mg/L)	True Colour (TCUs)	Total N (mg/L)	Ammonia - N (mg/L)	Nitrite+Nitrate (mg/L)	T0tal P (mg/L)	Phosphate -P (mg/L)	Fecal Coliforms (MPN/100ml)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	% DO Saturation
Habitant River	5-Sep-13	326.0	8.2	96.6	22.7	1.60	1.43	0.02	0.042	0.061	461	13.5	6.35	60.4
Sheffield Mills Marsh	5-Sep-13	259.0	8.1	83.1	43.7	1.37	0.90	0.12	0.042	0.081	126	17.7	6.45	67.2
North Bk.	5-Sep-13	528.0	8.1	102.0	34.8	2.82	2.48	0.06	0.124	0.149	291	15.4	6.50	64.5
Sleepy Hollow Bk.	5-Sep-13	410.0	8.0	53.7	32.6	1.59	1.38	0.01	0.016	0.045	921	14.2	8.80	85.0

Appendix 1I. Habitant Watershed Tributary Nutrient Loadings.

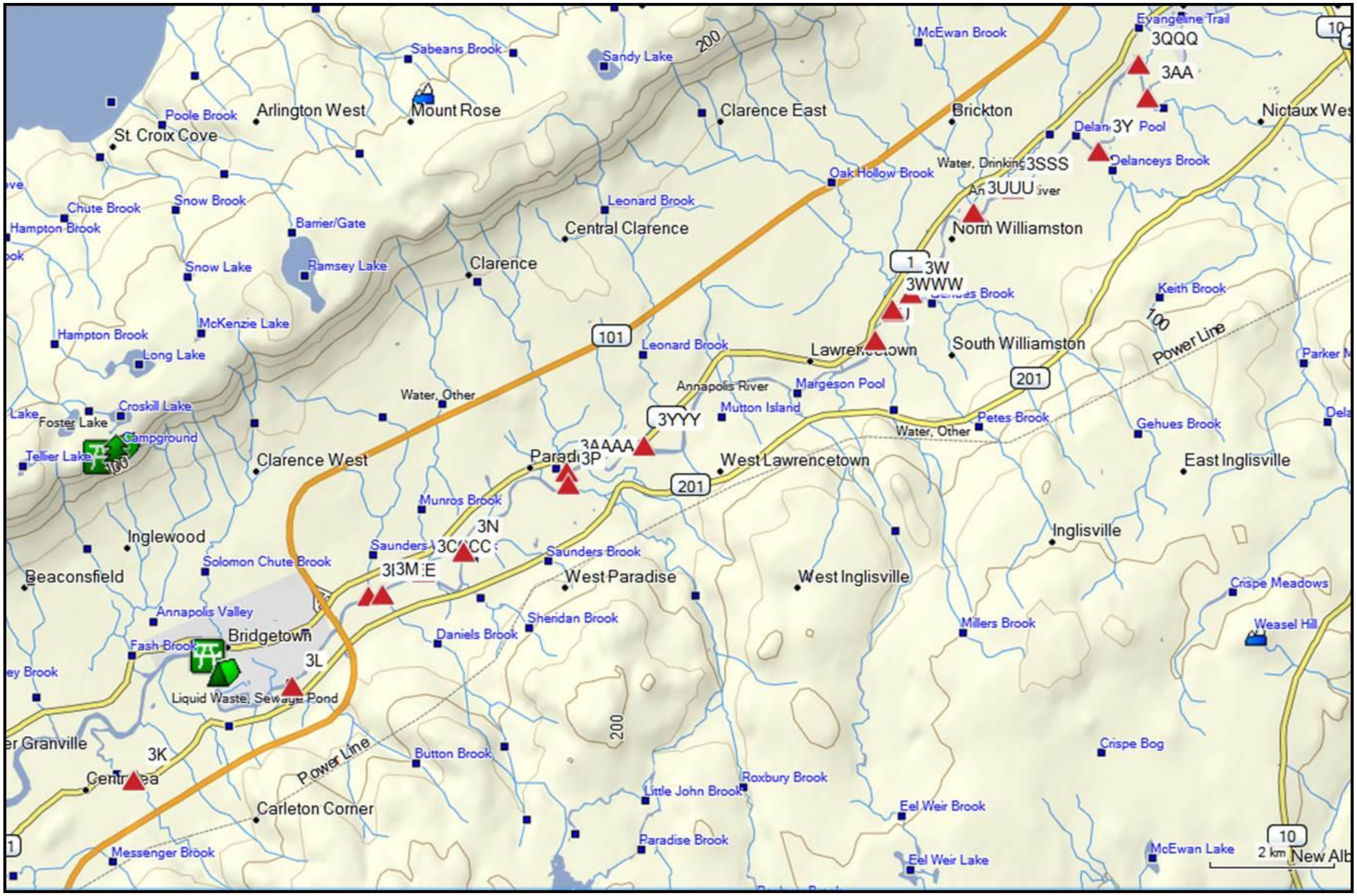
Tributary	Date	Current Velocity (m/sec)	Width (m)	Depth (m)	Surface Area (m^2)	Total N (mg/L)	Total P (mg/L)	Nitrogen Load (kg/day)	Phosphorus Load (kg/day)
Habitant River	5-Sep-13	0.01	1.0	0.01	1.60	0.061	0.01	0.007	0.000
Sheffield Mills Marsh	5-Sep-13	0.12	1.5	0.83	1.37	0.081	0.62	8.842	0.523
North Bk.	5-Sep-13	0.09	2.5	1.00	2.82	0.149	2.50	54.821	2.897
Sleepy Hollow Bk.	5-Sep-13	0.08	1.0	0.50	1.59	0.045	0.25	2.748	0.078

APPENDIX II

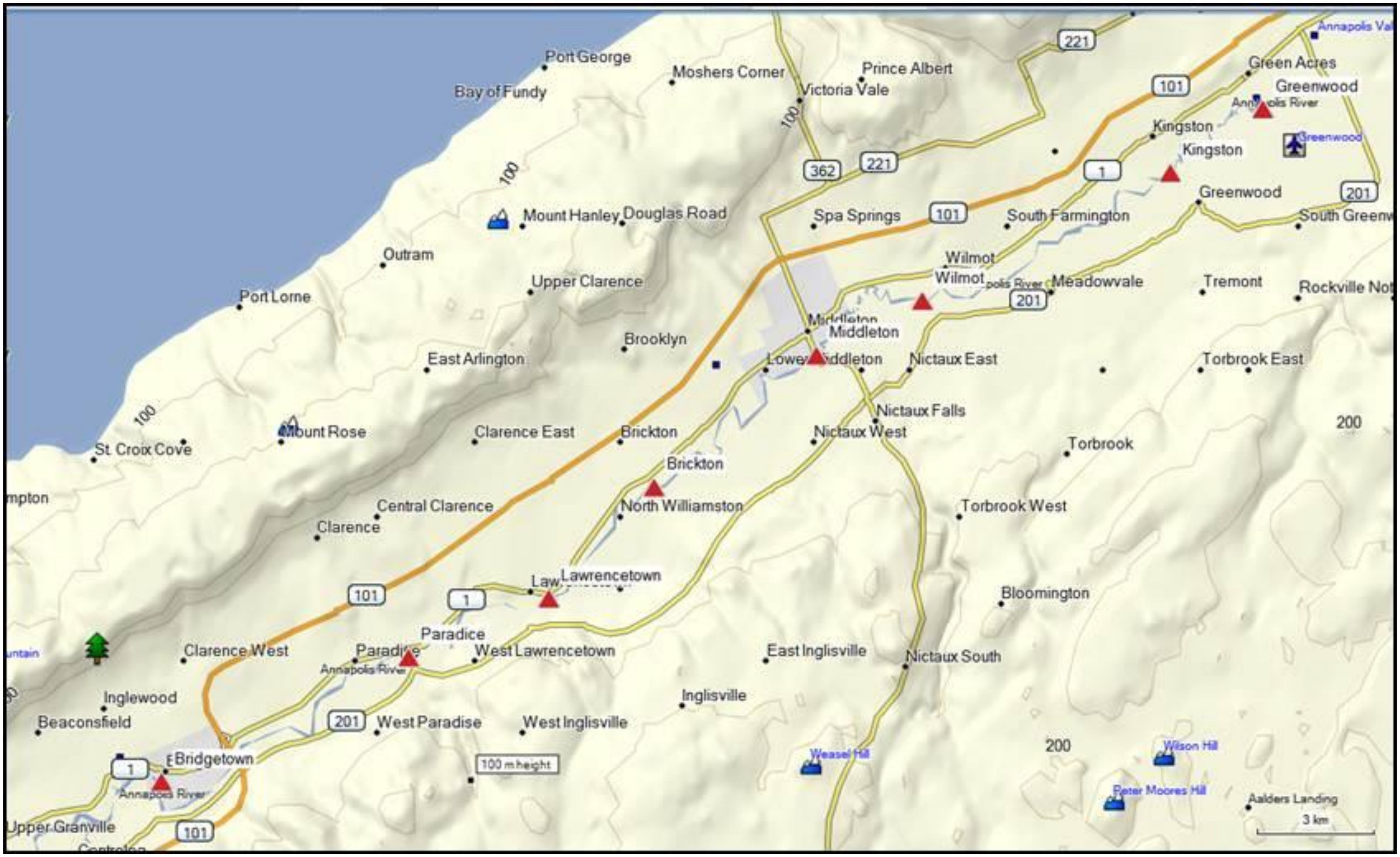
Maps Showing Locations of Water Quality Sample Sites



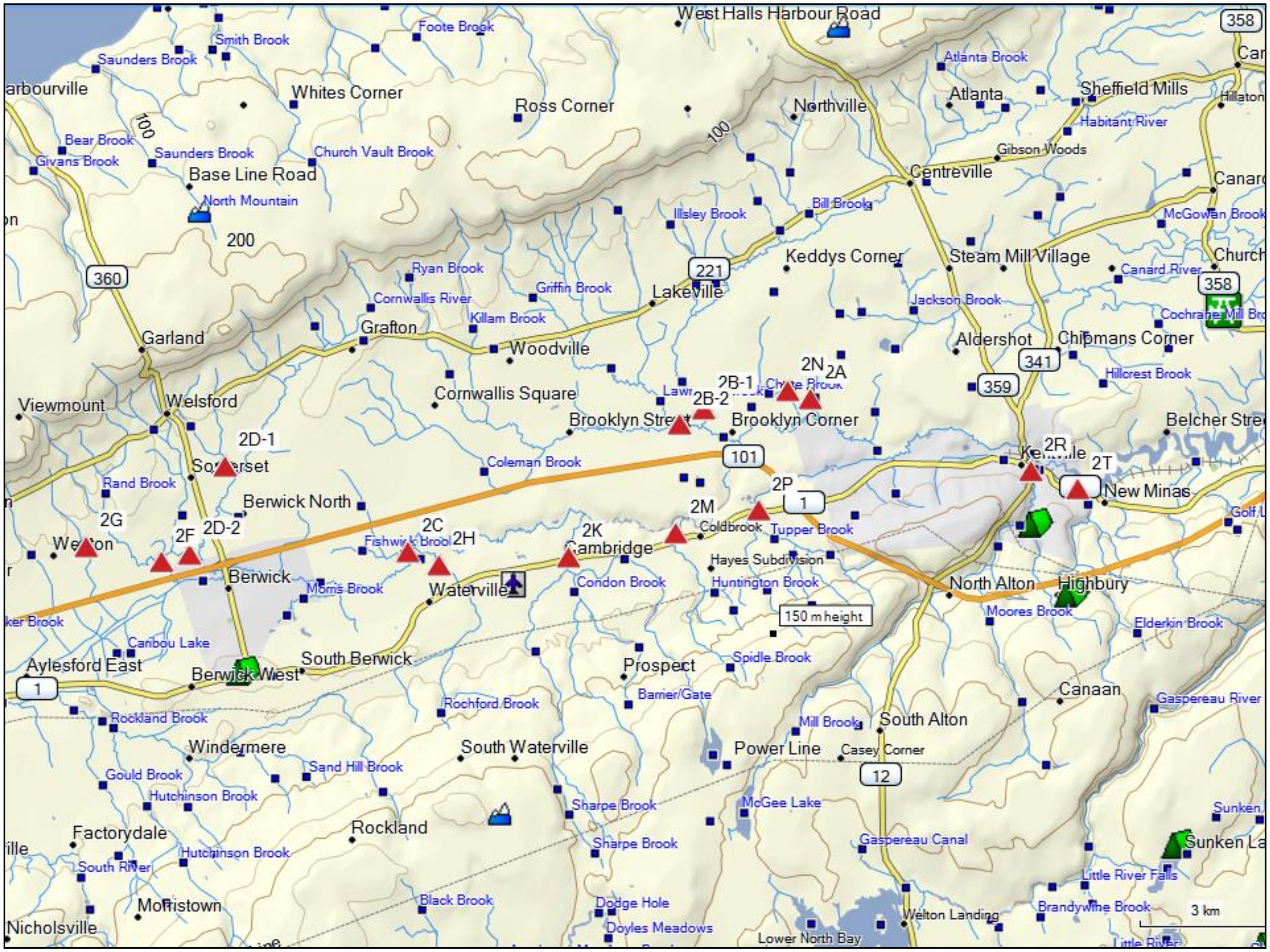
Appendix IIA. Upper Annapolis Watershed Tributary Sites



Appendix IIB. Lower Annapolis River Watershed Tributary Sites

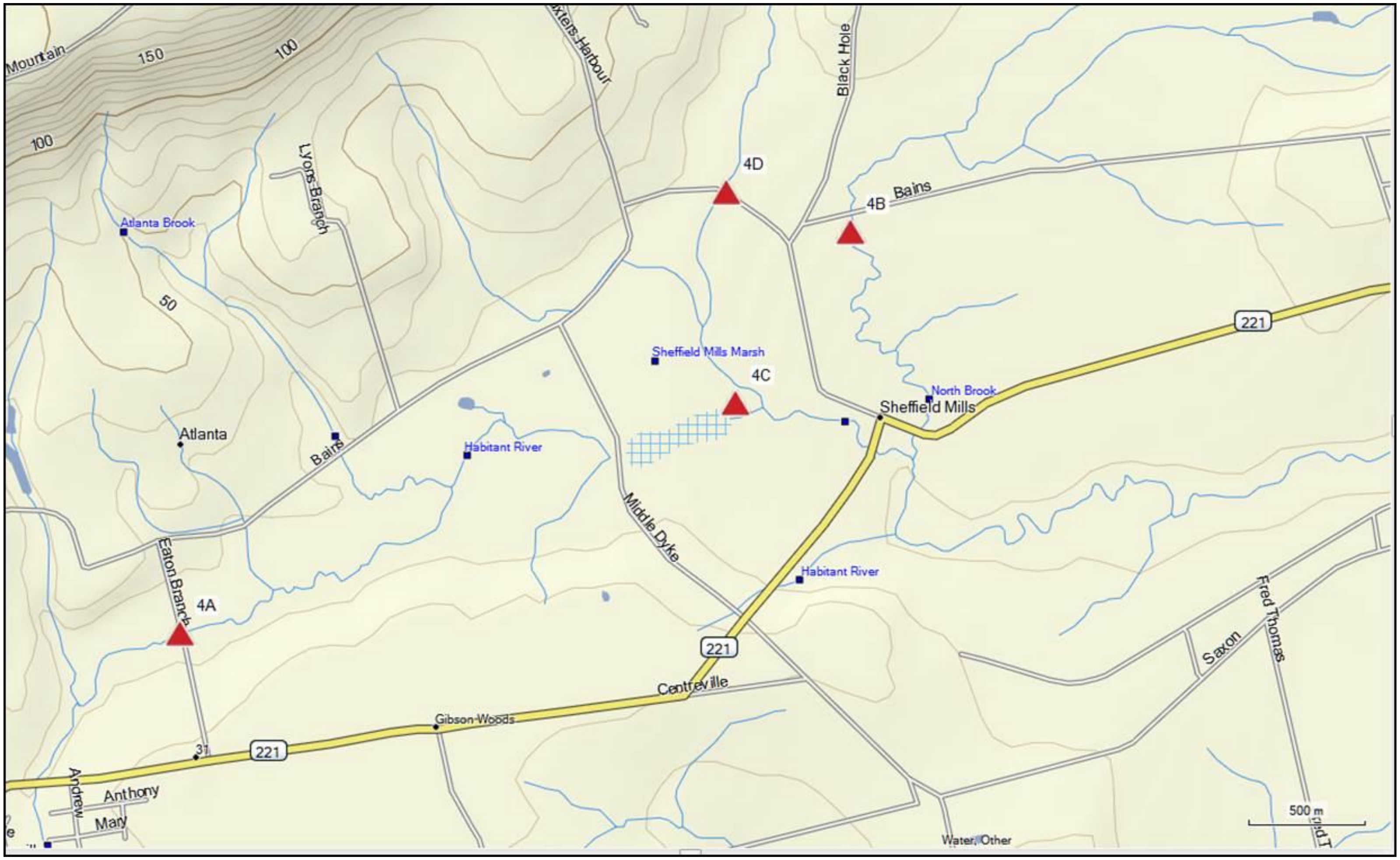


Appendix IIC. Annapolis Watershed Main River Sites

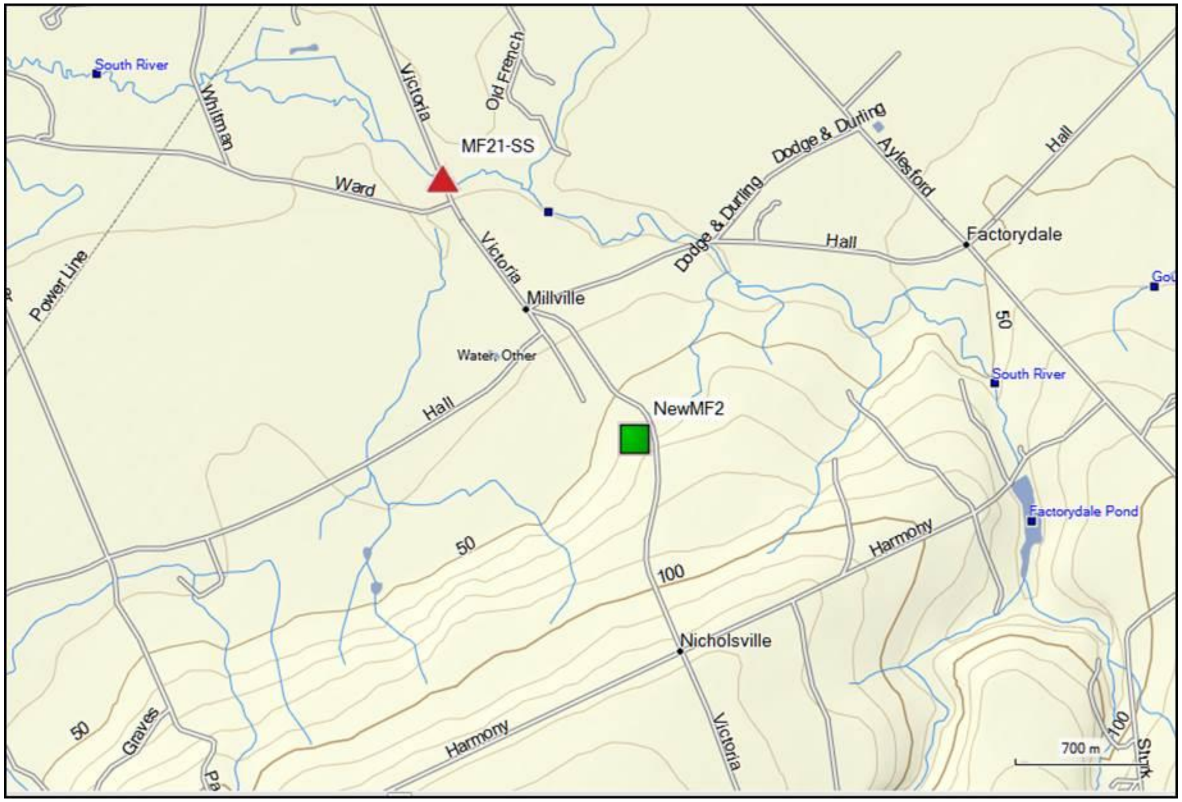


Appendix IID. Cornwallis Watershed Tributary Sites

Appendix IIE. Cornwallis Watershed Main River Sites



Appendix IIF. Habitant Watershed Sites



Appendix IIG. Location of proposed mink farm in the Annapolis Watershed (■) and location of nearest water quality sample station (▲).

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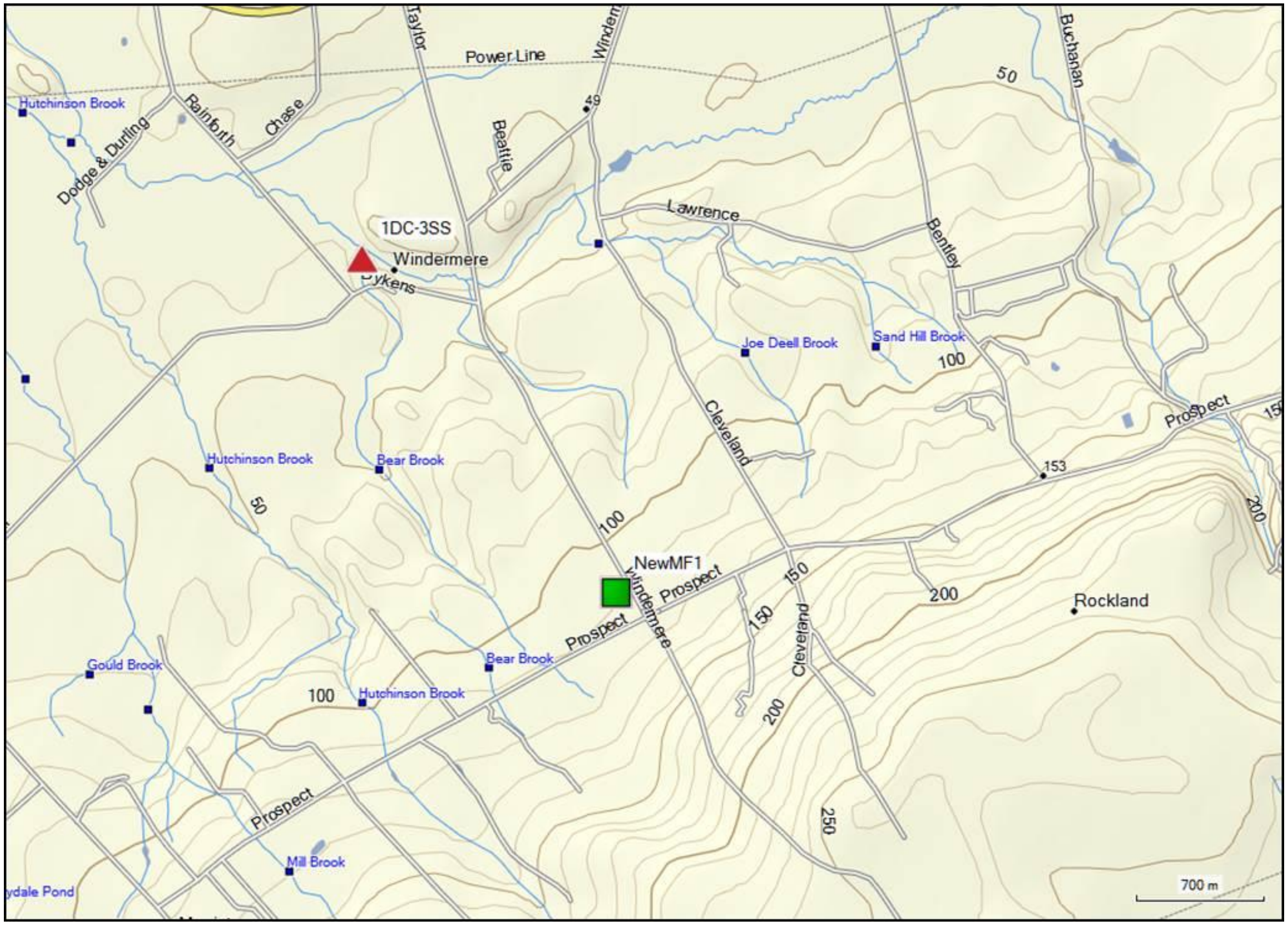
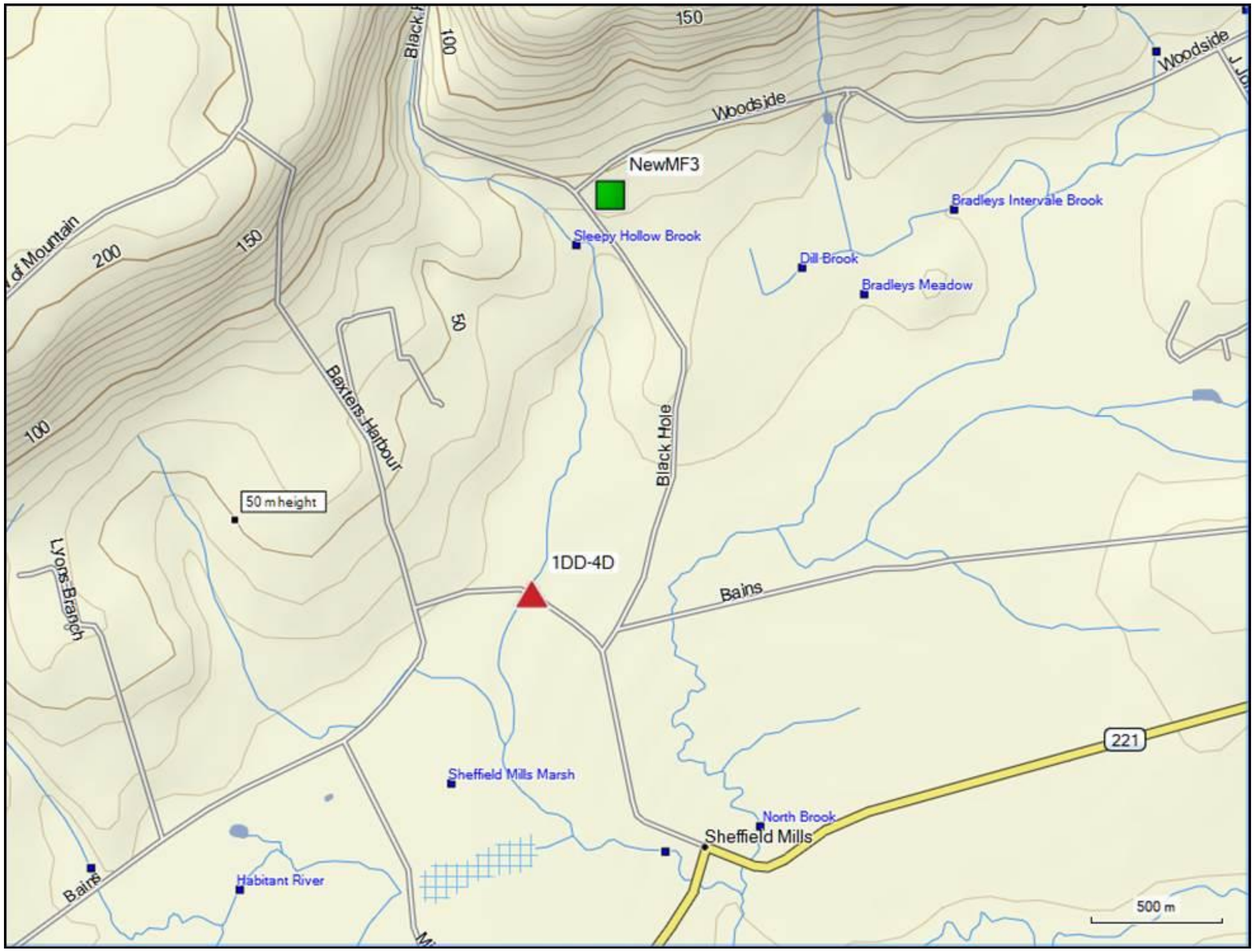


Appendix IIH. Location of proposed mink farm in the Cornwallis Watershed (■) and location of nearest water quality sample station (▲).



Appendix III Location of new mink farm in the Habitant Watershed (■) and location of nearest water quality sample station (▲).

Appendix III

Tertiary Watershed Codes and Areas for Each Surveyed Watershed

Appendix III Tertiary Watershed Codes and Areas for Each Surveyed Watershed					
Annapolis River Watershed		**Cornwallis River Watershed**		**Habitant River Watershed**	
Tertiary Code	**Area (Hectares)**	**Tertiary Code**	**Area (Hectares)**	**Tertiary Code**	**Area (Hectares)**
1DC-3-CC	29458.47	1DD-2-B	8563.7	1DD-4-E	1993.97
1DC-3-D	12047.50	1DD-2-R	4292.0	1DD-4-B	1750.95
1DC-3-JJ	11369.29	1DD-2-K	3411.1	1DD-4-D	1045.68
1DC-3-NN	10984.36	1DD-2-G	2735.4	1DD-4-A	792.93
1DC-3-P	10605.55	1DD-2-A	2659.7	1DD-4-C	9.08
1DC-3-GG	7423.72	1DD-2-D	2185.4		
1DC-3-K	5676.92	1DD-2-C	1884.5		
1DC-3-CCC	3740.83	1DD-2-P	1434.0		
1DC-3-Y	3578.88	1DD-2-H	1358.7		
1DC-3-SS	3398.06	1DD-2-T	968.5		
1DC-3-F	2848.27	1DD-2-U	906.1		
1DC-3-LL	2457.51	1DD-2-Y	819.7		
1DC-3-S	2130.54	1DD-2-Q	721.0		
1DC-3-L	2024.33	1DD-2-M	694.7		
1DC-3-TT	1927.44	1DD-2-F	658.5		
1DC-3-WWW	1869.24	1DD-2-Z	490.3		
1DC-3-H	1765.30	1DD-2-AA	448.5		
1DC-3-B	1739.01	1DD-2-N	442.8		
1DC-3-RRRR	1595.81	1DD-2-J	269.0		
1DC-3-LLL	1584.16	1DD-2-W	136.0		
1DC-3-EEE	1529.64	1DD-2-L	116.5		
1DC-3-W	1491.43	1DD-2-S	64.1		
1DC-3-AAA	1467.47	1DD-2-E	16.5		
1DC-3-MM	1465.81				
1DC-3-E	1347.34				
1DC-3-UUU	1324.07				
1DC-3-BBB	1243.10				
1DC-3-EE	1148.96				
1DC-3-QQQ	1126.92				
1DC-3-RR	1098.02				
1DC-3-YYY	994.70				

Appendix III (Con't.)

Annapolis River Watershed		Cornwallis River Watershed		Habitant River Watershed	
Tertiary Code	Area (Hectares)	Tertiary Code	Area (Hectares)	Tertiary Code	Area (Hectares)
1DC-3-QQ	989.20				
1DC-3-JJJJ	925.62				
1DC-3-ZZ	919.29				
1DC-3-SSS	900.01				
1DC-3-N	838.74				
1DC-3-CCCC	786.53				
1DC-3-AAAA	773.19				
1DC-3-TTTT	758.93				
1DC-3-PP	744.04				
1DC-3-UUUU	724.24				
1DC-3-M	717.52				
1DC-3-VV	716.88				
1DC-3-SSSS	707.79				
1DC-3-C	705.28				
1DC-3-GGGG	699.39				
1DC-3-NNNN	670.22				
1DC-3-A	630.37				
1DC-3-PPPP	628.99				
1DC-3-AA	617.52				
1DC-3-EEEE	594.93				
1DC-3-U	594.85				
1DC-3-XX	577.67				
1DC-3-FFF	566.51				
1DC-3-NNN	549.69				
1DC-3-V	536.64				
1DC-3-FFFF	536.02				
1DC-3-GGG	510.17				
1DC-3-MMMM	493.79				
1DC-3-BB	478.33				
1DC-3-Q	472.57				
1DC-3-JJJ	455.17				
1DC-3-QQQQ	426.32				
1DC-3-LLLL	423.19				

Appendix III (Con't.)					
Annapolis River Watershed		**Annapolis River Watershed**		**Annapolis River Watershed**	
Tertiary Code	**Tertiary Code**	**Tertiary Code**	**Tertiary Code**	**Tertiary Code**	**Tertiary Code**
1DC-3-XXX	415.90				
1DC-3-X	389.52				
1DC-3-R	385.39				
1DC-3-HH	304.08				
1DC-3-J	294.25				
1DC-3-BBBB	256.21				
1DC-3-ZZZ	206.30				
1DC-3-KKK	190.55				
1DC-3-VVVV	189.06				
1DC-3-DD	165.64				
1DC-3-WW	148.83				
1DC-3-RRR	138.36				
1DC-3-YY	133.03				
1DC-3-KKKK	122.35				
1DC-3-PPP	122.27				
1DC-3-MMM	93.84				
1DC-3-DDD	83.97				
1DC-3-G	83.72				
1DC-3-HHHH	76.66				
1DC-3-VVV	67.32				
1DC-3-Z	66.05				
1DC-3-FF	61.60				
1DC-3-DDDD	37.41				
1DC-3-HHH	31.46				
1DC-3-T	30.57				
1DC-3-UU	6.92				