



## WATER QUALITY REPORT

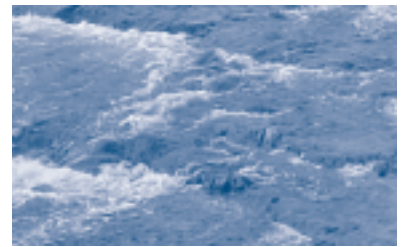
# Meduxnekeag Watershed Classification Project



Meduxnekeag River Association



George Peabody  
Simon J. Mitchell



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Mapping data and layers were provided by the Department of Natural Resources, Department of Environment and Local Government, Service New Brunswick, and NB Aquatic Data Warehouse, Canadian Rivers Institute. Climatological data was sourced from the Meteorological Service of Canada – Environment Canada. Hydrological data was provided by both the Water Survey of Canada and the United States Geological Survey. Information on the Meduxnekeag watershed in the State of Maine was sourced from the Maine Department of Environmental Protection. Additional information and assistance was provided by the Houlton Band of Maliseet Indians, the Organization for Watershed Living, and the Meduxnekeag Watershed Coalition.

This project would not have been possible without the generous and enthusiastic support of our volunteers and the Meduxnekeag River Association Inc. Financial support for this project was provided by the New Brunswick Environmental Trust Fund.

In this Report, except where noted otherwise, “Meduxnekeag watershed” refers to that portion of the watershed which lies in the province of New Brunswick.

## Executive Summary

This report presents an initial analysis and discussion of water quality in the Meduxnekeag watershed in New Brunswick. It is based on three years of data collection undertaken by volunteers over the period from 2002 to 2004 inclusive.

No previous water quality measurements had been carried out in the New Brunswick part of the Meduxnekeag watershed. These results, then, constitute a baseline measurement for the system.

Initial analysis suggests that the overall water quality in the Meduxnekeag river is relatively good. In the absence of historical water quality data, it is not possible to reach definitive conclusions on the state of the system in the past, but discussions with residents and stakeholders indicate a widespread perception that Meduxnekeag water quality was much lower in the middle to late 20th century than is the case today.

There are opportunities for further improvement in water quality, mainly through addressing point source and non-point source pollution identified in this report. Next steps for the Meduxnekeag Water Classification process will concentrate on the development of a provisional water classification recommendation and associated action plan.



Above Jackson Falls



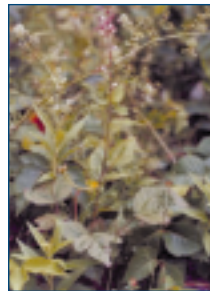
## Introduction

The Meduxnekeag River Association has participated in a Community Partnership with the New Brunswick Department of Environment and Local Government (DELG) to conduct water quality monitoring studies during the three years 2002 to 2004. Activities included in this partnership are: water quality monitoring, benthic macroinvertebrate collections and analysis, and watershed mapping. The goal of this partnership is to initiate community-based management of the water resources in the Meduxnekeag River watershed with a focus on interpreting and characterising the quality of the Meduxnekeag River and developing a plan for future water management.

## MEDUXNEKEAG RIVER ASSOCIATION

The Meduxnekeag River Association was formed in Woodstock, New Brunswick in 1995 as a community-based non-profit environmental organization. The organization was incorporated in 1998, and received charitable tax status in 2002. Our purposes are:

- to promote, encourage and assist in the protection, restoration and responsible use of the Meduxnekeag River Watershed;
- to promote and encourage the protection, conservation and enhancement of wild Brook trout, Brown trout and Atlantic salmon;
- to co-operate with landowners to conserve the natural riparian zone along the Meduxnekeag and its wildlife and plant species;
- to preserve remnant Appalachian Hardwood Forests and their inherent biodiversity and natural beauty;
- to promote public education and awareness of the value of preserving the natural qualities and biodiversity of the unique Meduxnekeag River watershed; and,
- to co-operate with and support any agency that shares a common purpose with the Association.



The provincially very rare *desmodium glutinosum* is known from only one New Brunswick location: the Meduxnekeag Valley Nature Preserve at Bell Forest.

The purpose of  
this activity is  
to create  
a broader  
environmental,  
ecological and social  
understanding of  
the river system...

The Association is governed by a 16 member volunteer Board of Directors (Appendix 1).



MRA President Steve Wilson and students from Southern Carleton Elementary measure one of the large pines on the Meduxnekeag Valley Nature Preserve

The Association has purchased and protected as the Meduxnekeag Valley Nature Preserve three ecologically significant properties on the Meduxnekeag river. The Association hosts an annual fundraising Dinner and Auction in Woodstock each Spring; organizes an annual student Environmental Showcase competition at local elementary schools; and provides guided walks for school classes on the Nature Preserve trails (*a well-marked 10 km network open to the public*).

The Meduxnekeag River Association was recognized for its commitment to the protection of the Meduxnekeag River when it was awarded a New Brunswick Environmental Leadership Award in 2004.

Since mid-2004, with the financial support of the New Brunswick Environmental Trust Fund and the encouragement, advice, oversight and general support of the Sustainable Planning Branch of the Department of Environment and Local Government, the Meduxnekeag River Association has actively engaged the general public and identified stakeholders in an education and awareness program about the Meduxnekeag River and its watershed. The purpose of this activity is to create a broader environmental, ecological and social understanding of the river system, and to lay the ground work for the development of provisional water classification recommendations for the river and its tributaries. Some of the activities that have been undertaken include:

- Meetings with stakeholders to create greater awareness of the river and begin to understand issues as perceived by members of this group
- The annual Meduxnekeag Environmental Awareness Showcase at five local elementary schools. More than 800 students (many with significant parental involvement) develop projects with both a written component and either a model or art element; the Meduxnekeag ecosystem plays a role in many projects. The competition is judged by local volunteers and financially supported by the Woodstock *Bugle-Observer*



- Meetings with provincial departments (Transportation, Environment and Local Government) and Ministers to address current issues within the watershed, in particular the twinning of Route 95 and its impact on Morrison Lake, and the drainage and wetland implications of commercial development on Connell Road in Woodstock
- Meetings with the Town of Woodstock to discuss the municipal restoration project on the banks of the Meduxnekeag River in downtown Woodstock
- Guided tours of the Meduxnekeag Valley Nature Preserve for school students and other groups, highlighting the ecological uniqueness of the Appalachian Hardwood Forest sites and the Meduxnekeag River
- Production and distribution of two editions of a newsletter, and an interim water quality report
- Development and maintenance of a comprehensive website which has had more than 8000 visits and 75,000 hits since December 2004 and is currently receiving more than 2000 visits a month.
- Presentations to community groups
- Stories in local media
- Open houses at our downtown offices during Woodstock's Victorian Christmas promotion in 2004 and Old Home Week celebrations in 2005.

## PURPOSE AND SCOPE OF REPORT

This report represents surface water data and analysis from sampling in the Meduxnekeag River watershed from 2002 to 2004. Samples were collected from fifteen sites, at approximately monthly intervals from July to October in each year, and analyzed through the Reporting and Assessment section of DELG. The data serve three purposes: (1) to establish a baseline of nutrient, organic compounds, microbiology, major ions, and solid (suspended and organic) levels; (2) as the basis for this water quality report; and, (3) to provide guidance for the development of provisional water classification recommendations for the Meduxnekeag River watershed.

[www.meduxnekeag.org](http://www.meduxnekeag.org)

## Character of the Meduxnekeag River Watershed

Flowing through western New Brunswick and draining into the St. John River at Woodstock, the Meduxnekeag River originates in two primary branches in the State of Maine (Figure 1). The southern branch begins in Meduxnekeag Lake west of New Limerick (Maine), with a significant tributary joining near Hodgdon, just south of Houlton. This branch then flows north east through the town of Houlton and north paralleling the border through an agricultural rural landscape before turning abruptly east and crossing into New Brunswick above Jackson Falls. The North Branch of the Meduxnekeag originates in an area northwest of Monticello, Maine, flows through predominantly agricultural areas, and crosses the Maine/New Brunswick border near Weston. It then flows south-east to join the main branch below Jackson Falls, New Brunswick. From the confluence, the river flows eastward to where it meets the St. John River in downtown Woodstock (Figure 2).

In Maine and New Brunswick, the Meduxnekeag watershed is bounded, beginning on the south and moving clockwise, by the watersheds of Bull's Creek, Eel River, the Ste-Croix, Mattawamkeag, Aroostook, Presqu'île, Little Presqu'île, and Lanes Creek. More than three-quarters of the total area of the Meduxnekeag watershed is in Maine.

### HUMAN HISTORY

The Meduxnekeag watershed is part of the Wulustuk watershed inhabited by the Maliseet people from a very early period. The first traces of human habitation have been dated to a time soon after the glacial ice withdrew, and there is no reason not to believe that the area has not been inhabited ever since. The known Maliseet settlement pattern included the establishment of villages at or near the mouths of major Wulustuk tributary streams; it is very likely that a Maliseet village long preceded the Town of Woodstock at the mouth of the Meduxnekeag and on the island which lay in the St. John off the mouth. As the prime settlement area has since been flooded by the Mactaquac headpond (1967), it is not possible to be certain of the size of the settlement or the length of time it existed, but the earliest surviving written historical records show a Maliseet settlement there in the 17th century.

In any event, the Maliseet residents will not have had a significant shaping effect on the ecology of the watershed or the quality of the water. They may have raised corn and other crops on the offshore island and some of the intervalles; they certainly harvested fiddleheads and other edible plants, as well as butternuts; they harvested salmon and other fish; hunted and trapped forest and aquatic animals and birds, and selectively harvested trees – and parts of trees – for raw materials and fuel. They used the Meduxnekeag as a canoe transportation route, but principally within its own watershed: it does not have heavily used portages to other watersheds.

More than  
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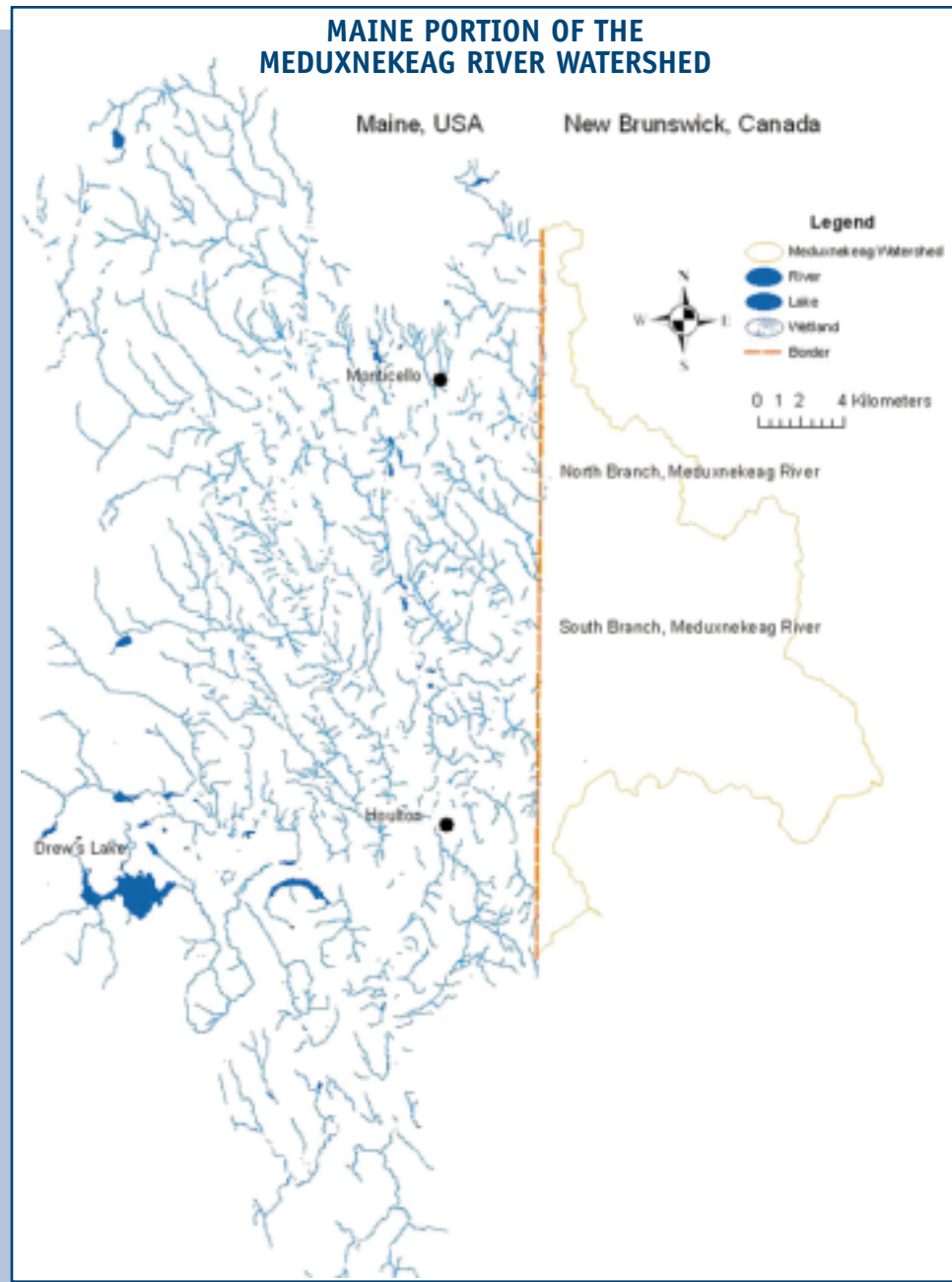


FIGURE 1: Meduxnekeag watershed (Maine portion)

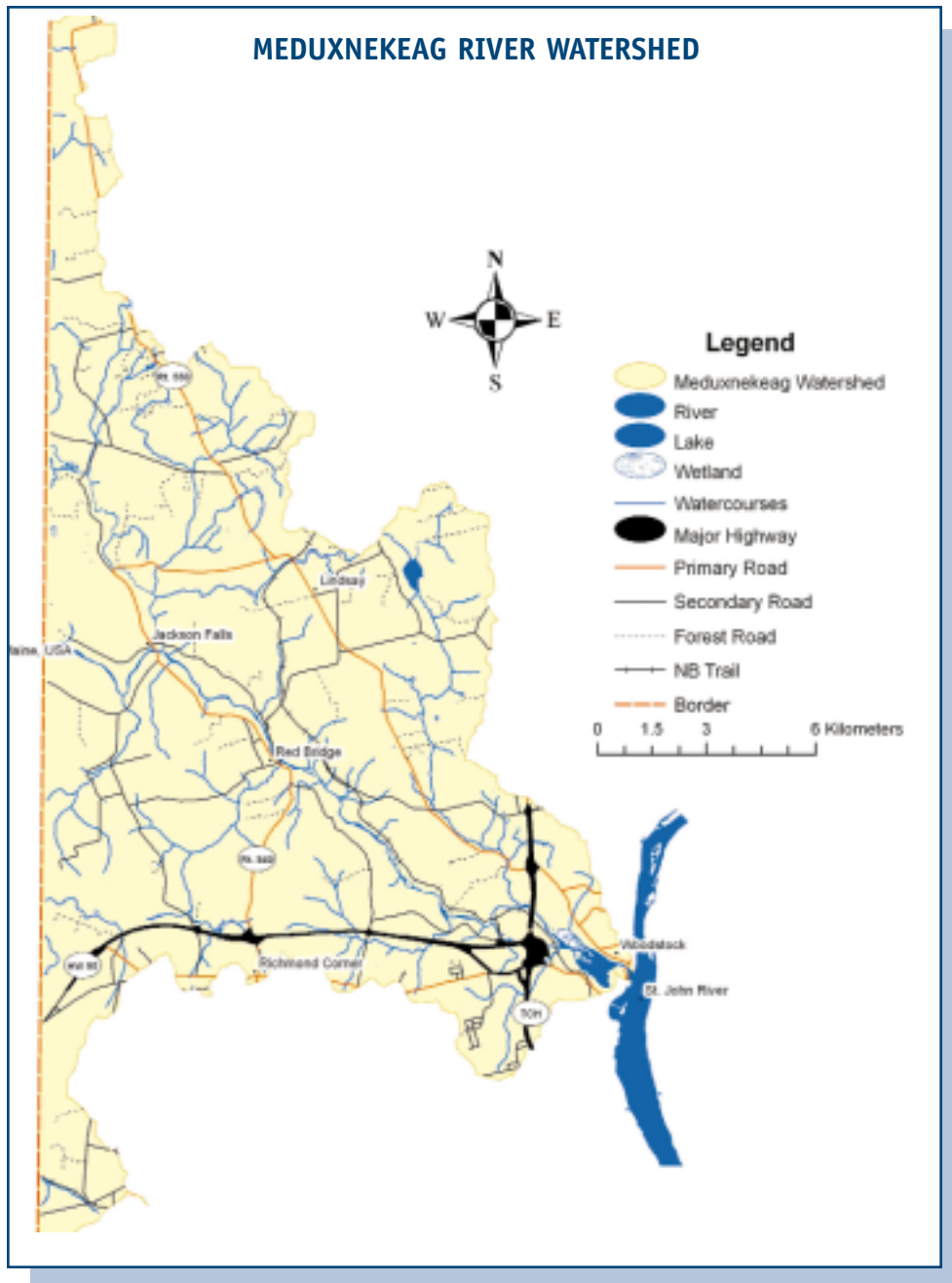


FIGURE 2: Meduxnekeag watershed (New Brunswick portion)



Major changes in the watershed began with the arrival of Loyalist settlers in the mid-1780s. Over the following fifty years, the appearance and ecology of much of the watershed was transformed. Many of the original growth trees were removed, beginning with the most valuable (oldest, largest, straightest) and most accessible (closest to the waterside). The land most suitable for agriculture (best drained, least steep, richest soils) was permanently cleared; virtually all other forest was high-graded for its most valuable trees, excepting only those places which were so remote from water transportation that it was not feasible to get the timber out. Fire, both deliberate and inadvertent, impacted many forested areas. The consequences of this human intervention included both a severe and sudden decline in quality and extent of mature forest; and a negative impact on water quality and aquatic life. Erosion increased, as did the frequency and severity of floods. At the same time, increased hunting, fishing and trapping combined with habitat loss to significantly reduce most animal, fish and bird populations.

This transformation continued throughout the 19th Century as settlement and population expanded: more parts of the watershed forests were permanently converted to agricultural uses; the urban areas expanded; economic changes placed further stresses on the remaining forests (these included a mid-19th century iron mine and smelter just outside the watershed at Upper Woodstock which consumed huge quantities of locally produced hardwood charcoal); a major lumber-milling industry developed on the Meduxnekeag at Woodstock, fed largely with timber from the watershed. In transporting the timber downstream, tributary streams were altered with temporary “driving dams”; boulders were removed or demolished with explosives; debris choked smaller streams; bark and waterlogged branches collected on the bottom of the river damaging spawning habitat and impacting benthic life. Water quality necessarily diminished.

By the early years of the 20th Century, agricultural settlement in the watershed had reached its maximum extent; roads had been established throughout; a railway had reached up the riparian corridor from Woodstock as far as Red Bridge before turning north and rising up out of the watershed on its way to Centreville; the last stands of the surviving old growth trees – the eastern hemlock – were being rap-



New Brunswick's first hydroelectric dam, built in 1905 on the Meduxnekeag: its remains are still visible just above the present TCH bridges

idly cut for their bark to feed the tanneries in Woodstock; dams had been built at several places on the river and its tributaries, interfering with fish migration.

While the New Brunswick portion of the watershed above Woodstock was impacted principally by agriculture and forestry, the upper watershed in Maine added the effects of urban and industrial development including the dumping of untreated municipal and industrial effluent into the river.

These impacts on the Meduxnekeag continued with little abatement until the middle of the 20th Century when agricultural land use began to contract with the abandonment of marginal farmland. Water quality in the Meduxnekeag River probably reached its lowest point about 1960.

By the end of that decade, the construction of the Mactaquac dam on the St. John had produced a headpond flooding the mouth of the Meduxnekeag and its upstream intervals almost as far as the newly constructed Trans-Canada Highway more than two kilometres from the mouth; the railway was abandoned, municipal and industrial effluent in Maine began to be treated and diverted from the river, the water had ceased to be used for the transportation of logs and pulpwood. Water quality slowly began to recover. In the intervening years, this recovery has continued.

Today, the Meduxnekeag in New Brunswick is an important recreational river. Its mouth provides some of the best Small-mouth Bass angling in eastern North America. It supports populations of Brook Trout and Brown Trout. Its intervals are among the best fiddlehead harvesting sites in the province. Jackson Falls on the South Branch, and the North Branch below Briggs's Mill Falls are challenging kayak runs in high water. From the confluence to Woodstock is an easy scenic canoe trip in Spring and Fall.

## TODAY'S POLITICAL BOUNDARIES

From the International border with Maine the watershed of the North Branch of the Meduxnekeag River in New Brunswick includes the south-west corner of the Parish of Wilmot and a part of the Parish of Wakefield. The main Branch serves as the boundary between the Parishes of Wakefield and Richmond between the International Border and the boundary of the Parish of Woodstock. From the confluence the river maintains a south-easterly course into the Parish of Woodstock and finally into the Town of Woodstock at the Trans Canada Highway bridge. The Town of Woodstock's eastern boundary is along the banks of the St. John River, which is also the culmination of the Meduxnekeag River.

The Meduxnekeag watershed in New Brunswick thus includes portions of the four parishes of Wilmot, Wakefield, Richmond and Woodstock, as well as much of the Town of Woodstock. A significant development with implications for the future is the present

organizing movement to amalgamate parts of the parishes (local service districts) into a single “rural community” which would contain most of the Meduxnekeag watershed outside the municipal boundaries of the Town of Woodstock.

## DEMOGRAPHICS AND ECONOMY

The Meduxnekeag River and its surrounding watershed is unique to western New Brunswick in both an ecological and a demographic sense. Its mosaic of farms and forest supports a diversity of resource-based operations and complements the region's strong service sector. The watershed includes much of the town of Woodstock – whose historic downtown lies at the junction of the Meduxnekeag and the St. John River. The parts of the local service districts of Richmond, Wakefield, Woodstock and Wilmot contained within the boundaries of the watershed contribute forty percent of the population, to a total of approximately 10,000 in the New Brunswick part of the watershed (Table 1).

TOWN / PARISH	POPULATION
Town of Woodstock	5198
Parish of Woodstock	1977
Parish of Wilmot	1219
Parish of Richmond	1404
Parish of Wakefield	2657

TABLE 1: Population of Woodstock and surrounding Local Service Districts.

Stats Can 2002

The local economy is diverse, providing employment for a skilled, trained and available workforce. The region boasts one of New Brunswick's highest employment participation rates, 2.9% higher than the provincial average (Enterprise Carleton, 2005) and has an unemployment rate around 8%, lower than the provincial average.

The town of Woodstock offers a high quality small town life to its residents, and serves as the urban economic and services centre for the villages, farms and rural residents of the surrounding region, which extends approximately from Nackawic in the east to Canterbury in the south and Florenceville in the north.

Woodstock and the surrounding region's business community can be grouped into the following categories:

- forestry and value added wood products
- manufacturing
- agriculture and food processing
- retail, service, communications and utilities
- transportation.



The Town of Woodstock and surrounding parishes have experienced considerable growth over the past decade. This is best evidenced by the property tax base, which has increased by over 46% during the past decade (Table 2).

TOWN / PARISH	1994 TAX BASE	2004 TAX BASE
Town of Woodstock	\$188,678,450	\$265,825,020
Parish of Woodstock	42,953,300	64,866,536
Parish of Wilmot	16,808,250	29,448,441
Parish of Richmond	17,664,450	23,282,034
Parish of Wakefield	55,532,600	86,003,500
<b>TOTAL</b>	<b>\$321,633,050</b>	<b>\$469,425,531</b>

TABLE 2: Comparison of the regions tax base in 1994 and 2004.

Source: DELG Local Services representative

The strong service sector includes transportation companies, call centres, information technology and tourism based businesses, as well as government services.

Woodstock's summer Old Home Week is the region's largest fair. Its five-week Victorian Christmas celebration highlights heritage - as well as shopping opportunities - and draws visitors from throughout the upper Valley. Richmond Corner Field Days are held in late summer on the southern boundary of the watershed. There is an annual bass tournament in Woodstock, attracting anglers from the Maritimes and beyond. Woodstock is beginning to host conventions, including in 2005 the Red Hat Society and a regional Legion convention. In 2006, the Town will celebrate the 150th anniversary of its incorporation.

In the watershed, there are two elementary schools, a middle school and Woodstock High School. The New Brunswick Community College Woodstock has an enrolment in the 325 student range, a mixture of recent high school graduates and mature students working towards diplomas in Agriculture and Trades, Business, Communication Arts, and Health Studies.

## LAND USE

Forests cover about 60 percent of the Meduxnekeag River watershed; agricultural lands about 30 percent; and urban areas about 10 percent (Figure 3). Agricultural operations are principally potato/grain rotations, with a small number of dairy farms, mixed farming beef producers, and two industrial-level hog production facilities. Forest ownership is mainly private woodlot with limited large freehold timberland and provincial Crown land. Agro-forestry is represented by a significant acreage in Christmas tree plantations, an acreage which is steadily increasing in the watershed. These include associated nursery and processing / packaging plants.

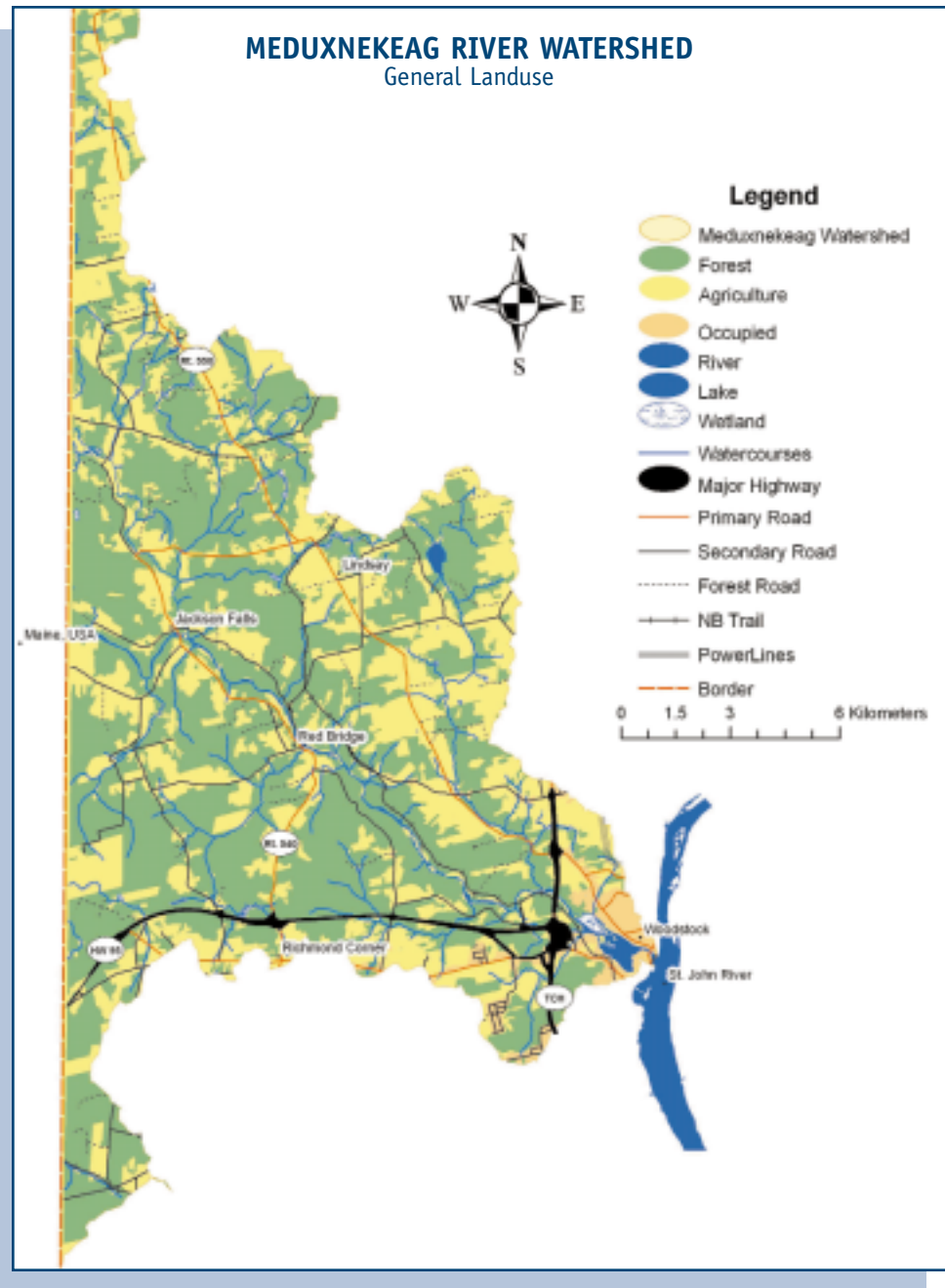


FIGURE 3: Land use in the Meduxnekeag watershed



## Meduxnekeag Watershed Classification Report

The principal recent trend in land use is towards increases in residential areas, at the expense of agricultural and forested land. This is predominantly occurring as strip development along road and stream corridors, particularly in well-situated view sheds and areas in close proximity to Woodstock. Sub-division development is occurring in locations near Hwy 555 and Hwy 550, again near Woodstock. Smaller cluster developments are noticeable at other locations throughout the watershed, and are usually indicative of remnant hamlet or proto-village 19th and early 20th century settlement. Many of these have been augmented by later 20th century houses on one or two acre lots, but few have more than two dozen homes. There are a half dozen cottages in the riparian zone of the Meduxnekeag, and two seasonal homes on Payson Lake.

Other land uses include clusters of light industrial (e.g., heavy equipment and transportation repair) and commercial development on the fringes of Woodstock both inside and outside the municipal boundary, and small, predominantly household-based businesses scattered throughout the watershed.

In some areas, small tracts of forest are being converted to agricultural or agro-forestry use. These are normally on the edges of existing agricultural land, and a comparison with historical aerial photos suggests most of this is a re-extension into former fields abandoned since the mid-20th Century.

No active mining operations exist in the watershed, although gravel deposits are being extensively exploited, particularly in the Red Bridge area, and there is one rock quarry not far above the Trans-Canada bridges.



Seasonally flooded riparian gravel pit near Red Bridge

The principal  
recent trend in  
land use is towards  
increases in  
residential areas,  
at the expense of  
agricultural  
and forested land.



Recreational land use includes seasonal fiddlehead harvesting in May and balsam fir tipping in October and November, and hunting in season. A branch of the Sentier-N.B. Trail uses the old Valley railway line right-of-way from Woodstock to Centreville. This follows the riparian zone from Woodstock, crossing the Meduxnekeag about four km above the mouth, and continuing near the riparian corridor to just above Red Bridge before turning north. It is, in practice, a multi-use trail, groomed as a snowmobile trail in winter and used by ATVs at other times of year, with some pedestrian and bicycle use near Woodstock.

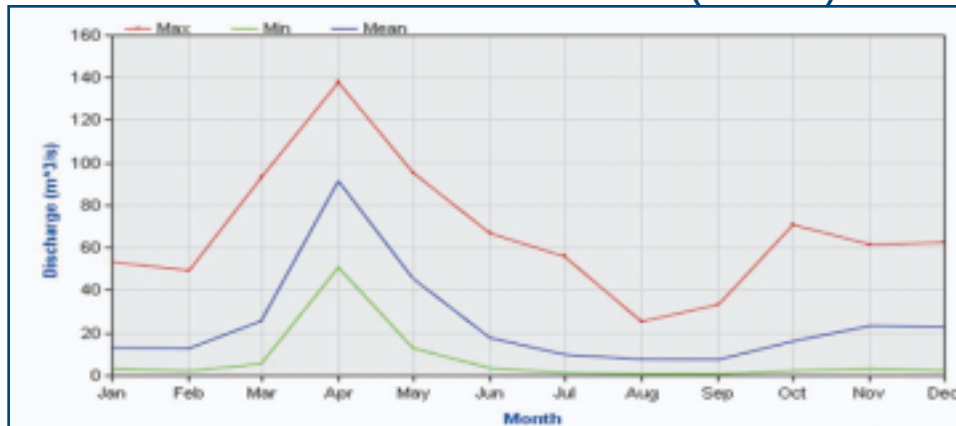
### THE WATER RESOURCE AND WATER USE

Water use is centred around the Meduxnekeag River itself, with recreation (canoeing and fishing) being the predominant use for the local population and tourists/visitors. Large bass tournaments (Mactaquac in late May and Woodstock on the September long weekend) bring a significant number of amateur and professional fishermen to the lower Meduxnekeag (below the Trans Canada Highway bridge) for smallmouth bass. Recreational angling for Brown and Brook trout occurs throughout the system in season. Canoeists put in below Jackson Falls during the spring, and at Red Bridge later in the summer when water levels drop. The main stem of the river is navigable by canoe or kayak through most of the summer, assuming water levels are not drastically low. Water levels in the Meduxnekeag River (Figure 4) are monitored at the Belleville Hydrological station, located about two km downstream from the confluence (Two hydrological stations in Maine provide stream flow data from the Meduxnekeag near Houlton).



Very low water levels at Woodstock in July 1934

### Monthly Discharge for MEDUXNEKEAG RIVER NEAR BELLEVILLE (01AJ003)



Statistics corresponding to 37 years of data recorded from January 1967 to December 2003.

FIGURE 4: Monthly and annual peak flows on the Meduxnekeag River at Belleville

(Source: [www.gm-wics.sr.unh.edu/html/Points/cd01AJ003.html](http://www.gm-wics.sr.unh.edu/html/Points/cd01AJ003.html))

The water flows exhibit expected seasonal variation, with highest flows normally occurring during the Spring freshet. The lowest period of flow normally occurs during mid to late summer in August and early September. It is worth noting, however, that in more than 30% of the years between 1968 and 2003, the Meduxnekeag peaked at some other time than the Spring freshet: with highest recorded flows for those years in December, January or February. Flow graphs show the Meduxnekeag as a rapid-draining system, characterized by abrupt rises to narrow peaks followed by equally abrupt declines.



Typical small tributary in early spring



Water withdrawals from the Meduxnekeag River and some of its tributaries in New Brunswick occur sporadically by individuals and businesses. They are rarely consistent or extensive.

### ECOLOGICAL LAND CLASSIFICATION

The New Brunswick Ecological Land Classification has been developed by the Department of Natural Resources, based on the Canadian Ecological Land Classification System (CELCS). The New Brunswick Ecological Land Classification integrates information from a series of bio-physical maps. Climate, landform, geology, hydrology, and soil maps were assessed and compared to evaluate factors most important in controlling the distribution of ecosystems at each level of the classification. The Ecoregions of New Brunswick are delineated primarily by climate, as shaped by major landforms, latitude, elevation,



FIGURE 5: Meduxnekeag Ecodistrict of the Valley Lowlands

(DNRE, 2003)



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marine influences and broad aspect. Ecodistricts are the next finer level of resolution in the ecological land classification, defining major breaks in predominant rock type, glacial deposit type, relief, and elevation. The delineation at each level was validated or refined using information on the geographic patterns of indicator species, forest stand types, wetlands or wetland types, or tree species. Soil lithology begins to show influences at the ecodistrict level (DNRE 2003). The Meduxnekeag Watershed is located within the Meductic Ecodistrict of the Valley Lowlands Ecoregion (Figure 5).



The provincially rare maidenhair fern is locally abundant in the Meduxnekeag watershed

## GEOLOGY

The majority of the watershed is manifested as a fault-bound wedge of Ordovician sedi-



Century-old graffiti along the Meduxnekeag

mentary strata, which narrows as it approaches the Maine border. Rocks within the wedge are dominated by greywacke, slate and siltstone of the Tetagouche Group, and are calcareous (Figure 6).

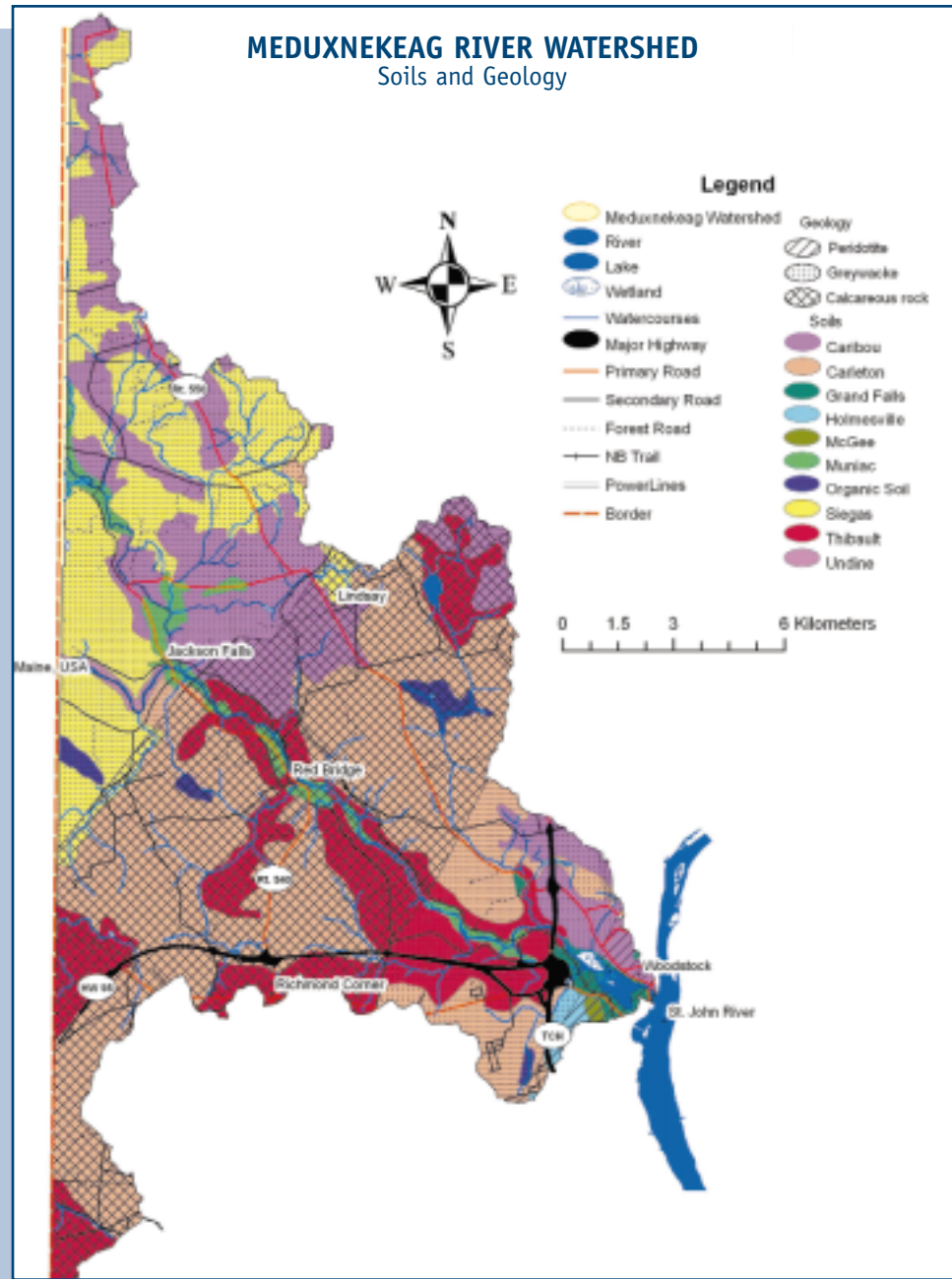


FIGURE 6: Geological and soil features of the Meduxnekeag watershed.



## LANDSCAPE AND CLIMATE

The dominant geographic feature of the ecodistrict is the expansive St John River. Its broad river valley has a pastoral appearance, reflecting the underlying calcareous bedrock and associated arable soils.

Relief of the gently rolling landscape rarely exceeds 100 metres, and is punctuated by small intrusions of resistant bedrock, which underlie several local hills and mountains. The distinctive character of this ecodistrict results in part from its relatively dry, warm climate combined with rich calcareous soils. Precipitation is average for the region, although drier than the adjacent Central Uplands.

Western New Brunswick is characterized by cold winters and short, warm summers. The growing season is 100 to 125 days (Figure 7).



Unusually high water levels and heavy ice flow in April 2005 scarred riverbanks and caused local flooding, as here, at Red Bridge



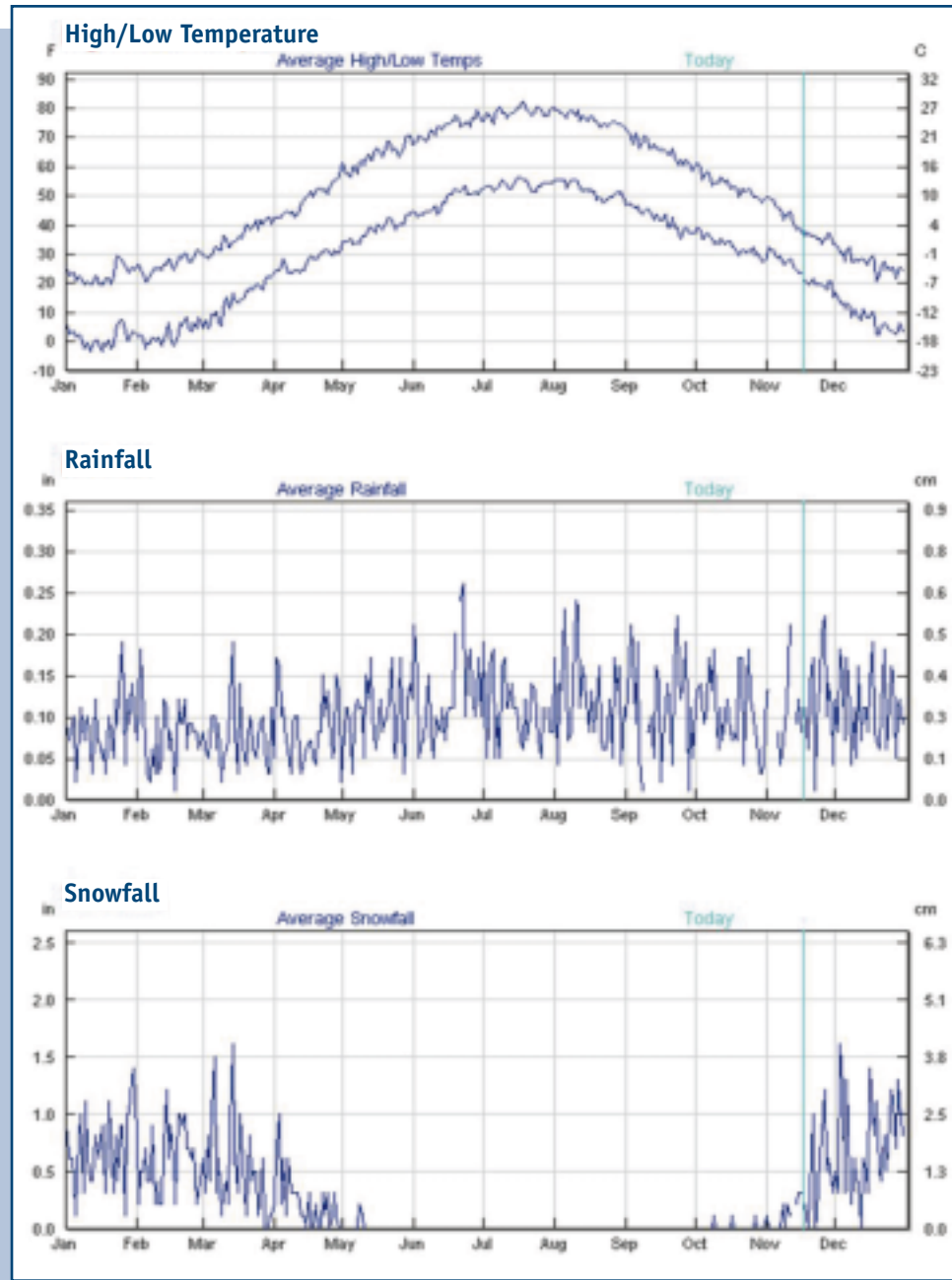


FIGURE 7: Precipitation and temperature averages for Houlton International Airport, Maine.

Source: [www.wunderground.com](http://www.wunderground.com)

## SOILS

Soils associated with the widespread calcareous bedrock dominate the ecodistrict. Much of the soils in the watershed are of the Carleton Unit. These well drained, deep and loamy soils contain easily crushed, weathered shale fragments and are among the most fertile soils in New Brunswick. These soils tend to be more compact at depth, than other soils found locally. Much of the soil is classified as highly erodible or potentially highly erodible (U.S. Department of Agriculture, 1994). Most of the arable soils have at one point in time, or are currently in agricultural production. The steep, stony, and poorly drained soils are covered in forest.

## VEGETATION

The uniquely calcareous soils of the region create suitable conditions for Appalachian Hardwood Forests (AHF), a tolerant hardwood forest type unique to the St. John River valley (MacDougall, Andrew, Nature Trust of New Brunswick 1997) aka Saint John River Hardwood Forests (SJRHF) (MacDougall, Andrew and Loo, Judy, Canadian Forest Service 1999). Remnant Appalachian Hardwood Forest sites today contain many flowering plants, ferns and bryophytes listed as rare or uncommon in New Brunswick. These include showy orchis, yellow lady's slipper, wild ginger, wild coffee, maidenhair fern, lopseed, Goldie's fern, and a number of others. Several species have few or no recorded occurrences outside the Meduxnekeag watershed.

The remainder of the forest is mixed, with hardwoods on the upper slopes and hill tops. The valley floors are predominantly conifers with some admixture of hardwood, mainly depending on previous harvesting practices. Along the Meduxnekeag valley - and in the immediate valleys of some of the larger tributaries - there is a significant portion of tolerant softwood species, namely hemlock, spruce, white pine and cedar. This differs from the remainder of the watershed, which has a higher proportion of intolerant species, such as balsam fir, poplar, white and grey birch and red maple.



Typical mature riparian forests near Wilson Mt.

The uniquely  
calcareous soils of  
the region  
create suitable  
conditions for  
Appalachian  
Hardwood Forests  
(AHF), a tolerant  
hardwood forest  
type unique to the  
St. John River  
valley.



## STREAM HABITAT

The Meduxnekeag River main stem and tributaries are characterised by low gradient riffles, pools and dead water sections. The primary stream substrate type is gravel with rock, and boulders. Sand and fines constitute a higher percentage in the remainder of the substrate types. The smaller tributaries can be categorized into two stream type: the lower reaches, which have higher gradients, higher water velocities and consequently larger substrate sizes; the upper reaches characterized by lower gradients, slower velocity rates and a higher percentage of smaller material in the substrate.

It is most likely that Jackson Falls (South branch) and Briggs Mills Falls (North branch) may obstruct upstream passage of fish species (DNR 2005).



Jackson Falls during high water in October 2005

## WILDLIFE SPECIES

Most terrestrial wildlife species recorded in New Brunswick are found in the Meduxnekeag watershed. The river and its tributaries provide habitat for aquatic and semi-aquatic species including mink, muskrat, otter and beaver. Dams and beaver lodges are found on virtually all significant tributary streams, while lodges and harvest activity are evident in several locations along the main stem of the river.

The diversity of  
fish species  
is a good indication  
of suitable water  
quality  
for their survival and  
reproduction.



## FISH SPECIES

The Department of Fisheries and Oceans and Department of Natural Resources have conducted electrofishing surveys at various locations on the Meduxnekeag River since 1992. The predominant recreational fish species occupying riffle habitats in the main stem and North and South Branches were juvenile Atlantic Salmon and smallmouth bass. Atlantic salmon, brook trout and brown trout dominated the smaller tributaries. The diversity of fish species is a good indication of suitable water quality for their survival and reproduction.

The following fish species are known to occur in the Meduxnekeag watershed:

Atlantic Salmon	American Eel	Finescale Dace
Brook Trout	American Smelt	Blacknose Dace
Brown Trout	Pumpkinseed	Common Shiner
Smallmouth Bass	Alewife	Golden Shiner
White Perch	Blueback Herring	Blacknose Shiner
Yellow Perch	Fallfish	Banded Killifish
Chain Pickerel	Creek Chub	Northern Redbelly Dace
Brown Bullhead	Lake Chub	Slimy Sculpin
White Sucker	Pearl Dace	

TABLE 3: Fish species known to occur in the Meduxnekeag River

DNR 2005

Fish population estimates for the Meduxnekeag Watershed have been determined by the Department of Natural Resources based on survey information (1997-2004). These estimates indicate generally healthy population numbers, with considerable yearly fluctuations in some cases. There is a declining population for salmon parr, which is consistent with other fish data and anecdotal information along the St. John River Valley. Some salmon hatchlings are placed in the upper river each year under an elementary school rearing project.

In 1996 and 1997 the Meduxnekeag River Association undertook an anglers' survey to determine the state of the brown trout fishery. It is evident from that survey that the recreational fishery during the spring is centred around trout, while angling during late May, June and July, is for smallmouth bass. It is estimated that 40 to 50% of anglers over this period were successful in their attempts to land fish, generally in a 2 to 4 hour period on the river.

## UNIQUE INSECTS

Recent research along the Meduxnekeag River, particularly at Wilson Mountain and Bell Forest has revealed some unique insect populations, mainly associated with the Appalachian Hardwood Forests. In the summer of 2004, a team of entomologists – Reginald Webster, Kate Bredin, and Jim Edsall – spent about two weeks during July, August and September collecting specimens and documenting biodiversity. Their survey found a number of beetle and moth species at Bell Forest, Leonard Woods and Wilson Mountain which had not been recorded in New Brunswick. Some of these were new records for the Maritimes, and one is believed to be a first for Canada (Webster et. al. 2005). The majority of these species live within the river margin, with a few occurring within the water course and a select number only being present along spring-fed seepages. The water bound species, namely dragon flies and Hydrolcolis spp., a predaceous form of water beetle, are susceptible to fluctuations in water quality. Sudden fluctuations in water quality can be beneficial, providing decaying organic matter upon which some of the species feed, or may have a negative impact by increasing siltation, thereby damaging stream bottom habitat.

[www.meduxnekeag.org](http://www.meduxnekeag.org)



## Water sampling, sampling frequency, and methodology

Volunteers were utilized to collect water quality samples over a three year period. The methodology and sampling frequency were according to the *Volunteer's Guide to Water Quality Monitoring, version T2000-1* (DELG 2000). The volunteers were trained by the Department of Environment and Local Government (DELG), with continued support being provided by the Meduxnekeag River Association and DELG.

MRA staff and volunteers collected water samples once a month during July, August, September and October in 2002, 2003, and 2004. Collection bottles were provided by the DELG laboratory. They were pre-washed and pre-sealed before shipment. All bottles were labelled according to field procedures to ensure proper identification and data warehousing. Field data forms and observations were made at each site and included with the samples when shipped to DELG. Collected samples were preserved in a cooler on ice immediately after collection. Upon completion of the day's sampling, samples were packaged and shipped to the DELG laboratory in Fredericton, being received within 24 hours of collection.

## SAMPLE ANALYSIS

Water samples were analyzed for E.coli and \*B suite of parameters and suspended solids. These parameters, including the methods used for analysis, are outlined in Appendix II. The sub labs used in the baseline assessment and the parameters they were analysed at the DELG lab are as follows:

Microbiology Sub Lab – bacteria, in particular E. coli

Metals Sub Lab - all metals

Major Ions Sub Lab – general chemistry tests such as pH, conductivity, alkalinity, hardness

Engineering Sub Lab – suspended solids, dissolved solids

Nutrients Sub Lab – nutrients

## QUALITY ASSURANCE

Quality-assurance samples are designed to provide information on the bias and representativeness of samples. During this study, one type of quality-assurance sampling was utilized, namely duplicate samples were collected at some sites during each sampling period. A total of six duplicate samples were collected between 2002 and 2004, representing 6 percent of the total number of samples. Analysis of the duplicate samples indicates that sample results were not biased by equipment contamination or sampling method.

A Quality Assurance technician at DELG made sure that all sample information was properly entered and that a complete set of results arrived from the lab for each sample. This sample data was tabulated and copies were forwarded to the Meduxnekeag River Association once all results were checked for errors, verified and quality assured (DELG 2000).

Benthic macro-invertebrate samples were collected in the fall of 2004 from five locations throughout the watershed by DELG (John O'Keefe) and MRA staff (George Peabody and Simon J. Mitchell), utilizing a U frame net at riffle habitats. This data will be available upon completion of the analysis phase. A further benthic sample collection was carried out at the same sites in the fall of 2005.

Benthic macroinvertebrates are primary indicators of the status and health of any aquatic system. They are broadly used in most assessments and interpretation of water quality or environmental integrity. Their numerical presence, diversity and community structure can reveal present and historical conditions of a river or lake as well as indication of change and the probable causes. Understanding the BMI ecology can prove invaluable in reporting on any aspect of surface water and their aquatic habitats.

DELG has utilized BMI monitoring as a tool in various programs from the late 1970's to the present. Receiving waters and baseline conditions of rivers and lakes were the occasional focus in the early years using traditional natural substrate methodologies (Serber samplers) and some artificial substrate colonization techniques (Pot samplers, etc.).

In the 1990's the Water Classification Program began to evolve and with it, the proposal that benthic standards be applied when classifying all New Brunswick waters. Initially and for several years, that program followed the State of Maine's lead with their



Collecting benthic samples in 2005

own Water Class Program, in using colonization rock bags as the accepted methodology. This led toward the development of a New Brunswick model that applies this BMI information to standards which help form the basis of the classification process.



## Meduxnekeag Watershed Classification Report

As Water Classification and other DELG programs evolved, so, coincidentally, did the New Brunswick-based Canadian Rivers Institute (CRI). They had become cooperative partners with DELG on various projects and provided technical and strategic advice on many issues and processes. In 2004 under the guidance of the CRI, DELG moved back to a natural substrate methodology for benthic applications for its programs, including Water Classification, as science and most other jurisdictions were moving in that direction.

The Meduxnekeag River Watershed Classification project is one of the first to utilize this current/future methodology for DELG programs overall. Basically it employs a device – a \*U-net - created by NWRI (Env. Can.) scientists and now adopted by many agencies and research institutions, including the CRI. It captures invertebrates in their natural substrate in an efficient and effective manner. Three riffle sequences of a stream each receive three timed exposure sets of this device with the substrate immediately in front of the net and within the “quadrant” the net being “washed” and distributed to release any BMI’s on, between or under rocks and or gravel and sediment.

These sets are collected into specimen jars labeled and preserved for transportation in the field and returned for identification, and eventual interpretation and reporting on the findings. Depending on assessment type and or need, organisms can be identified to family or all the way to specimens.



Benthic sample as collected with a U-net

[www.meduxnekeag.org](http://www.meduxnekeag.org)

\* U-net – resembles the combination of a kick seine and serber sampler with a drift mesh bag (400 um) extending from a U-shaped frame placed on the substrate with its opening facing upstream. A long handle facilitates use in deeper water. (Must be riffle stretch or fast run of water)

## Sampling Sites

Fifteen water quality stations were determined for the Meduxnekeag Watershed in 2001. These stations (MR1 to MR15) were chosen with the goal of evaluating the baseline water quality in the Meduxnekeag River watershed. Sites were located to ensure ease of access and consistent application of the sampling procedure (Appendix III, IV, Figure 8).

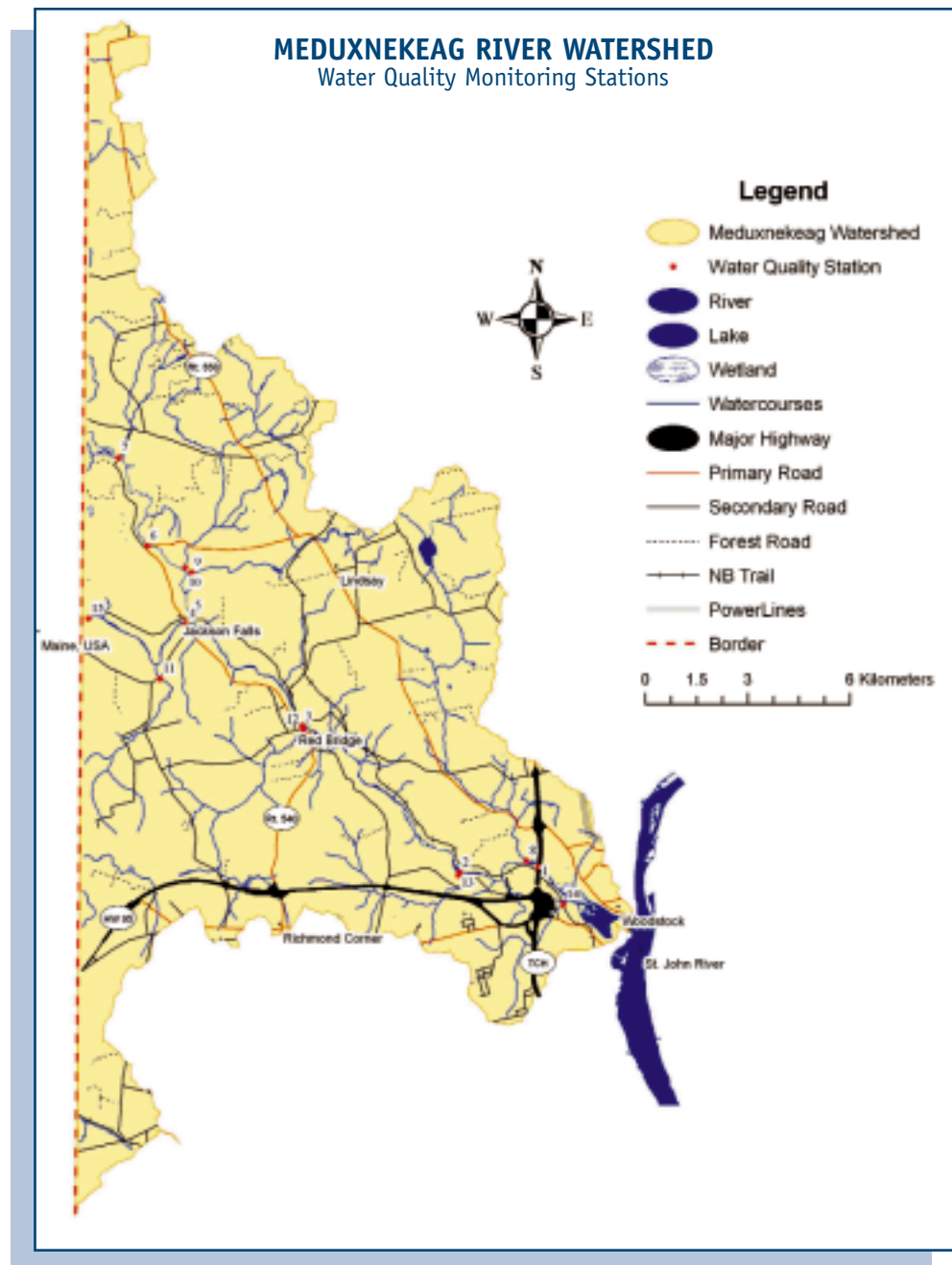


FIGURE 8: Location of sample sites in the Meduxnekeag watershed



## Meduxnekeag Watershed Classification Report

Over the three-year sampling period several of the sites were dropped, namely: North Branch Meduxnekeag River at Oakville (MR6); Hagermann Brook (MR10); Carters Brook (MR9); and, Upham Brook (MR14). North branch sites are accurately represented by sampling at Weston (MR7) and above the confluence with the south branch (MR5). The Upham Brook site enters the Meduxnekeag river along the intervale zone, an area where water flow is minimal and it was therefore determined that the site was not ideal for water sampling purposes. The overall impact of removing these sampling sites does not appear significant on initial analysis; that is, it has not negatively affected the integrity of analysis of water quality parameters in the Meduxnekeag watershed.

Samples were collected at five sites on the Meduxnekeag River in the fall of 2004, and again in 2005, for benthic assessments. A complete description of these sites is provided in Appendix IV.



North Branch of the Meduxnekeag above Weston

[www.meduxnekeag.org](http://www.meduxnekeag.org)

## Water Classification

In the 1990's New Brunswick developed a provincial Water Classification system. The system utilizes information on the current biological health of the river, and objectives as determined by the stakeholders, to create a Provisional Water Classification. The six "classes" of New Brunswick's water classification system are defined in Appendix V.

### MAINE WATER CLASSIFICATION

Prior to further discussing the Meduxnekeag river watershed water quality it is necessary to discuss the Maine situation, as both the North and South Branches of the Meduxnekeag originate in Maine. The Meduxnekeag watershed was classified in Maine in 1986 and partially reclassified in 1999 (Table 4, Figure 9) using a system on which New Brunswick's letter-grade system is based. (Appendix VI)

PORTION OF WATERWAY CLASSIFICATION	
1) Meduxnekeag River Main Stem	
(a) From the outlet of Meduxnekeag Lake to the international boundary.	Class B
2) Meduxnekeag River, tributaries – Class B unless otherwise specified	
(a) North Branch of the Meduxnekeag River and its tributaries above the Monticell – T.C, R.2, W.E.L.S. boundary.	Class A
(b) Moose Brook and its tributaries, upstream of the Ludlow Road in Ludlow.	Class A
(c) South Branch of the Meduxnekeag River and its tributaries upstream of the Oliver Road in Cary.	Class A
(d) B Stream and tributaries upstream of the Burnt Brow Bridge in Hammond	Class A

TABLE 4: Maine water classification for the Meduxnekeag River

Source: <http://janus.state.me.us/legis/statutes/38/title38sec467.html>

Both branches of the Meduxnekeag at the point where they cross the international border into New Brunswick, and hence into the area covered by this classification project, are Class B waterways under the Maine system.

Over the past few years algal blooms have occurred in the Meduxnekeag River around the Houlton area. The resulting depressed dissolved oxygen (DO) levels alter the habitat of fish and other biota. The Maine State Planning Office's River Study lists the Meduxnekeag River as having natural and recreational values of statewide significance. However, the algal blooms and resulting low DO levels are threatening this status. A 6-mile segment of the river downstream of Houlton is listed on the state's 303d and 305b



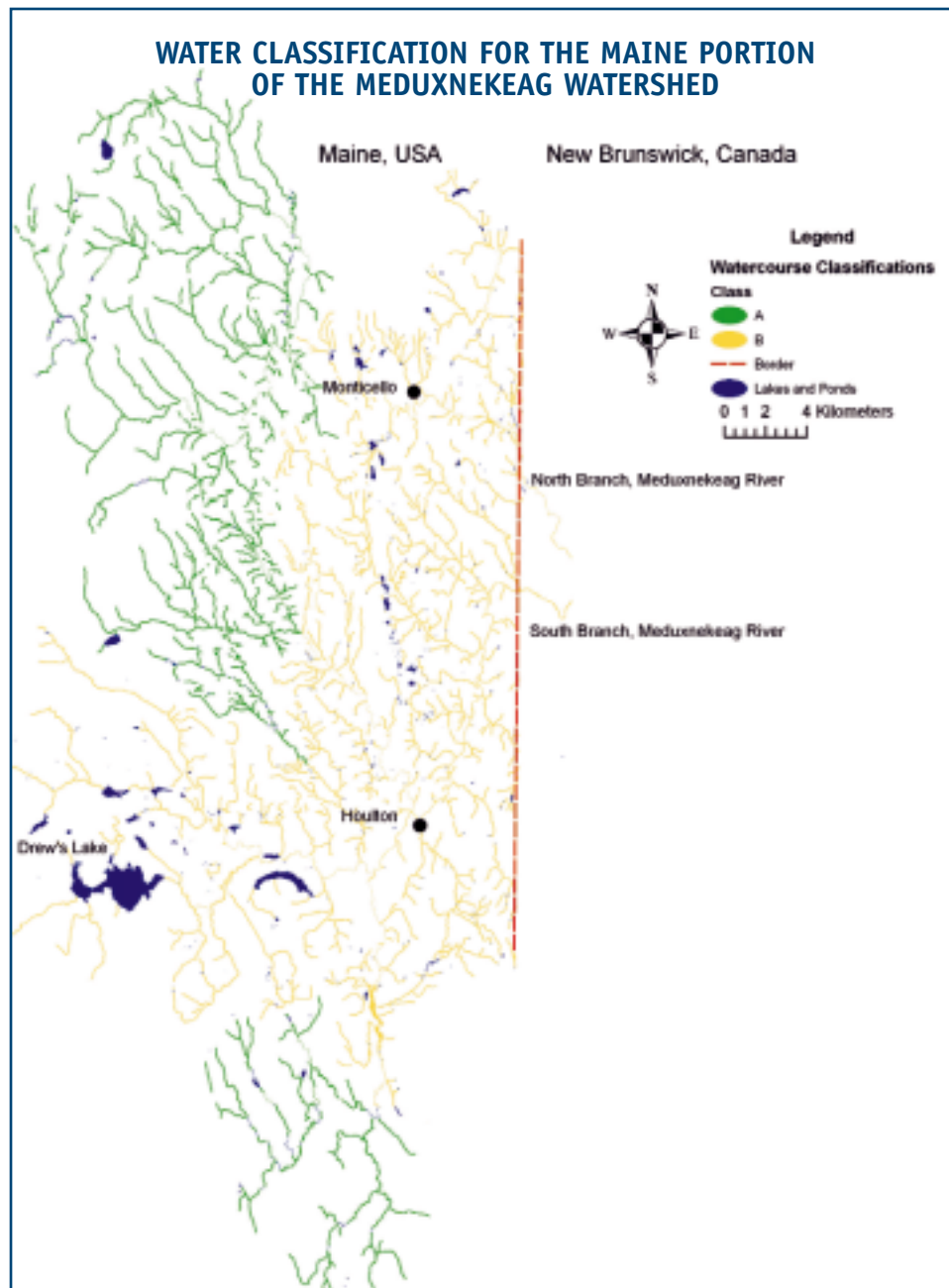


FIGURE 9: Maine water classification

list for non-attainment of water quality standards because of high nutrient loads and low DO levels. In 2003 the United States Geological Service and the Houlton Band of Maliseet Indians under took a joint research project (USGS 2003) to better understand the algal bloom problem in the vicinity of Houlton. Unfortunately during the field season no algal blooms were observed, directly impacting the purpose of the research.

## Understanding pollution: non-point source vs. point source

The non-point source pollution within the Meduxnekeag watershed is difficult to characterize, although this does not diminish the impact of these pollution sources and their affect on water quality within the watershed. Alternatively, potential point source discharges in the watershed can be more accurately identified, quantified and ultimately controlled. There are several non-point source pollution generators within the watershed, namely;

- **Stream and shoreline development:** residential development along streams and shorelines increases nutrient levels and may replace natural vegetation with lawns, pavement and buildings. Additionally, septic systems that are not properly installed and maintained have the potential to release nutrients and bacteria into watercourses.
- **Run-off from farmland:** harmful bacteria and nutrient loading is a concern where livestock are present. Pesticides and herbicides applied to farm crops and Christmas trees pose a significant risk to watercourses as a result of surface run-off. In the Meduxnekeag watershed, both potato and Christmas tree cultivation require numerous herbicide, fungicide and pesticide applications. Additionally, native biodiversity is negatively affected, decreasing the ability of ecosystems to respond to natural changes in climate. In some tributary streams, notably Marven Brook and Fitzpatrick Brook, high levels of sedimentation are evident during and after periods of heavy rain.
- **Forest removal:** site degradation as a result of timber harvesting along rivers and tributary streams can increase sedimentation levels, contaminating watercourses and damaging or even destroying fish habitat. It can also change water flows and water temperatures, altering habitat conditions for many aquatic species.
- **The flooding of the St. John River Valley** with the installation of the Mactaquac Dam (1967) has created a backwater on the lower portion of the Meduxnekeag River at its confluence with the St. John River. The flooding of the lower Meduxnekeag River contributes to a settling of sediments and inhibits the river's ability to flush pollutants. This is compounded by the Town of Woodstock's use of the area beyond the New Brunswick Community College parking lot as a snow dump for the town.



The potential point sources of pollution in the Meduxnekeag watershed are as follows:

- The closed Woodstock municipal landfill extends from the Simcox Road to the bank of the Meduxnekeag. It has been clay capped and seeded with ground cover, but it was not constructed with a liner. Monitoring wells are in place. Adjacent to the dump site is a now disused septage disposal site. Nearby are a now closed petroleum-contaminated soil remediation (UTM Northing 46.15587, Westing 067.62215) site; adjacent to this site is an abandoned asphalt plant; there is visual evidence of petroleum-based contamination in surface water pools near this site. Also within this area is a construction and demolition waste disposal site, in which other materials – plastic fuel containers, old tires – are evident. Surface run-off from this entire area is a potential water quality issue.



Riparian gravel pit near Red Bridge flooded in high water

- There are numerous gravel pits located in the riparian zone of the Meduxnekeag River along its length from Woodstock to Jackson Falls. The major environmental impact of the gravel pits centres around the potential for sedimentation as a result of surface run-off and the potential for stream bank collapse. Exceptional freshets, such as that experienced in the Spring of 2005, may flood river side gravel pits, contributing to bank erosion and indicating that gravel extraction is occurring below Spring flood levels, and in some cases below Summer water levels. Soil and water contamination from fuel and asphalt operations is an additional water quality concern at some of the gravel pits.

- A ready-mix concrete plant located in the Town of Woodstock overlooking the intervale zone, has, over the years been encroaching, principally with waste concrete, on the water course. Surface run-off, as evidenced by water discolouration and sedimentation in the immediate vicinity of the plant - intervale mixing zone is occurring.
- Commercial development on and near Connell Road in Woodstock is having an impact on Connell Brook (within town limits). This is compounded by urban surface runoff and storm drain outflow from Connell Road. Other commercial development storm drainage in this area reaches Marven Brook. Further along Connell Road (Highway 550), linear residential development has the potential to lower water quality in Marven Brook.
- The Town of Woodstock currently has storm drains that empty into the Meduxnekeag River between the Trans Canada Highway and the St. John River. These outflows release water that gathers roadside and as a result of urban development, both residential and commercial, and bring contaminants to the Meduxnekeag River. The result is poorer water quality within the lower Meduxnekeag.
- Alignment of NB Hwy 95 – the highway between Woodstock and the Maine border at Houlton is being widened to accommodate increased border traffic and as part of the Federal/Provincial upgrading of highways throughout the region. This twinning of Hwy 95, as currently proposed, will directly impact Morrison Lake - an important source of the key Meduxnekeag tributary Mill

Brook - along its southern boundary.

Other point sources may exist and it is hoped that over time they will be identified and measures will be taken to mitigate the impacts associated with them.



Land clearing for Hwy 95 January 2006: Morrison Lake in background



## Results of Sampling

The parameters tested during the sampling period (2001 to 2004) that are most relevant to the Water Classification process are associated with the water quality and management standards for NB water classification classes (Appendix VIII) are: dissolved oxygen, bacteria (E-coli) and trophic levels. Additional parameters were measured in order to characterize the water quality to the extent possible.

### BACTERIA (E.coli)

The "A" classification requires that E-coli be as naturally occurring, "B" class requires E-coli to be less than 200 per 100ml, while the "C" class requires E-coli to be less than 400 per 100ml. These E-coli levels are safe for recreational uses of the water, assuming these identified levels are met. Prolonged exceedances and sustained raised levels of E-coli are of concern.

As presented in Figure 10, nearly all of the bacteria concentrations were less than 200 MPN per 100 mL. This indicates that according to the bacteria standard, the waters meet a minimum of B class. The source of the one exceedance (MR 12 in 2001) is unknown: however, it could result from a single cause: a dead animal in the water course upstream, for example, although further investigation is warranted given the magnitude of this data anomaly.

It should be emphasized that the E-coli parameter is used here as a general water quality indicator and the samples have not been collected according to Drinking Water protocols. Therefore the data presented here can not be used to indicate the suitability of the water for drinking purposes – this requires a much more rigorous sampling procedure.

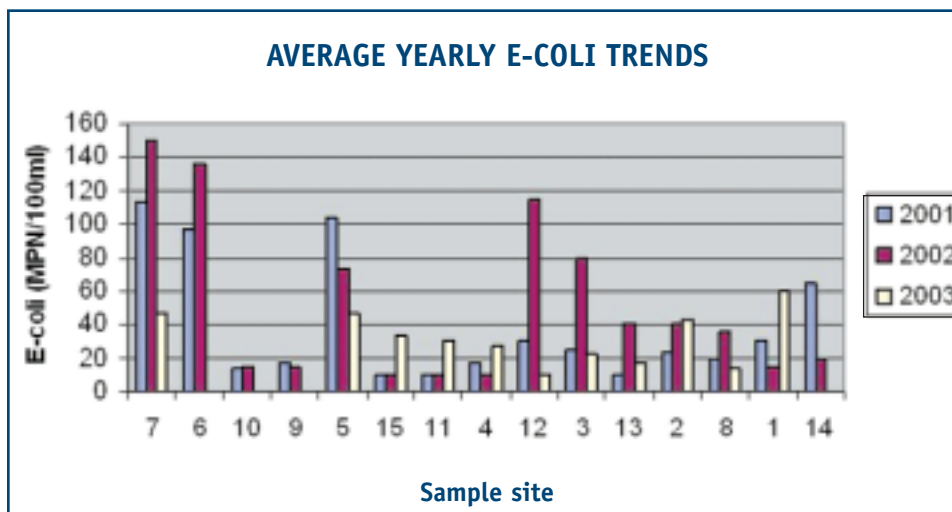


FIGURE 10: Average yearly E-coli trends

## TROPHIC STATUS

Overall understanding of trophic levels can be gained by examining nitrogen and phosphorus levels. These are two key nutrients that play an important role in the development of algal blooms at certain times of the year when temperatures are high and the nutrient loads are excessive. It is generally considered that Total Phosphorus (TP) is the most important nutrient in fresh water, however nitrogen can also be important in some areas. Total Nitrogen (TN) is a simple parameter to investigate, however, other nitrogen species such as nitrate can also be investigated.

The “A”, “B”, and “C” classifications require that the trophic status shall be stable or naturally changing; the water shall be free of algae blooms that impair use as habitat for aquatic life, or use for primary or secondary contact activity.

Additional observations of actual algal blooms, where and when they occur etc. can be used to gauge trophic levels.

The total phosphorous, nitrate, and total nitrogen are presented in Figures 11, 12 and 13.

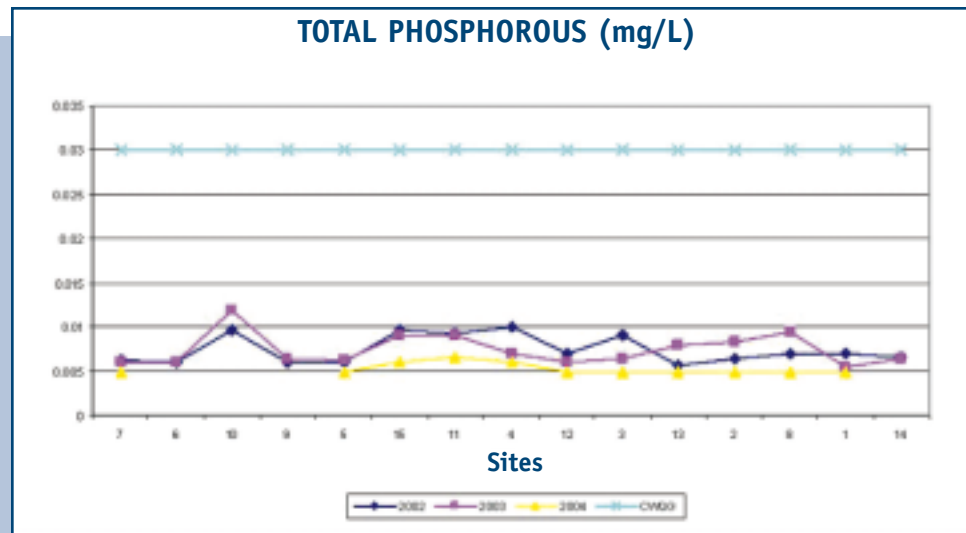


FIGURE 11: Average yearly Total Phosphorous levels



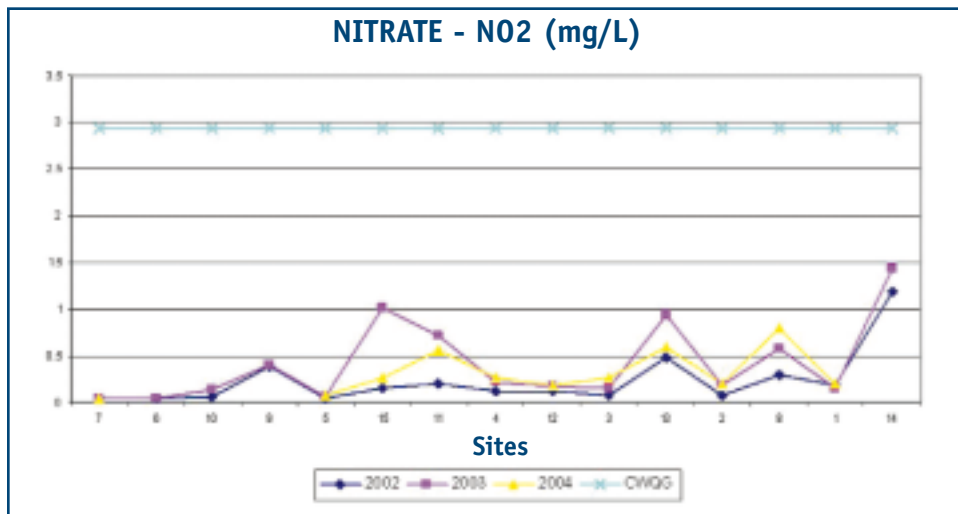


FIGURE 12: Average yearly Nitrate levels

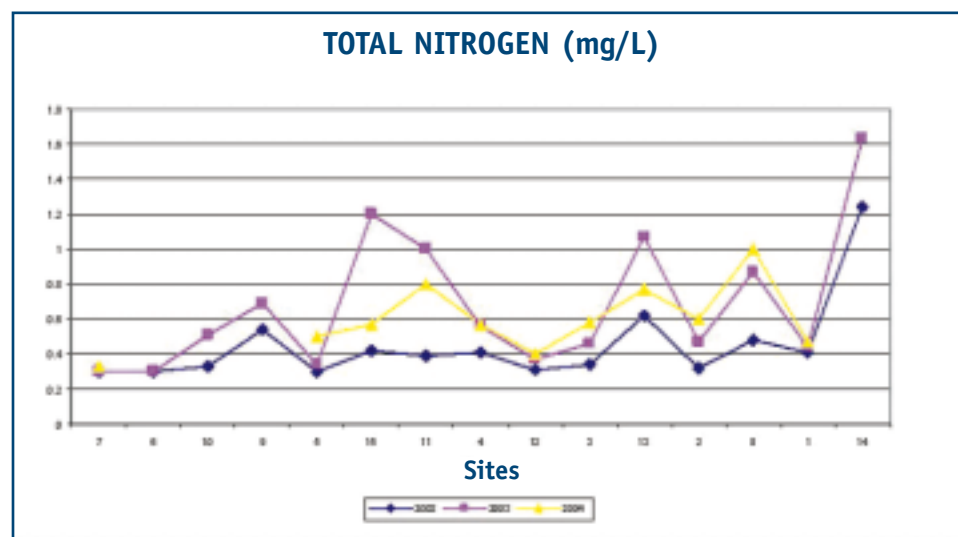


FIGURE 13: Average yearly Total Nitrogen levels

Most parameters tested during the sampling period (2001 to 2004) showed levels below the Canadian Water Quality Guideline (CWQG) for aquatic life.

## DISSOLVED OXYGEN

Dissolved oxygen levels within the Meduxnekeag watershed were measured during the benthic sampling in 2004 and 2005 (Table 5). Although data is limited, the dissolved oxygen readings meet water quality and management standards for cold water species, having  $\geq 9.5$  ppm (early life stages) and  $\geq 6.5$  ppm (other life stages; for warm water species:  $\geq 6.0$  ppm (early life stages) and  $\geq 5.0$  (other life stages).

STATION #	NBDELG STATION #	2004	2005
B1	AJ 0053	10.75 ppm	10.88 ppm
B2	AJ 0073	11.31 ppm	11.69 ppm
B3	AJ 0057	11.2 ppm	
B4	AJ 0072	10.78 ppm	10.2 ppm
B5	AJ 0060	10.5 ppm	10.95 ppm

TABLE 5: Dissolved oxygen levels measured during benthic sampling (in parts per million)

## AQUATIC COMMUNITY STANDARDS

The Water Quality and Management Standards states for "A" class waters aquatic life shall be as naturally occurring. For "B" and "C" class releases into the water shall not cause adverse impacts to the aquatic community in that the receiving water shall be of sufficient quality to support all indigenous aquatic species without detrimental changes to the resident biological community. Our initial impression of water quality based on a preliminary assessment of the benthic data utilizing population indices indicates the water quality as outlined in table 6.

STATION #	NBDELG STATION #	2004	2005
B1	AJ 0053	Excellent	Very Good
B2	AJ 0073	Fair*	Very Good
B3	AJ 0057	Good	
B4	AJ 0072	Excellent	Excellent
B5	AJ 0060	Very Good	Very Good

TABLE 6: Preliminary assessment of benthic macro-invertebrate data (\* water levels were very low and ideal habitat was not sampled as a result)

This information does not represent a full interpretation of the benthic macro-invertebrate data for the Water Classification purposes, but does support the overall understanding that water quality in the Meduxnekeag watershed is good.



## ADDITIONAL PARAMETERS

Most parameters tested during the sampling period (2001 to 2004) showed levels below the Canadian Water Quality Guideline (CWQG) for freshwater aquatic life. The noted exception is copper. The copper exceedance of the CWQG at MR 14 in 2002 (4.7 mg/L on August 14th, 2002) does not correspond with a rainfall event at, or near the time of sampling. It isn't associated with an increase in phosphates (TP-L) or suspended solids (SS). Given that natural sources of copper only affect a small percentage of surface water it is possible that this peak is the result of human induced input into the water course.

It should be noted that portions of some parameters such as copper, aluminum, manganese, iron, and chromium are typically associated with particulate matter in the water and do not occur in the dissolved form. It is generally known that it is the dissolved form that is mostly available to the biological community. Therefore, occasional exceedances of CCME guidelines do not necessarily harm the biological communities as a result.

## TRENDS

There are some interesting trends exhibited in the water quality data for the Meduxnekeag river. Most are the result of natural occurrences, although some are linked to land use. Anecdotal information collected over the past year indicates there are some issues associated with sedimentation, which is not necessarily reflected in the water quality data.

The preferred pH range for aquatic life is between 6.5 and 9.0. The Meduxnekeag river exhibits a suitable pH range (Figure 14), with values tending towards a more basic pH as one travels downstream towards Woodstock. This is likely a result of the increased presence of calcareous bedrock through the watershed. It indicates that the Meduxnekeag is "naturally" well equipped to buffer the effects of acidic precipitation.

[www.meduxnekeag.org](http://www.meduxnekeag.org)

Anecdotal information collected over the past year indicates that the sedimentation from non-point sources is a serious issue, particularly during periods of heavy rainfall.

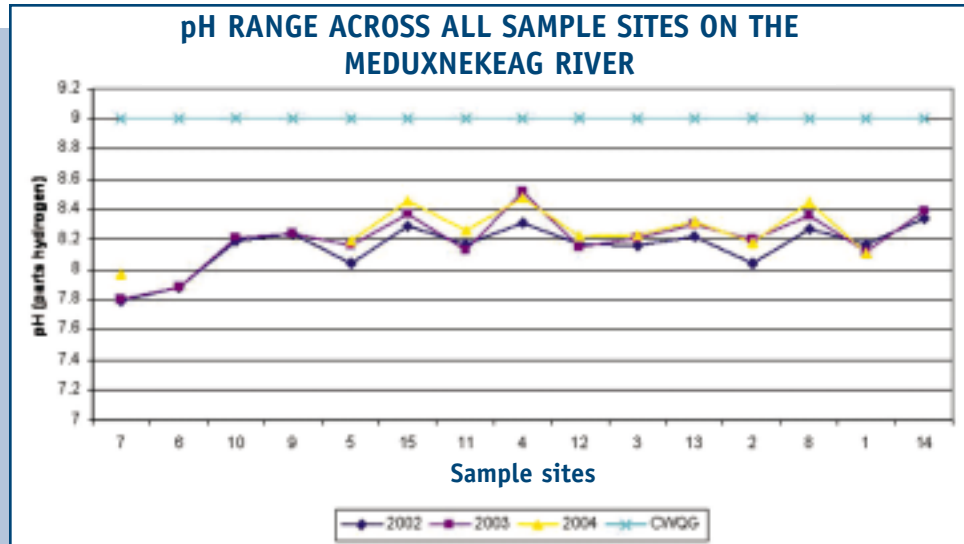


FIGURE 14: Yearly average range of pH values across all sample sites on the Meduxnekeag river

The total organic carbon (TOC) decreases as one travels down the Meduxnekeag river (Figure 15). Agricultural runoff and industrial and municipal waste are the major sources of plant material and humic substances which form the basis for total organic carbon. The decrease in TOC does not correspond to the total dissolved solids (TDS) parameter as might expect (Figure 16), indicating that there is an increase in calcium, chlorides, nitrates, iron, sulphur and phosphorous. Possible sources include dissolved solids derived from bedrock or soils, or from agricultural runoff.

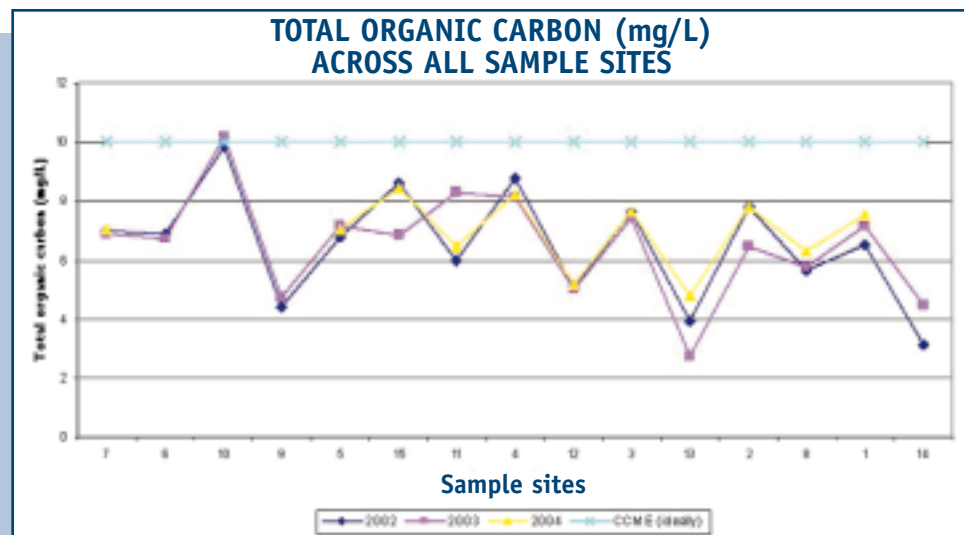


FIGURE 15: yearly average of total organic carbon (mg/L) across all sample sites



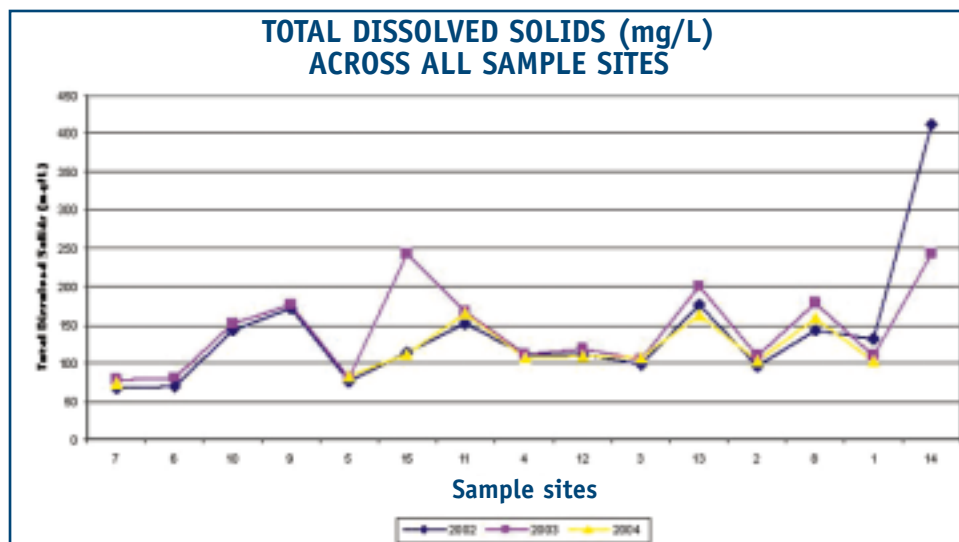


FIGURE 16: Yearly average of Total Dissolved Solids (mg/L) across all sample sites

Anecdotal information collected over the past year indicates that the sedimentation from non-point sources is a serious issue, particularly during periods of heavy rainfall. This was not captured during sampling of the Meduxnekeag river between 2001 and 2004 owing to the fact that no heavy rainfall was experienced immediately before or during the sampling. Sedimentation as a result of heavy rainfall was most noticeable this past year at Marven Brook (Figure 17), north branch below McBride Bridge (Figure 18) and on the main branch above Red Bridge (Figure 19).

## DATA ANOMALIES

The E-coli exceedance at MR12 in 2002 is likely the result of sampling or data analysis error. Throughout the water sampling period the E-coli measurements remained steady. It is important to note that the E-coli parameter in this context does not provide an indication of water drinkability. This requires a different sampling procedure than the process used during field sampling on the Meduxnekeag River. It is relatively safe to say that the presence of E-coli does not always represent a significant health hazard, especially when considered in the context of recreational use.



FIGURE 17a: Marven Brook during normal summer water conditions



FIGURE 17b: Marven Brook after heavy rainfall, July 15, 2005





FIGURE 18a: North Branch below McBride Bridge during normal summer water conditions



FIGURE 18b: North Branch below McBride Bridge after heavy rainfall, July 15, 2005



FIGURE 19a: Meduxnekeag River above Red Bridge during normal summer water conditions, July 22, 2005



FIGURE 19b: Meduxnekeag River above Red Bridge after heavy rain, July 15, 2005



## Major issues and findings

The majority of the parameters tested in the Meduxnekeag watershed between 2002 and 2004 were found at levels lower than the CWQG for aquatic life, with the exception of chromium, copper and total organic carbon.

Mineral dissolution and/or industrial discharges are the most likely reason for increased copper levels. Without further testing it is not possible to say for sure what the exact source of copper is. Total organic carbon exceedance is most likely a result of agricultural runoff. Further sampling at this site (the site was not sampled in 2004) is advisable to better understand possible associations with this parameter.

Clearly there are some issues associated with sedimentation, mainly as a result of heavy rainfall, as evidenced by the anecdotal information contained within this report.

The identification of non-point source and potential point sources within the watershed are cause for concern. Additionally, the existence of algal blooms in the portions of the Meduxnekeag river around Houlton, Maine are cause for concern. The parameters tested along the Meduxnekeag river as part of this study do not flag this as a major issue, but given that the conditions exist upriver, measures should be taken to avoid this situation arising in the New Brunswick portion of the Meduxnekeag river.

It is important to note that over the past year several initiatives have been undertaken to mitigate potential point source pollution within the watershed. Most notable are:

- In 2004 and 2005, the Town of Woodstock carried out an extensive riparian rehabilitation project above the mouth of the Meduxnekeag. This has included moving parking lots back from the river's edge and planting buffer strips.
- Damage to wetlands during the Hwy 95 construction is being compensated for with wetland improvement and rehabilitation within the watershed on a 3:1 basis.

[www.meduxnekeag.org](http://www.meduxnekeag.org)

Clearly there is room for further improvement – as noted in this report through the identification of non-point source and point source pollution sources within the watershed, but this should be seen within the context of a generally good water quality situation at present.

## Summary

The overall quality of water is good according to the parameters tested for in the Meduxnekeag watershed. This has not always been the case. As late as the 1970s raw sewage and starch from the factories in Houlton, Maine negatively impacted water quality and fish habitat. Over the years these facilities have altered their practices, mainly as a result of more stringent environmental regulations. This hasn't been the only change resulting in improved water quality. The use of stream buffers by woodland owners and farmers, integrated pest management practices and a greater awareness of the impacts humans and development can have on water quality have all contributed to improvements. Clearly there is room for further improvement – as noted in this report through the identification of non-point source and point source pollution sources within the watershed, but this should be seen within the context of a generally good water quality situation at present.

This report establishes the baseline ambient condition of the river based on three years of water quality sampling. The sampling has formed the basis for this report, which will inform the discussion on the development of a provisional water classification recommendation for the Meduxnekeag river.

## Next Steps

Following the public consultation process around the water quality report a water classification recommendation will be made to the Minister of Environment and Local Government based on findings of the consultation and the water quality and management standards (Appendix VIII) for the various water classes and for use in future water management efforts in the watershed. This will be accompanied by an action plan to address non-point source and point source pollution issues in the watershed.

[www.meduxnekeag.org](http://www.meduxnekeag.org)

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**Appendix I: Meduxnekeag River Association Board of Directors – 2005**

**President:** Stephen Wilson

**Vice-President:** Kent Orlando

**Treasurer:** John Murray

**Secretary:** Catherine Sutherland

**Directors:** Carl Faulkner,  
Rex Brown,  
Ken Langdon,  
Greg Hayden,  
Darlene Tapley,  
Peter Porteous,  
Ken Wright,  
Angie Reid,  
Brian Boyd,  
Heather Jones,  
Peter Hall,  
John Young

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**APPENDIX II: Parameters measured**

PARAMETER	ANALYTE	METHOD DETECTION LIMIT / UNITS	TECHNIQUE	ALTERNATE REFERENCE
NO3	Nitrate	0.05 mg/L	Calculated	
HARD	Total Hardness	0.67 mg/L	Calculated	
Al	Aluminum	0.001 mg/L	ICP-MS	EPA 200.8
ALK-G	Alkalinity	mg/L **	Titration	
As	Arsenic	1.5 µg/L	ICP-MS	EPA 200.8
Ca	Calcium	0.10 mg/L	ICP-OES	EPA 200.7
Cd	Cadmium	0.1µg/L	ICP-MS	EPA 200.8
Cl	Chloride	0.050 mg/L	Ion Chromatography	
CLRA	Color, Apparent	0 TCU	Color Comparator	
COND	Conductivity	µSeimen/cm **	Direct Measurement	
Cr	Chromium	0.5 µg/L	ICP-MS	EPA 200.8
Cu	Copper	0.5 µg/L	ICP-MS	EPA 200.8
F	Flouride	0.100 mg/L	Ion Selective Electrode	
Fe	Iron	0.010 mg/L	ICP-OES	EPA 200.7
K	Potassium	0.10 mg/L	ICP-MS	EPA 200.8
Mg	Magnesium	0.10 mg/L	ICP-OES	EPA 200.7
Mn	Manganese	0.005 mg/L	ICP-MS	EPA 200.8
Na	Sodium	0.10 mg/L	ICP-OES	EPA 200.7
	Ammonia Nitrogen	0.005 mg/L	Alkaline Phenol	
Ni	Nickel	0.005 mg/L	ICP-MS	EPA 200.8
NO-X	Nitrate/Nitrite	0.05 mg/L	Sulphanilamide/ Cadmium Reduction	
NO2	Nitrite	0.05 mg/L	Sulphanilamide	
Pb	Lead	1 µg/L	ICP-MS	EPA 200.8
PH	pH	pH units **	Electrometric	
Sb	Antimony	1 µg/L	ICP-MS	EPA 200.8
SO4	Sulfate	0.050 mg/L	Ion Chromatography	
	Total Nitrogen	0.005 mg/L	UV Persulphate	
TOC	Total Organic Carbon	1.0 mg/L	Combustion	
TP-L	Total Phosphorous	0.005 mg/L	UV Irradiation, Ascorbic Acid	
TURB	Turbidity	0.01 NTU	Nephelometry	
Zn	Zinc	0.005 mg/L	ICP-MS	EPA 200.8

**APPENDIX III: Site locations and descriptions for water sampling during 2002–2004**

FIELD STATION	NBDLG STATION #	SITE DESCRIPTION	RATIONALE FOR SITE	LONGITUDE	LATITUDE
MR7	00 AJ0075	Weston	To monitor water quality near Maine border on North Branch	46.26935	067.76991
MR6	00 AJ0074	Oakville	Representative of North Branch	46.24605	067.75026
MR10	00 AJ0051	Mouth of Hagerman Brook	To monitor influence of Hagerman Brook	46.24062	067.74706
MR9	00 AJ0052	Mouth of Carter Brook	To monitor influence of Carter Brook	46.23669	067.74619
MR5	00 AJ0053	McBride Bridge	To monitor influence of north branch prior to confluence with south branch	46.22765	067.74133
MR15	00 AJ0078	500 m east of Maine border	To monitor water quality at Maine border on south branch	46.22866	067.77469
MR11	00 AJ0076	Fitzpatrick Brook	To monitor influence of Fitzpatrick Brook	46.21135	067.75335
MR4	00 AJ0073	Jackson Falls	To monitor influence of south branch prior to confluence with north branch	46.22557	067.74309
MR12	00 AJ0057	Mouth of Mill Brook	To monitor influence of Mill Brook	46.19926	067.69794
MR3	00 AJ0056	Red Bridge	Representative of upper reaches of main branch of Meduxnekeag River	46.19984	067.70022
MR13	00 AJ0058	Mouth of MacQuarrie Brook	To monitor influence of MacQuarrie Brook	46.16058	067.63838
MR2	00 AJ0072	50 m below mouth of MacQuarrie Brook	Representative of middle section of main branch of Meduxnekeag River	46.16238	067.64082
MR8	00 AJ0060	Mouth of Marven Brook	To monitor influence of Marven Brook	46.16383	067.61343
MR1	00 AJ0061	Above TCH bridge	Representative of lower reaches of main branch of the Meduxnekeag River and to monitor influence of industrial waste oil site and old town dump	46.16488	067.61144
MR14	00 AJ0077	Mouth of Upham Brook	To monitor influence of Upham Brook	46.15368	067.59776



## APPENDIX IV: Station listing Meduxnekeag River, DELG

**STATION LISTING**  
**MEDUXNEKEAG RIVER, OLD PROP/PROJ #: 309**

<b>Station Name:</b> Carters Brook @ mouth			
<b>Description:</b> Stn. 9 Drive on Rte. 540 past Jackson Falls for 5 minutes. A small farm road is on the right and leads to the river. (House 4895 is on the left just before this road.) Go down this road past the old trucks to a dead end. Go left through a field and into the woods. You will be walking on a slope overlooking the river for 5 minutes. Work your way down to the river and then walk upriver. Two brooks enter the river on the opposite side before the falls. The first one is Carters Brook. Go 12 ft. up the brook and sample a little on the right facing u/s.			
<b>Site:</b>			
<b>Water Body:</b> Carters Brook; Flows W. into North Branch Meduxnekeag		<b>Historical ID:</b> 00BR01AJ0052	
<b>Station ID:</b> 1106	River. aka Strongs Brook	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>		<b>UTM Zone:</b>	19
<b>Station:</b> Active	<b>Latitude:</b> 46.239439	<b>UTM Northing:</b> 5121199	
<b>Status:</b>	<b>Longitude:</b> 67.743045	<b>UTM Easting:</b> 596850	

<b>Station Name:</b> Fitzpatrick Brook near Watson Settlement			
<b>Description:</b> Stn. 11 From Rte. 540 take left on dirt road to Woodlawn south of Jackson Falls. Stop at big culvert almost 3 km down road. Go u/s of culvert until you find first moving water (above still pool) within sight of culvert. Take midstream.			
<b>Site:</b>			
<b>Water Body:</b>		<b>Historical ID:</b> 00BR01AJ0076	
<b>Station ID:</b> 30358		<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>		<b>UTM Zone:</b>	19
<b>Station:</b> Active	<b>Latitude:</b> 46.211188	<b>UTM Northing:</b> 5118049	
<b>Status:</b>	<b>Longitude:</b> 67.752115	<b>UTM Easting:</b> 596200	

<b>Station Name:</b> Hagerman Brook @ mouth			
<b>Description:</b> Stn. 10 Drive on Rte. 540 past Jackson Falls for 5 minutes. A small farm road is on the right and leads to the river. (House 4895 is on the left just before this road.) Go down this road past the old trucks to a dead end. Go left through a field and into the woods. You will be walking on a slope overlooking the river for 5 minutes. Work your way down to the river and then walk upriver. Two brooks enter the river on the opposite side before the falls. The first one is Carters Brook. Hagerman Brook is a few 100 m up the river before the falls. Go 5 ft. up the brook and take the sample. Hagerman Brook is on the same side as Carters Brook.			
<b>Site:</b>			
<b>Water Body:</b> Hagerman Brook		<b>Historical ID:</b> 00BR01AJ0051	
<b>Station ID:</b> 919		<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>		<b>UTM Zone:</b>	19
<b>Station:</b> Active	<b>Latitude:</b> 46.240346	<b>UTM Northing:</b> 5121299	
<b>Status:</b>	<b>Longitude:</b> 67.743673	<b>UTM Easting:</b> 596800	

## APPENDIX IV: Station listing Meduxnekeag River, DELG

### STATION LISTING MEDUXNEKEAG RIVER, OLD PROP/PROJ #: 309

<b>Station Name:</b> MacQuarrie Brook @ mouth		
<b>Description:</b> Stn. 13 From TCH go down Rte. 550 about 2 km. On the left (west) there is a small bridge crossing Marven Brook. Take this. Go through farm fields and past a huge sign and the train track bed. It's about an 8-10 minute drive. Follow road to the end where it forks. The river is 50 m down the right-hand fork. Straight across the river barely visible is MacQuarrie Brook. Wade across the Meduxnekeag. Walk 10 ft. up MacQuarrie Brook and take sample.		
<b>Site:</b>		
<b>Water Body:</b>	<b>Historical ID:</b> 00BR01AJ0058	
<b>Station ID:</b> 745	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b> 19	
<b>Station:</b> Active	<b>Latitude:</b> 46.159927	<b>UTM Northing:</b> 5112499
<b>Status:</b>	<b>Longitude:</b> 67.637357	<b>UTM Easting:</b> 605150

<b>Station Name:</b> Marven Brook @ mouth		
<b>Description:</b> Stn. 8 Go towards Fredericton on TCH and stop before bridge over Meduxnekeag. Walk down the hill towards the river. As you get lower, on your left will be a crushed rock hill. At the hill turn right into the woods. A walking trail will be heading downhill. Follow this as it turns parallel to the river for 4 or 5 minutes. The trail then turns left and goes straight down to the river. Marven Brook will be about 300 m u/s. Walk along the bank until you reach it. Take sample 10 m up from mouth of Marven Brook.		
<b>Site:</b>		
<b>Water Body:</b> Marven Brook; aka Bulls Creek	<b>Historical ID:</b> 00BR01AJ0060	
<b>Station ID:</b> 713	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b> 19	
<b>Station:</b> Active	<b>Latitude:</b> 46.164115	<b>UTM Northing:</b> 5112999
<b>Status:</b>	<b>Longitude:</b> 67.611349	<b>UTM Easting:</b> 607150

<b>Station Name:</b> Meduxnekeag River @ Belleville below Mill Brook		
<b>Description:</b> Stn. 3 From the bridge at Belleville you can see "Haddy's Rock" about 300 m d/s. Walk d/s on right-hand side (facing d/s). Get sample off the rock. It is the first major rock formation below the bridge.		
<b>Site:</b>		
<b>Water Body:</b> Meduxnekeag River; Flows E. across N.B.-Maine boundary into Saint John River, N.B. aka Meduxnekeag River	<b>Historical ID:</b> 00BR01AJ0056	
<b>Station ID:</b> 705	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b> 19	
<b>Station:</b> Active	<b>Latitude:</b> 46.198405	<b>UTM Northing:</b> 5116699
<b>Status:</b>	<b>Longitude:</b> 67.695378	<b>UTM Easting:</b> 600600



## APPENDIX IV: Station listing Meduxnekeag River, DELG

**STATION LISTING**  
**MEDUXNEKEAG RIVER, OLD PROP/PROJ #: 309**

<b>Station Name:</b> Meduxnekeag River @ Jackson Falls		
<b>Description:</b> Stn. 4 At Rte. 540 bridge go u/s out of the fast-moving water to the top of the rapids just around the corner from the bridge (about 150 m). Go 6 m out into the stream for a sample. The corner is actually on an island. Be sure to stay on the mainstem.		
<b>Site:</b>		
<b>Water Body:</b> Meduxnekeag River; Flows E. across N.B.-Maine boundary into Saint John River, N.B. aka Meduxnekeag River		<b>Historical ID:</b> 00BR01AJ0073
<b>Station ID:</b> 30353	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b> 19	
<b>Station:</b> Active	<b>Latitude:</b> 46.226407	<b>UTM Northing:</b> 5119749
<b>Status:</b>	<b>Longitude:</b> 67.744639	<b>UTM Easting:</b> 596750

<b>Station Name:</b> Meduxnekeag River @ TCH below Marven Brook		
<b>Description:</b> Stn. 1 Go towards Fredericton on TCH and stop before bridge over Meduxnekeag. Walk down the hill towards the river. As you get lower, on your left will be a crushed rock hill. At the hill turn right into the woods. A walking trail will be heading downhill. Follow this as it turns parallel to the river for 4 or 5 minutes. The trail then turns left and goes straight down to the river. Marven Brook will be about 300 m u/s. Walk along the bank until you reach it. When you get there, walk 50 m d/s and take sample midstream.		
<b>Site:</b>		
<b>Water Body:</b> Meduxnekeag River; Flows E. across N.B.-Maine boundary into Saint John River, N.B. aka Meduxnekeag River		<b>Historical ID:</b> 00BR01AJ0061
<b>Station ID:</b> 704	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b> 19	
<b>Station:</b> Active	<b>Latitude:</b> 46.163207	<b>UTM Northing:</b> 5112899
<b>Status:</b>	<b>Longitude:</b> 67.610724	<b>UTM Easting:</b> 607200

<b>Station Name:</b> Meduxnekeag River @ Trans-Canada Highway		
<b>Description:</b> Station 2, above Woodstock, at bridge, 150m north of railway bridge, tributary to Saint John River.		
<b>Site:</b>		
<b>Water Body:</b> Meduxnekeag River; Flows E. across N.B.-Maine boundary into Saint John River, N.B. aka Meduxnekeag River		<b>Historical ID:</b> 00BR01AJ0046
<b>Station ID:</b> 17715	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b> 19	
<b>Station:</b> Active	<b>Latitude:</b> 45.262894	<b>UTM Northing:</b> 5012849
<b>Status:</b>	<b>Longitude:</b> 67.629658	<b>UTM Easting:</b> 607450

## APPENDIX IV: Station listing Meduxnekeag River, DELG

### STATION LISTING MEDUXNEKEAG RIVER, OLD PROP/PROJ #: 309

<b>Station Name:</b> Meduxnekeag River 500 m east of U.S. border			
<b>Description:</b> Stn. 15 Take Rte. 540 past Jackson Falls and turn left at church onto London Rd. Follow road until it ends near barn. Go past barn onto wooded road for short distance and take first left. Follow road as far down as you can and then walk down to river. Take sample about 20 ft. from shore.			
<b>Site:</b>			
<b>Water Body:</b> Meduxnekeag River; Flows E. across N.B.-Maine boundary into Saint John River, N.B. aka Meduxnekeag River		<b>Historical ID:</b> 00BR01AJ0078	
<b>Station ID:</b> 30360	<b>NAD-83 (CSRS)</b>		<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b>		19
<b>Station:</b> Active	<b>Latitude:</b> 46.226723	<b>UTM Northing:</b> 5119749	
<b>Status:</b>	<b>Longitude:</b> 67.773808	<b>UTM Easting:</b> 594500	

<b>Station Name:</b> Meduxnekeag River below MacQuarrie Brook			
<b>Description:</b> Stn. 2 (2 of 15 in 2002) From TCH go down Rte. 550 about 2 km. On the left (west) there is a small bridge crossing Marven Brook. Take this. Go through farm fields and past a huge sign and the train track bed. It's about an 8-10 minute drive. Follow road to end where it forks. The river is 50 m down the right-hand fork. Straight across the river barely visible is MacQuarrie Brook. Walk 30 m down Meduxnekeag until you find moving water midstream. Water is very slow-moving here.			
<b>Site:</b>			
<b>Water Body:</b> Meduxnekeag River; Flows E. across N.B.-Maine boundary into Saint John River, N.B. aka Meduxnekeag River		<b>Historical ID:</b> 00BR01AJ0072	
<b>Station ID:</b> 30352	<b>NAD-83 (CSRS)</b>		<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b>		19
<b>Station:</b> Active	<b>Latitude:</b> 46.160812	<b>UTM Northing:</b> 5112599	
<b>Status:</b>	<b>Longitude:</b> 67.63604	<b>UTM Easting:</b> 605250	

<b>Station Name:</b> Meduxnekeag River North of Dump			
<b>Description:</b> Meduxnekeag river north of dump, Carleton Co.			
<b>Site:</b>			
<b>Water Body:</b>		<b>Historical ID:</b> 00BR01AJ0059	
<b>Station ID:</b> 703	<b>NAD-83 (CSRS)</b>		<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b>		
<b>Station:</b> Active	<b>Latitude:</b>	<b>UTM Northing:</b>	
<b>Status:</b>	<b>Longitude:</b>	<b>UTM Easting:</b>	



## APPENDIX IV: Station listing Meduxnekeag River, DELG

**STATION LISTING**  
**MEDUXNEKEAG RIVER, OLD PROP/PROJ #: 309**

<b>Station Name:</b> Mill Brook @ mouth		
<b>Description:</b> Stn. 12 Go to the bridge at Belleville on Rte. 540. Mill Brook is just a few metres below the bridge on the right (facing d/s). Take sample u/s of mouth in fast-moving water.		
<b>Site:</b>		
<b>Water Body:</b> Mill Brook; Flows NE. into meduxnekeag River. aka Mill Stream <b>Historical ID:</b> 00BR01AJ0057		
<b>Station ID:</b> 696	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b>	19
<b>Station:</b> Active	<b>Latitude:</b> 46.197542	<b>UTM Northing:</b> 5116599
<b>Status:</b>	<b>Longitude:</b> 67.698638	<b>UTM Easting:</b> 600350

<b>Station Name:</b> North Branch Meduxnekeag River @ covered bridge south of Weston		
<b>Description:</b> Stn. 7 Go past Jackson Falls and Briggs Mill to a bridge with a cattle farm on the right. Take sample 40 m d/s of bridge just after stream from cow pasture.		
<b>Site:</b>		
<b>Water Body:</b> North Branch Meduxnekeag River; Flows SE. from Maine, then S. into Meduxnekeag River. aka North Meduxnekeag River <b>Historical ID:</b> 00BR01AJ0075		
<b>Station ID:</b> 30355	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b>	19
<b>Station:</b> Active	<b>Latitude:</b> 46.268965	<b>UTM Northing:</b> 5124449
<b>Status:</b>	<b>Longitude:</b> 67.768325	<b>UTM Easting:</b> 594850

<b>Station Name:</b> North Branch Meduxnekeag River @ mouth		
<b>Description:</b> Stn. 5 Near Jackson Falls. Go to McBride's bridge, which is east of Jackson Falls if you go right around the church. There is an overhanging cedar about 35 m u/s from the bridge. Go midstream and take sample here.		
<b>Site:</b>		
<b>Water Body:</b> North Branch Meduxnekeag River; Flows SE. from Maine, then S. into Meduxnekeag River. aka North Meduxnekeag River <b>Historical ID:</b> 00BR01AJ0053		
<b>Station ID:</b> 564	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b>	19
<b>Station:</b> Active	<b>Latitude:</b> 46.228171	<b>UTM Northing:</b> 5119949
<b>Status:</b>	<b>Longitude:</b> 67.741357	<b>UTM Easting:</b> 597000

**APPENDIX IV: Station listing Meduxnekeag River, DELG**

**STATION LISTING  
MEDUXNEKEAG RIVER, OLD PROP/PROJ #: 309**

<b>Station Name:</b> North Branch Meduxnekeag River @ Oakville		
<b>Description:</b> Stn. 6 Briggs Mill. Go to bridge at Oakville. Go to house 5043. Go on left side (facing d/s) of stream. Sample at beach 45 ft above start of falls midstream.		
<b>Site:</b>		
<b>Water Body:</b> North Branch Meduxnekeag River; Flows SE. from Maine, then S. into Meduxnekeag River. aka North Meduxnekeag River		
<b>Historical ID:</b> 00BR01AJ0074		
<b>Station ID:</b> 30354	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b>	19
<b>Station:</b> Active	<b>Latitude:</b> 46.245766	<b>UTM Northing:</b> 5121899
<b>Status:</b>	<b>Longitude:</b> 67.745495	<b>UTM Easting:</b> 596650

<b>Station Name:</b> South Branch Meduxnekeag River		
<b>Description:</b> South Branch Meduxnekeag River, Carleton County		
<b>Site:</b>		
<b>Water Body:</b>		
<b>Historical ID:</b> 00BR01AJ0054		
<b>Station ID:</b> 243	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b>	
<b>Station:</b> Active	<b>Latitude:</b>	<b>UTM Northing:</b>
<b>Status:</b>	<b>Longitude:</b>	<b>UTM Easting:</b>

<b>Station Name:</b> South Brook		
<b>Description:</b> South brook @ meduxnekeag river, Carleton Co.		
<b>Site:</b>		
<b>Water Body:</b>		
<b>Historical ID:</b> 00BR01AJ0055		
<b>Station ID:</b> 238	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b>	
<b>Station:</b> Active	<b>Latitude:</b>	<b>UTM Northing:</b>
<b>Status:</b>	<b>Longitude:</b>	<b>UTM Easting:</b>

## APPENDIX IV: Station listing Meduxnekeag River, DELG

**STATION LISTING**  
**MEDUXNEKEAG RIVER, OLD PROP/PROJ #: 309**

<b>Station Name:</b> Upham Brook @ mouth		
<b>Description:</b> Stn. 14 Coming from town of Woodstock on old Houlton Road turn right after cemetery onto road to Plymouth. Turn right onto Grant St.. Turn left after house 106. Turn left onto gravel/dirt road before house 123 (the big one). Sample on left side facing d/s next to fallen tree and before deadwater, 50 or 60 m from the mouth.		
<b>Site:</b>		
<b>Water Body:</b> Upham Brook; aka Wallace Brook	<b>Historical ID:</b> 00BR01AJ0077	
<b>Station ID:</b> 30359	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b> 19	
<b>Station:</b> Active	<b>Latitude:</b> 46.153152	<b>UTM Northing:</b> 5111799
<b>Status:</b>	<b>Longitude:</b> 67.598027	<b>UTM Easting:</b> 608200

<b>Station Name:</b> Weston Brook		
<b>Description:</b> Weston brook @ meduxnekeag river, Carleton Co.		
<b>Site:</b>		
<b>Water Body:</b>	<b>Historical ID:</b> 00BR01AJ0050	
<b>Station ID:</b> 54	<b>NAD-83 (CSRS)</b>	<b>NAD-27</b>
<b>PID:</b>	<b>UTM Zone:</b> 19	
<b>Station:</b> Active	<b>Latitude:</b> 46.269393	<b>UTM Northing:</b> 5124499
<b>Status:</b>	<b>Longitude:</b> 67.766369	<b>UTM Easting:</b> 595000

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**APPENDIX V: Site locations and descriptions for benthic sampling in 2004/05**

STATION	NBDLG STATION #	SITE DESCRIPTION	RATIONALE FOR SITE	LONGITUDE	LATITUDE
B1	AJ0053	Below McBride Bridge	To monitor north branch above confluence with south branch	46.22733	67.74111
B2	AJ0073	Above Jackson Falls	To monitor south branch above confluence with north branch	46.22557	67.74309
B3	AJ0057	Mill Brook upstream of culvert over Rt. 540, near Belleville	To monitor Mill Brook	46.19793	67.69878
B4	AJ0072	Near gravel pit above mouth of MacQuarrie Brook	To monitor main stem of Meduxnekeag River	46.16177	67.63902
B5	AJ0060	Marven Brook, road side above bridge	To monitor Marven Brook	46.17445	67.61723

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## APPENDIX VI: New Brunswick Water classification classes

### THE CLASSES

#### *Outstanding Natural Waters Class – special lakes and rivers*

These waters remain relatively unaffected by human activities and possess an unaltered, natural water quality, quantity, and biology. They may be unique or they may represent good examples of typical natural water quality commonly found in New Brunswick. These lakes or rivers tend to be located at the headwaters of river systems. Their protection will safeguard downstream water quality and quantity. The goal of the *Outstanding Natural Waters Class* is to protect the water quality of these watercourses for posterity in their natural state. These waters are classified through a nomination process, involving objective selection criteria and a Review Panel.

#### *AP Class – designated surface drinking water supplies*

These are waters of watercourses that are designated as Protected Areas under the *Watershed Protected Area Designation Order - Clean Water Act*.

#### *AL Class – lakes, ponds and impoundments*

These are lakes, ponds or impoundments that are not classified into the Outstanding Natural Waters Class or into the AP Class.

The remaining three classes are primarily for rivers and streams, or parts of rivers and streams that are not placed into one of the first three classes. These three classes are likely to best reflect the majority of the Meduxnekeag watershed:

- A CLASS Waters that can support use as habitat for aquatic life, use for primary contact activities such as swimming and secondary contact activities such as boating. These watercourses would be managed to have water quality and aquatic life as it occurs naturally;
- B CLASS Waters that can support use as habitat for aquatic life, use for primary contact activities such as swimming and secondary contact activities such as boating. These watercourses would be managed to have water quality that would support all native species, and to maintain health in the resident aquatic community;
- C CLASS Waters that can support use as habitat for aquatic life, and use for secondary contact activities such as boating, but not for primary contact activities such as swimming. These watercourses would be managed to have water quality that would support native fish species and, although changes to the aquatic community could occur, the resulting aquatic community would be viable.

**APPENDIX VII: Maine water classification guidelines**

WATER QUALITY CLASS	BIOLOGICAL STANDARDS
AA	No direct discharge of pollutants; aquatic life shall be as naturally occurs.
A	Natural habitat for aquatic life; aquatic life shall be as naturally occurs.
B	Unimpaired habitat for aquatic life; discharges shall not cause adverse impact to aquatic life in that the receiving waters shall be of sufficient quality to support all aquatic species indigenous to the receiving waters without detrimental changes in the resident biological community.
C	Habitat for aquatic life; discharges may cause some changes to aquatic life, provided that the receiving waters shall be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community.

Source: <http://www.state.me.us/dep/blwq/docmonitoring/biomonitoring/sampling.htm>

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**APPENDIX VIII: Meduxnekeag watershed and sub-watersheds**

From the old railway bridge (now the NB Trail bridge) at the mouth of the Meduxnekeag in Woodstock, look upstream, over the Main Street bridge and the wide wetland beyond to the TCH bridges two kilometres away. This is the urban Meduxnekeag, within the municipal boundaries of Woodstock. Its waters are subject to run-off from streets and parking lots and to storm sewer outflows. Most of it is heavily influenced by the Mactaquac headpond; its water levels vary with headpond management. Flows are slow except in flood and freshet. In the immediate downtown area, its banks are being stabilized and revitalized with rockwork and buffer plantings. Beyond the downtown, in most places, buffers exist between residential land use and the water. There is one industrial use: a ready-mix concrete plant where significant and continuing degradation of the riparian zone is evident.

This urban Meduxnekeag has water quality sufficient to provide excellent small-mouth bass habitat; habitat, including nesting sites, for ducks and Canada geese; active beaver and muskrat populations and a range of other aquatic, semi-aquatic and bird life, including ospreys.

Two named tributary streams enter the Meduxnekeag in the urban zone. On the right bank, facing upstream, Connell Brook flows in approximately half-way between the mouth and the TCH bridges. It originates in a still undeveloped area of the town, though under encroachment from new commercial development on one side and expanding residential construction on the other. Its course is approximately a kilometre long; its immediate banks in the upper portion are buffered, mostly with cedar and alder, but siltation is evident, becoming more so the further downstream one moves. In its lower course, it passes between Woodstock High School, and a plant nursery business, receives ditch drainage from a major commercial street, passes through an area of expanding commercial businesses, and becomes highly silted as well as choked with litter and debris including discarded concrete construction materials. Its lower course is through treed but eroded banks before reaching the Meduxnekeag intervals. Visual examination shows that fish manage to survive in the upper portion. Connell Brook habitat will be improved in the spring of 2005 through a volunteer rehabilitation project sponsored by the Meduxnekeag River Association.

On the left - south - side of the Meduxnekeag, at about the same distance from the mouth, Upham Brook enters the river. Upham Brook rises in two branches, one in a mature cedar swamp owned by the Town of Woodstock and another in the midst of agricultural fields in potato/grain rotation. After the branches join, it passes through privately-owned woodland and agricultural land, crosses beneath the TCH and a major

access highway and near a small industrial zone before reaching the river. Its length is approximately two kilometres. In its upper reaches, it drains an expanding residential sub-division as well as an agricultural area in potato-grain rotation. Upham Brook supports a trout population; in the late 1990s, it received some restoration / rehabilitation work through Meduxnekeag River Association summer projects. The Upham Brook watershed includes three identified Appalachian Hardwood Forest sites of ecological value. One of these is at the extreme southwest corner of the watershed and is owned by the Town of Woodstock. Another is adjacent to and partially owned by Southern Carleton Elementary School. Both of these sites have some measure of protection. The third is privately owned and has recently become subject to major forest removal which may result in its conversion to agriculture or residential use or some combination of the two.

Water samples were taken from the mouth of Upham Brook in 2002 and 2003.

In the free-flowing part of the Meduxnekeag above the Trans-Canada Highway bridges, the first tributary stream is Marven Brook, which enters the river on the north bank about 250 metres above the bridges. Marven Brook is the largest of the Meduxnekeag tributaries (other than the North Branch of the river itself), and drains the most extensive sub-watershed. It originates in two branches between Lindsay and Briggs's Corner east of Hwy 550, and is significantly augmented in a swampy area about two kilometres downstream by the outflow from 40-hectare Payson Lake carried by Hopkins Brook. There are two cottages on Payson Lake and its immediate shoreline remains wooded. The Payson Lake / Hopkins Brook drainage area constitutes the north-east section of the Marven Brook sub-watershed. Marven Brook then flows south and east roughly parallel to Highway 550, which it crosses on the outskirts of Woodstock before reaching the Meduxnekeag. Its sub-watershed above this crossing is roughly bounded by Highway 550 on the west, and the height of land at the summit of Maple Hill, Iron Ore Hill and Moody Hill on the east. It has some small feeder streams, and also receives drainage from a wetland area on either side of the Trans-Canada Highway between Woodstock and Jacksonville (this wetland will be heavily impacted by the TCH twinning currently in progress). Most of the immediate valley of Marven Brook is wooded. Working agricultural land, much of it in potato/grain rotation, lies close by and constitutes a significant part of the overall sub-watershed. A major Christmas tree growing operation continues to expand. Fertilizer and chemical run-off from these may be reaching the water. In the lower portion of its valley, residential development continues, some of it adjacent to the stream itself. Horses pastured on one hobby farm have full access to the stream. Where Marven Brook lies close to Hwy 550 near Woodstock, an easy

opportunity exists for water removal, and this has been a factor in the past for use in dust suppression in highway construction, by a mobile car wash operator, and others. Two Appalachian Hardwood Forest sites with conservation significance are known from this sub-watershed.

Water samples were collected from the mouth of Marven Brook in 2002, 2003 and 2004, and benthic samples were taken from Marven Brook just above the “water removal” point in 2004.

Proceeding upstream, the next significant tributary is MacQuarrie Brook, which enters the Meduxnekeag on the south side approximately two kilometres higher up. Between the mouths of Marven and MacQuarrie brooks, the Meduxnekeag passes through steep wooded hills with riparian lowland strips varying in width from a few metres to perhaps a hundred metres. Near the river, on the south side, are a quarrying operation which seasonally includes an asphalt plant; a contaminated soil remediation site established in the 1990s and not now receiving soil; and the old (unlined) municipal solid waste site which was closed and capped in the late 1990s.

MacQuarrie Brook originates in several branches in an agricultural and forested area between Hwy 150 and Hwy 540. It crosses Hwy 95 and flows through forested land before reaching the Meduxnekeag. Some agricultural impact on water quality is probable, and the present culvert beneath Hwy 95 has been undercut and is now a barrier to fish movement (NB DoT is aware of this and a replacement culvert is planned). Hwy 95 is being twinned, and some impact can be anticipated from this process, although the EIA takes MacQuarrie Brook into account. Much of the sub-watershed is agricultural. Residential use is expanding here as well. One species-rich Appalachian Hardwood Forest site has been identified in the MacQuarrie Brook sub-watershed.

Water quality samples were collected in 2002, 2003, and 2004 from MacQuarrie Brook at its mouth, and from the Meduxnekeag just below MacQuarrie Brook. Benthic samples were collected from the Meduxnekeag just above the mouth of MacQuarrie Brook in 2004. One of the principal deep water pools on the Meduxnekeag is just below the mouth of MacQuarrie Brook.

No named tributaries enter the Meduxnekeag between the mouth of MacQuarrie Brook and Red Bridge, some six kilometres upstream. For almost all this distance, the Meduxnekeag flows through mature forest extending back between several hundred metres and several kilometres on either side of the river. This forest has been subject to relatively little recent activity. The immediate riparian zone varies between steep banks and intervalles backed by steep slopes, with many islands and braided channels. Tributary



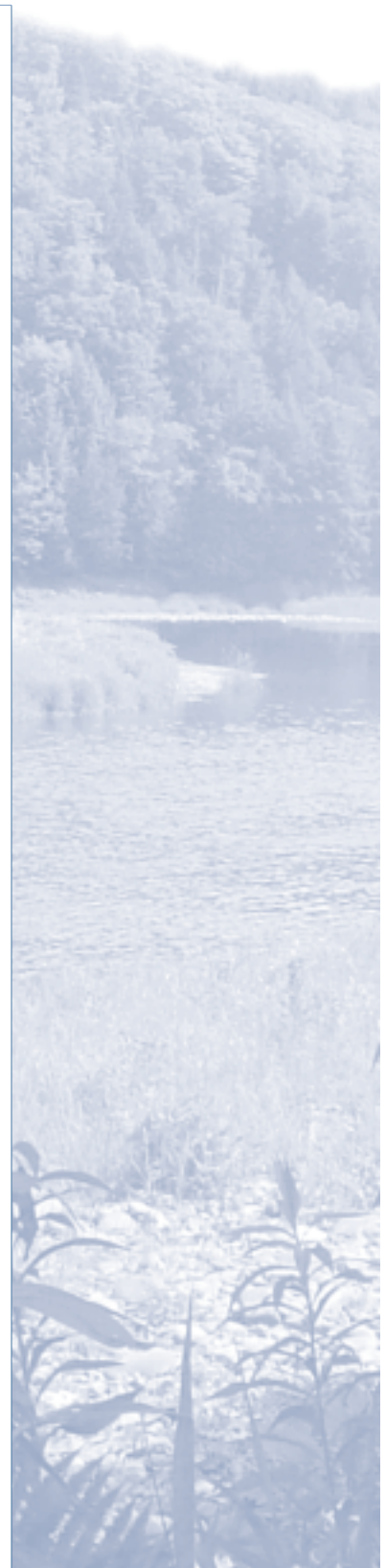
streams are small, seldom reaching above two kilometres in length, and most originate within the forested area. Three gravel pits exist in the riparian zone; one, now disused, is literally on the riverbank and erosion from it continues to impact the course of the stream. Two small camps - single buildings - are located on riparian land in this section; no other buildings are visible until just below Red Bridge. On the north side of the river, the Meduxnekeag River Association owns 60 hectares with approximately two kilometres of river frontage, constituting the Wilson Mountain and Leonard Woods portions of the Meduxnekeag Valley Nature Preserve. This stretch of the river contains several deep cold water pools important to the summer survival of the river's brown trout population. At least five ecologically rich Appalachian Hardwood Forest sites (other than the Preserve) are found in this part of the watershed.


Approaching Red Bridge, the steep banks withdraw somewhat and the river passes through an agricultural and residential area. The principal farm - of two - here permits unrestricted cattle access to the river from a pastured section of intervale. Some run-off from outside manure storage also reaches the river. The arable and pasture land of other farms in this part of the watershed lies much further back from the river. There is a continuing conversion of upland farm land, principally on the north side of the river, to Christmas tree plantations.

Just downstream from the bridge at Red Bridge, Mill Brook enters from the south. Mill Brook is a significant Meduxnekeag tributary, whose ultimate origin is near Parks Hill in the extreme southwest of the watershed. From there it accepts and carries drainage from a mostly forested and often swampy area near Highway 95, and adds the outflow from the small Morrison Lake. The twinning of Hwy 95 will have some impact on this part of the Mill Brook sub-watershed. Mill Brook then drains an extensive, largely forested area between Watson Settlement and Hwy 540. For much of its lower section it flows in a steep and narrow valley. The quality of the forest in this sub-watershed ranges from relatively recent clear cuts to mature woodland of very high ecological value, including at least three rich Appalachian Hardwood Forest sites. The so-called "Watson Settlement Pine" - believed to be the largest white pine in the Meduxnekeag watershed and one of the largest in New Brunswick - is in the Mill Brook sub-watershed.

Water quality tests were carried out in 2002, 2003, and 2004 from the mouth of Mill Brook and from the Meduxnekeag River at Mill Brook. Benthic samples were collected in 2004 from the mouth of Mill Brook.

Immediately above Red Bridge, the Meduxnekeag passes through an area of major gravel deposits (the gravel area extends below Red Bridge as well, particularly on the





south side of the river) which are being worked. Highway 540 and the Belleville Road parallel the river on the south and north sides respectively. On the north side of the river, the road separates a narrow strip of agricultural land and three dwellings from the river; after this 250 metre section is passed, the road separates a large area of gravel pits from the river, then rises high above and back from the river, with a widening section of mature forest intervening. On the south side, three gravel pits succeed each other in the immediate riparian area for nearly a kilometre, with the margins of the gravel workings, in some parts, less than ten metres from the river's edge.

No significant tributary brooks enter the Meduxnekeag between Red Bridge and the confluence of the South and North branches of the river. Above the gravel pits, the river flows between steep, mostly forested, banks. Some intensive cutting has occurred within the past decade on a portion of the south bank. Two kilometres of the north bank are Bell Forest, part of the Meduxnekeag Valley Nature Preserve. Further back from the river, within the main drainage and the sub-watersheds, there is limited residential settlement and a mix of agriculture and forest. Some land, particularly on the north side, has been converted to conifer plantations. On the south side, an extensive area of forest has been clear cut within the past three years. Some pastured agricultural land approaches the immediate riparian zone here.

Above the confluence, the South Meduxnekeag has an extensive wetland intervalle area below Jackson Falls. Between Jackson Falls and the International Boundary, the immediate riparian area is forested, with a mixture of forest and agriculture - predominantly potato/grain rotation, with some cattle - further back. Three small, and one significant, tributary streams enter the river in this stretch.

The significant tributary, Fitzpatrick Brook, drains an agricultural and forested area from the south and enters the Meduxnekeag approximately a kilometre above Jackson Falls. Some of its headwater tributaries rise in Maine. Agriculture in its watershed is mixed, although potato/grain rotation dominates. A large industrial hog rearing operation with two barns is located in this sub-watershed.

Water sampling in 2002, 2003, and 2004 was conducted on Fitzpatrick Brook, approximately 500 metres above its mouth; on the Meduxnekeag at Jackson Falls, and on the Meduxnekeag approximately 500 metres below the international boundary. Benthic samples were collected in 2004 from the Meduxnekeag just above Jackson Falls.

The North Branch of the Meduxnekeag between the confluence and Briggs's Mill Falls approximately three kilometres upstream flows rapidly through a narrow rocky gorge with three sets of waterfalls and numerous deep holding pools. Two significant tributar-

ies enter from the northeast. The immediate riparian zone is forested, but the zone is relatively narrow on the western side with farmland and increasing residential development along Hwy 540 which parallels the course of the river.

The first of the principal tributary streams is Carter's Brook which originates in two branches between Lindsay and Briggs's Corners (where its sub-watershed meets that of Marven's Brook) and drains a forested and agricultural area, flowing through a set of linked swampy wetlands around Hwy 550, and passing through forest, some of which has been heavily harvested, before joining the North Branch approximately 1.5 kilometres above the confluence.

The other principal tributary is Hagerman's Brook, which flows into the Meduxnekeag about 200 metres above the mouth of Carter's Brook, and drains a larger sub-watershed, originating in two primary branches on either side of Hwy 550 in Lower Bloomfield. Parts of its upper watershed are principally agricultural, in potato/grain rotation; much of its lower watershed is forested. Its watershed contains one known Appalachian Hardwood Forest site of conservation significance.

Water samples were taken from Hagerman's Brook and Carter's Brook in 2002 and 2003. Samples were taken from the North Branch just above McBride Bridge (approximately 100 metres above the confluence) in 2002, 2003 and 2004. Benthic samples were collected just below McBride Bridge in 2004.

Between Briggs's Mill Falls and the International Border, the North Branch flows through about 6 kilometres of mixed forest and agricultural land. The river has numerous riffles and deep pools. The immediate riparian zone varies between forest and agricultural uses, with the river open to seasonal pasture in several places: agricultural use is more dominant here than at any point along the river and the riparian zone is often only a fringe of alders with arable farmland or pasture on either side. Some residential use is apparent but this does not seem to be increasing significantly.

Water samples were collected in 2002, 2003, and 2004 from this section of the North Branch at a point just above the bridge at Weston (approximately 700 metres below the international border).

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**APPENDIX IX: Water quality and management standards for NB water classification classes**

NAME OF CLASS	SUITABLE USES	AQUATIC COMMUNITY STANDARDS	DISSOLVED OXYGEN STANDARDS	BACTERIA STANDARDS	STANDARDS FOR TROPHIC STATUS (lakes, ponds & impoundments only)	PROHIBITED ACTIVITIES
Outstanding Natural Waters	habitat for aquatic life; primary and secondary contact activity; other appropriate uses.	the aquatic life shall be as naturally occurring.	the concentration of dissolved oxygen shall be as naturally occurring.	the faecal coliform organisms and <i>E. coli</i> shall be as naturally occurring.	the trophic status shall be as naturally occurring.	release of a contaminant creation of a new mixing zone; release of a contaminant into a mixing zone; significant withdrawals.
AP (designated surface drinking water supplies)	raw drinking water (treated or untreated); uses permitted under the <i>Watershed Protected Area Designation Order</i> (WPADO).	the aquatic life shall be as naturally occurring.	the concentration of dissolved oxygen shall be as naturally occurring.	<i>E. coli</i> shall be as naturally occurring; the total coliform organisms shall be as naturally occurring.	the trophic status shall be as naturally occurring.	see the <i>Watershed Protected Area Designation Order</i> .
AL (lakes, ponds and impoundments)	habitat for aquatic life; primary and secondary contact activity (see glossary) other appropriate uses.	the aquatic life shall be as naturally occurring.	for cold water species $\geq 9.5$ ppm (early life stages) and $\geq 6.5$ ppm (other life stages); for warm water species: $\geq 6.0$ ppm (early life stages) and $\geq 5.0$ (other life stages); for estuarine waters: $\geq 80\%$ saturation.	the faecal coliform organisms and <i>E. coli</i> shall be as naturally occurring.	the trophic status shall be stable or naturally changing; the water shall be free of algae blooms that impair use as habitat for aquatic life, or use for primary or secondary contact activity.	direct discharge of a contaminant that is not being released, or any increase in the volume or concentration of a contaminant that is being directly discharged, on the date of commencement of the <i>Regulation</i> ; creation of a new mixing zone.

NAME OF CLASS	SUITABLE USES	AQUATIC COMMUNITY STANDARDS	DISSOLVED OXYGEN STANDARDS	BACTERIA STANDARDS	STANDARDS FOR TROPHIC STATUS (lakes, ponds & impoundments only)	PROHIBITED ACTIVITIES
A	as habitat for aquatic life; primary and secondary contact activity; other uses that will not prevent the standards from being met.	the aquatic life shall be as naturally occurring.	for cold water species: $\geq 9.5$ ppm (early life stages) and $\geq 6.5$ ppm (other life stages); for warm water species: $\geq 6.0$ ppm (early life stages) and $\geq 5.0$ (other life stages); $\geq 80\%$ of saturation in estuarine waters.	the faecal coliform organisms and <i>E. coli</i> shall be as naturally occurring.	the trophic status shall be as naturally occurring.	release of a contaminant creation of a new mixing zone; release of a contaminant into a mixing zone; significant withdrawals.
B	as habitat for aquatic life; primary and secondary contact activity; other uses that will not prevent the standards from being met.	releases shall not cause adverse impact to the aquatic community in that the receiving water shall be of sufficient quality to support all indigenous aquatic species without detrimental changes to resident biological community.	for cold water species: $\geq 9.5$ ppm (early life stages) and $\geq 6.5$ ppm (other life stages); for warm water species: $\geq 6.0$ ppm (early life stages) and $\geq 5.0$ (other life stages); $\geq 80\%$ of saturation in estuarine waters.	the faecal coliform organisms shall be less than 14 per 100 ml for estuaries with identified shellfish beds, and <i>E. coli</i> shall be less than 200 per 100 ml for all other watercourses (geometric mean of a minimum of 5 samples in a 30 day period).	the trophic status shall be stable or naturally changing; the water shall be free of algae blooms that impair use as habitat for aquatic life, or use for primary or secondary contact activity.	
C	as habitat for aquatic life; secondary contact activity; other uses that will not prevent the standards from being met.	releases that may cause some changes to the aquatic community are permitted if the receiving water is of sufficient quality to support indigenous fish species and maintain the structure and function of the resident biological community despite the releases.	for cold water species: $\geq 9.5$ ppm (early life stages) and $\geq 6.5$ ppm (other life stages); for warm water species: $\geq 6.0$ ppm (early life stages) and $\geq 5.0$ (other life stages); $\geq 80\%$ of saturation in estuarine waters.	the faecal coliform organisms shall be less than 14 per 100 ml for estuaries with identified shellfish beds, and <i>E. coli</i> shall be less than 400 per 100 ml for all other watercourses (geometric mean of minimum of 5 samples in a 30 day period).	the trophic status shall be stable or naturally changing; the water shall be free of algae blooms that impair use as habitat for aquatic life, or use for primary or secondary contact activity.	



## **WATER QUALITY REPORT**

Meduxnekeag River Association

WOODSTOCK, NB

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